INTERIOR DESIGN & DECORATION

NSQF LEVEL - 3

TRADE THEORY

SECTOR : CONSTRUCTION

(As per revised syllabus July 2022 - 1200 hrs)

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Mentor Councils comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **Interior Design & Decoration Trade Theory NSQF Level - 3 (Revised 2022) in Construction Sector.** The NSQF Level - 3 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Addl. Secretary/Director General (Training)
Ministry of Skill Development & Entrepreneurship,
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New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi (NSQF LEVEL - 4) under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Theory)** for the trade of **Interior Design & Decoration** (NSQF LEVEL - 3) (Revised 2022) under **Construction** Sector for ITIs.

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NIMI records its appreciation for the Data Entry, CAD, DTP operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks the invaluable efforts rendered by all other NIMI staff who have contributed towards the development of this Instructional Material.

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intented to be used in workshop . It consists of a series of practical exercises to be completed by the trainees during the course of the **Interior Design & Decoration** Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with **NSQF LEVEL - 3 (Revised 2022)**

Module 1 - Basics of Interior Design and Functional Aspects

Module 2 - Furniture Design and Details

Module 3 - Planning of Residential Interior Spaces

Module 4 - Civil Components

Module 5 - Perspective Drawing and Basics of Computer

Module 6 - Basic of Auto CAD software and Preliminary Auto CAD Software

Module 7 - Civil Components (Ceiling & Flooring)

Module 8 - Joinery Details and Paints

Modfule 9 - Civil Components (Partition)

Module 10 - Plumbing and Sanitation, Lighting, Electrical & Air Conditioning

Module 11 - Commercial Interior Guidelines and Design

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI, looks forward to the suggestions from the experienced training faculty for improving the manual.

TRADE THEORY

The manual of trade theory consists of theoretical information for the course of the **Interior Design & Decoration** Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indicating about the corresponding practical exercise are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise atleast one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self learning and should be considered as supplementary to class room instruction.

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No.
1	Appraise the importance of interior designing & drawing instruments, drawing sheets, Lettering following safety precautions. (Map Nos:IES/N9454)	1.1.01 - 1.1.06
2	Draft the Geometrical shapes and projection with the help of engineering scale and free hand sketches. (Map Nos:IES/N9455)	1.1.07 - 1.1.12
3	Draft the design with the help of color scheme and apply with rules and calculations. Analysis and uses of building materials. (Map Nos:IES/N9456)	1.1.13 - 1.1.16
4	Draw furniture designing & detailing. (Map Nos:IES/N9457)	1.2.17 - 1.2.19
5	Draw residential plan with necessary working drawing. (Map Nos:IES/N9458)	1.3.20 - 1.3.24
6	Draw different types of staircase. (Map Nos:IES/N9459)	1.4.25 - 1.4.27
7	Apply basic knowledge of structural part of building. (Map Nos:IES/N9460)	1.4.28 - 1.4.29
8	Draw doors and windows & details. (Map Nos:IES/N9461)	1.4.30 - 1.4.33
9	Draw one and two points perspective view. (Map Nos:IES/N9462)	1.5.34 - 1.5.35
10	Prepare power point presentation with animation. (Map Nos:IES/N9463)	1.5.36 - 1.5.37
11	Create object on 2D using tool bars, commands. (Map Nos:IES/N9464)	1.6.38 - 1.6.40
12	Draw different types of false ceiling by using CAD. (Map Nos:IES/N9465)	1.7.41 - 1.7.42
13	Draw different types of flooring by using CAD. (Map Nos:IES/N9466)	1.7.43 - 1.7.44
14	Draw different types of carpentry joints by using CAD. (Map Nos:IES/N9467)	1.8.45 - 1.8.47
15	Analyse and uses of paints polish and varnish. (Map Nos:IES/N9468)	1.8.48 - 1.8.50
16	Draw different types of partition wall by using CAD. (Map Nos:IES/N9469)	1.9.51 - 1.9.52
17	Draw plumbing and drainage details and sanitary fittings by using CAD. (Map Nos:IES/N9470)	1.10.53 - 1.10.55
18	Draw lighting and electrical layout plan by using CAD. (Map Nos:IES/N9471)	1.10.56 - 1.10.58
19	Draw air conditioning layout by using CAD./other software. (Map Nos:IES/N9472)	1.10.59
20	Draw commercial interiors by using CAD. other software. (Map Nos:IES/N9473)	1.11.60 - 1.11.63

SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 10 Hrs; Professional Knowledge 06 Hrs	Appraise the importance of interior designing & drawing instruments, drawing sheets, Lettering following safety precautions. (Map Nos:IES/N9454)	1. Familiarization with the trade & institute. (01 hrs) 2. Importance of trade training. (01 hrs) 3. Uses of tools, equipments & instruments. (01 hrs) 4. Free hand sketches of objects. (02 hrs) 5. Recognize & Layout of drawing sheet including title card as an example portrait & landscape. (03 hrs) 6. Importance of Lettering with the help of single stroke Gothic Letter. (02 hrs)	Importance OF TRADE & necessity of interior designing. In industry Interior design as a profession Modern interior design feature Introduction of tools and equipments, and raw material their used. like drafting board, T scale mini drafter (M.D.), Set Square etc. pencill etc(06 hrs.)
Professional Skill 34 Hrs; Professional Knowledge 10 Hrs	Draft the Geometrical shapes and projection with the help of engineering scale and free hand sketches. (Map Nos:IES/N9455)	7. Draw different types of lines by Free hand. (04 hrs) 8. Introduce the scale MKS and FPS for making the drawing. (06 hrs) 9. Draw the simple composition of geometrical object with help of scale. (06 hrs) 10. Draw the simple exercise using lines in different angles. (04 hrs) 11. Draft the plan, elevation & sectional elevation & isometric view of geometrical solids. Regular, Irregular shapes. (10 hrs) i. Cube ii. Cuboids iii. Triangular prism iv. Cylinder v. Pyramid vi. Hexagonal prism vii. Hexagonal Pyramid viii. Cone 12. Free hand sketches of graphic symbols. (04 hrs)	Introduction to Indian Standards Institution Code of practice for general interior drawing. Introduction & Importance of lines i. Continuous thick & thin line ii. Dashed thin line iii. Cutting plan line iv. Long & short break line thick line Basic knowledge of geometrical shapes & lines. Definition of projection Types of projection Parallel projection i. Oblique ii. Orthographic iii. Axonometric iv. Isometric Definition: - i. Layout of plan ii. Elevation (Front & side elevation) (10 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 12 Hrs	Draft the design with the help of color scheme and apply with rules and calculations. Analysis and uses of building materials. (Map Nos:IES/N9456)	**Functional designing of interiors:** 13. How to make design: - (12 hrs) i. Flow of circulation chart (Bubble diagram) ii. Concept of design, pattern, colour iii. Designing of space with furniture layout 14. Design knowledge of interior in residential & commercial. (20 hrs)	**Principle of elements and interior design:** Introduction of basic interior design. i. Elements- example: line, etc. ii. Principle of design example: balance, emphasis etc. Colors: Types of color schemes based on the color wheel. i. triad colour scheme: a) Primary.

		i. Basic layout plan. ii. Elevation. 15. Free hand sketches of Graphic symbols for landscape and building materials. (12 hrs) 16. Rendering with pencil and pencil colour. (06 hrs)	b) Secondary. c) Tertiary. ii. related colour scheme: a) Analogues. b) Monochromatic. c) Achromatic. d) Neutral. iii. contrasting: a) Complementary. b) Split complementary. c) Double split d) Complementary. e) Cool colour, warm colour. Understand the psychological affects by different colours on different person and places. Introduction of Graphic symbols in interior. Understand impartance of building materials (12 hrs.)
Professional Skill 48Hrs; Professional Knowledge 10 Hrs	Draw furniture designing & detailing. (Map Nos:IES/ N9457)	**Furniture design and detail:** 17. Residential furniture. Table, chair, sofa, cabinet, bed, wardrobe, dining table,wall unit. (20 hrs) 18. Commercial furniture. Executive table/ office table, Reception table, cabinet storage, Display unit. (23 hrs): Note: Necessary practical training will be carried out on site. 19. Free hand sketches of graphic symbol of furniture (5hrs)	**Furniture design:** Furniture styles: i. Traditional/classic style. ii. Ethnic style. iii. Contemporary style. Types of furniture: i. Daily uses furniture ii. Loose carpentry furniture. iii. Fixed carpentry furniture. iv. Multi-utility storage v. Open & closed storage Importance of anthropometric and ergonomics. (10 hrs.)
Professional Skill 100Hrs; Professional Knowledge 23Hrs	Draw residential plan with necessary working drawing. (Map Nos:IES/ N9458)	**Drafting of Residential Plan (Any Room):** 20. Concept plan with circulation flow (Bubble Diagram). (10 hrs) 21. Basic furniture layout plan with working drawing. (20 hrs) 22. Wall elevation with dimension and specification. (20 hrs) 23. Necessary details. (30 hrs) 24. Rendering the plan & elevations. (20 hrs)	**Planning of Interiors:** Space selection for circulation and furniture. Selection of furniture according to functional space. Uses of furniture templates. (22 hrs.)
Professional Skill 28 Hrs; Professional Knowledge 06 Hrs	Draw different types of staircase. (Map Nos:IES/N9459)	25. Prepare drawing with technical details of the R.C.C. Stair case. (14 hrs) i. Straight Staircase. ii. Open newel Staircase. iii. Dog legged Staircase. iv. Bifurcated Staircase. 26. Calculation of Staircase (tread and riser). (10 hrs) 27. Model of staircase (4hrs)	**Stair case:** Requirement and placement of good Staircase. Basic terminology of R.C.C. Staircase. Types of Staircase. i. Straight. ii. Quarter turn iii. Half turn (Dog legged) iv. Three quarter turn v. Bifurcated vi. Open newel.

			vii. Geometrical viii. Circular ix. Spiral. Model of Staircase: - Demonstration of R.C.C. Staircase with the help of respective models. (06 hrs.)
Professional Skill 36 Hrs; Professional Knowledge 06 Hrs	Apply basic knowledge of structural part of building. (Map Nos:IES/N9460)	**Preparing drawing:** 28. Basic concept of section of a building through toilet & balcony introducing the beam & column. (20 hrs) and kitchen 29. Preparing of drawings i)types of brick bond ii) English and Flemish bond iii) lintals & arches iv) foundation drawing (16hrs)	Basic knowledge & importance in PPT/ video presentation i. Mezzanine floor a) Temporary b) Semi permanent ii. Stone masonry & types iii. Brick masonry & bonds • Stretcher bond • Header bond • English bond • Flemish bond • Raking bond • Zigzag bond iv. Lintels & types v. Arches & types and terminology vi. foundation (06 hrs.)
Professional Skill 48 Hrs; Professional Knowledge 12 Hrs	Draw doors and windows & details. (Map Nos:IES/N9461)	30. Model of Door window: - Demonstrate doors and windows with the help of respective models. (04 hrs) 31. Preparing of plan, elevation & section of door (16 hrs) i. Panelled door ii. Glazed or sash iii. Flush door 32. Preparing of plan, elevation & section of window. (16 hrs) i. Casement window with ventilator (wooden) ii. Sash window (wooden) iii. Sliding window (aluminium) 33. Free hand sketches of graphic & symbols for doors and windows (12hrs)	**Wooden Doors & Windows** Introduction of hardware fitting in door & windows with dimension Types of Doors i. Batten and ledged door ii. Framed and panelled door iii. Glazed or sash door iv. Flush door v. Louvered door vi. Wire gauged door vii. Revolving viii. Sliding (Aluminium) ix. Swing door/ floor spring door Placement of door & windows regarding circulation of space Definition of technical terms of doors & window Size of doors & windows, ventilators Types of windows • Fixed window • Casement window • Sliding window • Sash window • Louvered window • Metal window • Bay window • Corner window • Dormer window • Gable window • Sky light window Fixture and fastening a) hinges, b) bolts, c) handles d) locks (12 hrs.)

Professional Skill 30 Hrs; Professional Knowledge 10Hrs	Draw one and two points perspective view. (Map Nos:IES/ N9462)	**Preparation of drawing** 34. Draft one-point perspective view with approximate method (any room). (20hrs) 35. Render the perspective view with any medium. (10 hrs) Computer & drawing software 36. Installation and use of software i.e. Coral Draw, Photoshop and Sketch up,3D's Max with V-ray and Luminous Prepare the power point still presentation. (26 hrs) 37. Prepare the power point animated presentation. (20 hrs)	**Projection** Perspective projection definition i. 1 point ii. 2 point iii. 3 point (Describe the one-point perspective with approximate method) Definition i. Ground plane ii. Station point iii. Picture plane iv. Horizontal plane v. Ground line vi. Horizontal line or eye level Vanishing point (10 hrs.)
Professional Skill 46 Hrs; Professional Knowledge 12 Hrs	Prepare power point presentation with animation. (Map Nos:IES/N9463)	**Computer & drawing software** 36. Installation and use of software i.e. Coral Draw, Photoshop and Sketch up,3D's Max with V-ray and Luminous Prepare the power point still presentation. (26 hrs) 37. Prepare the power point animated presentation. (20 hrs)	Knowledge of Computer and software Microsoft Power point, commands and their uses. Basic introduction of 3 DMax (12 hrs.)
Professional Skill 110Hrs; Professional Knowledge 23 Hrs	Create object on 2D using tool bars, commands. (Map Nos:IES/N9464)	**2D Software training-** 38. Installation of AUTOCAD software. (10 hrs) 39. Elementary commands and menus of AUTOCAD software. (45 hrs) 40. Drawing practice on AUTOCAD software.Drawing practice on AUTO CAD or other software (55 hrs)	**Preliminary Drawing in AUTO CAD** i) 2D commands and use of different menus. ii) Concept of 2D drawing. iii) Concept of rendering. (23 hrs.)
Professional Skill 40 Hrs; Professional Knowledge 10 Hrs	Draw different types of false ceiling by using CAD. (Map Nos:IES/ N9465)	Preparing of drawing with AUTOCAD and user software Installation and uses of software i.e. coral drawing, photoshop and sketches up 30 s mac with v.rag anf lumion 40. drawing practice on AUTOCAD and other software 41. Design a false ceiling in a room. (20 hrs) 42. Specify the level and section and finishing material (laminate, veneer, paints). (20 hrs)	**Ceiling** Definition of false ceiling to understand the job fabrication installation process of false ceiling with Gyp board / POP board / Ply / Wood Types of ceiling i. Grid ii. Coffered iii. Cove iv. Plain Finishing materials used for false ceiling. Laminate, veneer, stone, glass, acrylic sheet, MDF, paints, wall paper, fabric, stainless steel, wood. (10 hrs.)
Professional Skill 40 Hrs; Professional Knowledge 10 Hrs	Draw different types of flooring by using CAD. (Map Nos:IES/N9466)	**Preparing of drawing with AUTOCAD and user software** 43. Design a flooring pattern with finishing material (Marble, Vitrified tile, PVC. Laminated). (30 hrs) 44. Specify the starting point of flooring and Specify the dimension & sizes. (10 hrs)	**Types of floor finishing** i. Stone ii. Marble iii. Mosaic iv. Vinyl v. Vitrified tiles vi. Ceramic tiles vii. PVC viii. Carpet ix. Laminated x. Glass (10 hrs.)

Professional Skill 36 Hrs; Professional Knowledge 10 Hrs	Draw different types of carpentry joints by using CAD. (Map Nos:IES/ N9467)	**Drafting simple joints used in furniture** 45. Drafting details drawing of different types of joints. (20 hrs) 46. Draft a sheet of door/ window/ chair/ table/ bed (any one) (14 hrs) 47. Model of carpentry joints.Demonstration of Stair Case with the help of respective models (2hrs)	**Carpentry joints** Types of joints i. Butt joint ii. Mitre joint iii. Lap joint iv. Mortise and Tenon joint v. Tounge and groove joint vi. Housed joint vii. Cross joint Joints used in furniture Joints used in doors/ windows/ ventilators.
Professional Skill 20 Hrs; Professional Knowledge 06 Hrs	Analyse and uses of paints polish and varnish. (Map Nos:IES/N9468)	**Generate Power Point Presentation for Paint, Polish and Varnish -** 48. Practicing processes & techniques of paints, polishing & varnishing on surfaces. (12 hrs) 49. Recognize the tool & equipment and their uses. (02 hrs) 50. Estimate quantity of materials used on surface and labour cost. (06 hrs) **NOTE: - necessary practical training will be carried out on site.**	**Paints and polishing/varnishing:** What is paint Types of paints i. Synthetic enamel ii. Acrylic Emulsion iii. distemper iv. Epoxy v. Nitro Cellulose vi. Metallic vii. Texture viii. Lime wash ix. Exterior paint Painting techniques i. By Brush ii. By Roller iii. By spray gun Paintings defeats and remedies. Introduction of polish and varnish: Method of preparation and types of polish on wood. Types of varnishes: i. Oil ii. Spirit iii. Turpentine iv. Melamine v. PU (polyurethane) (06 hrs.)
Professional Skill 36 Hrs; Professional Knowledge 10 Hrs	Draw different types of partition wall by using CAD. (Map Nos:IES/N9469)	51. Design the full height and low height partition wall with different construction and finishing materials. (18 hrs) 52. Draft Plan, sectional plan, front elevation and section with specification and dimension. (18 hrs)	**Partition wall:** Introduction of partition wall Property of a good partition wall Types of partition wall i. Brick partition ii. Glass partition iii. Timber or wooden partition iv. Aluminium partition (10 hrs.)
Professional Skill 28 Hrs; Professional Knowledge 06 Hrs	Draw plumbing and drainage details and sanitary fittings by using CAD. (Map Nos:IES/N9470)	53. Layout the plumbing / drainage /Sanitary plan and sectional elevation. (10 hrs) 54. Make Top plan, side elevation, and front elevation of all sanitary plumbing fittings with dimension. (12 hrs) 55. Free hand sketches of graphic symbols for plumbing and sanitary (06hrs)	**Plumbing:** Purpose and principle of house drainage. Types of Drainage plumbing system i. One pipe system ii. Single stack system iii. Single stack (partially ventilated system) iv. Two pipe system Sanitation: Traps i. Gully trap ii. Intercepting trap iii. Grease trap iv. Floor trap or Nahni trap Waste water disposal: i. Inspection chamber ii. Septic tank Pipes: i. Soil pipe

			ii. Waste water pipe iii. Rain water pipe Sanitation fitting: i. Wash basin ii. Sink iii. Bath tub iv. Water closet v. Urinals vi. Flushing cisterns (06 hrs.)
Professional Skill 36 Hrs; Professional Knowledge 10 Hrs	Draw lighting and electrical layout plan by using CAD. (Map Nos:IES/N9471)	56. Layout plan of false ceiling with lighting position, dimensions and specifications. (16 hrs) 57. Layout of electrical plan & elevation along with switch board, electrical fittings & light fittings on wall with dimension. (15 hrs) 58. Free hand sketches of graphic symbols for electrical (05hrs)	**Lighting:** Introduction of natural and artificial light. Differenttypes of lighting arrangements i. Direct lighting • Angular lighting • Down lighting • Eyeball fitting • Track lighting • Shade lighting ii. Indirect lighting iii. Diffused lighting iv. Concealed lighting Varity of lampsi. Incandescent ii. Tungsten halogen iii. Florescent iv. Mercury v. Sodium vapour vi. LED Electrical accessories i. Switches & sockets with box ii. DB (distribution board) & MCB iii. Lamp holders iv. Ceiling roses v. Introduction of LAN/ CCTV/ Biometric/ Speaker/ Smoke Detector (10 hrs.)
Professional Skill 28 Hrs; Professional Knowledge 06 Hrs	Draw air conditioning layout by using CAD./other software. (Map Nos:IES/N9472)	59 Layout plan of window and Split air Conditioning with specification. (28 hrs)	**Air conditioning**: Introduction of Air Conditioning Principle of Air Conditioning Types of Air Conditioning i. Window Air Conditioning ii. Split Air Conditioning iii. Centralised Air Conditioning iv. Cassette Air Conditioning (06 hrs.)
Professional Skill 36 Hrs; Professional Knowledge 10 Hrs	Draw commercial interiors by using CAD. other software. (Map Nos:IES/N9473)	**Office design project: -** 60. Layout plan and Elevations. (06 hrs) 61. Necessary working details to execute the project smoothly. (10 hrs) 62. Free hand sketch for necessary details. (10 hrs) 63. Rendering with gradient & hatches. (10 hrs)	**Planning of commercial interiors: -** Introduction of office building. Offices- i. Interior designer/Architect ii. Lawyer office iii. Administration Room iv. Hotel waiting lounge Follow design guidelines and office space standard. (10 hrs.)

		Workshop Calculation & Science: 32 Hrs.
Professional Knowledge WCS- 32 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (Map Nos:IES/N9402)	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multilipication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Properties and uses of rubber, timber and insulating materials **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, Finding the lateral surface area, total surface area **Levers and Simple machines** Lever & Simple machines - Lever and its types

Project Work: - One room estimation of interiors works.
Industrial Visit [Visit to different places for interior work and to different sites where interiors works are in progress & Necessary practical training to be carried out on site.]

Introduction to interior designing and its importance

Objectives: At the end of this lesson you shall be able to
- **explain importance and necessity of interior designing**
- **describe role of interior designer in terms of design, economy, approach and execution.**

Introduction to Interior design : Interior design has been defined as the creation and organization of interior spaces to perform specific function within an architectural environment. Such interior space must combine the functional technical, and economic aspects of design with aesthetic and psychological consideration needed by the intended users.

An interior is a space that is enclosed by walls, floors and ceilings. It has one or more entries/exist and usually one or more openings, such as windows, for light and ventilation. Those enclosing elements may be composed of any number and can be formed of countless shapes.

To design is to conceive, envision, plan, and compose things. The design methods include communicating the concept the client-owner and to the crafts people who will build or execute those designs. It includes appropriate use of materials, attention to scale and attention to functional and psychological aspects.

Who is an interior designer? : In profession interior designer is a person qualified by education, experience and examination. Who identifies research and creatively solves problems pertaining the function and quality of the interior environment.

Performs, relative to interior spaces, including programming, design analysis, space planning and aesthetics using specialized knowledge of Interior construction, building codes, equipment, materials and furnishing.

Prepare drawings and documents relative to the design of interior spaces in order to enhance and protect the health, safety and welfare of the public.

Necessity of Interior Designer : Today's interior designer is not a more decorator, he/she is a profession in the true sense. Interior design is not only an art, it is a science and technology also, as an interior designer encompasses the fields traversed by an architect, engineer, psychlogist, graphic designer furniture designer and a host of other professions.

Role of Interior Designer : The profession includes problem definition and analysis, space planning, selection and specification of the interior furnishings as well as finish and coordination of the installation. All this require technical knowledge of construction, codes, zoning laws, fire regulations, product technology, fabrication techniques, product source and an understanding of social, cultural, religious practices. He/she performs the following functions.

A Design : The interior designer designs a client's spaces keeping in mind the client's life style requirements, likes and dislikes, personal taste, financial constraints, family conditions and religious and social practices. to design interiors exceed for the Design objectives is intended to provide a clear understanding of the goal from interior designer to the user.

Aspects of design

- **Structural Interior Design** – This process involves the selection and coordination of interior materials and finishes that are part of the building or built-in items (i.e., cabinets, equipment, etc).
- **Comprehensive Interior Design** – This process involves designing, selecting, and developing interior building materials, finishes, special effects, and furnishings for an integrated visual design theme related to interior.

B Economy

A designer's efforts result in 4 types of economies.

i Economy of spaces : He arranges the space, furniture and other elements in such a way that it leads to optimum use of space.

ii Economy of materials : Since designer is intimately aware of available materials in the trade market, their suitability, qualities. defects and the precise qualities to be used for the proposed and as he already made the plans, he economizes on materials.

iii Economy of time : As everything is schedules, executed and supervised by an expert designer there is no wastage of time, and the project is completed in on time.

iv Economy of finances : The consequence of above mentioned economies result in financial economy.

Approach : A professional interior designer, experience and often state, is concerned with space planning and the selection of materials and furnishings to fulfill the functional requirements of interior spaces. The designer must follow these steps to ensure a well-planned interior:

Programming - Meet with the user, gather information, understand the requirements, and identify special needs.

Concept Development - Perform space planning, architectural design, and material selection; and identify desired atmosphere and color themes, such as warm/ cool. neutral/pastel, etc.

Design Development - Formalize the design concept into a presentation.

Concept Presentation - Educate the users and gain their approval through a formal presentation.

Design Execution - Prepare contract documents, specifications, and working drawings.

i **Programming :** To meet a facility's functional requirements, the designer must define the facility function and understand the user's needs.

The designer accomplishes this by using communication skills, technical knowledge, and artistic talent.

1 **Functional Requirements:** It can be divided into several categories based on residential, commercial etc.

Each requirements should be specific to its function. The designer must identify and understand these requirements and translate them into a design.

2 **Understanding the User's Needs:** The designer must visit the project site, get to know the user, and gather data about the function, occupancy, and the user's expectations. This can be accomplished through meetings, surveys, and research.

a **Meetings:** These include, but are not limited to, conferences held for predesign, presentation of concept, and review of various stages of project development.

b **Surveys:** These can be performed by face-to-face interviews or written questionnaires. Surveys are an efficient way of gathering information concerning:

- Expected occupancy
- Types of duties or operations involved
- Individual space and requirements
- Shared or common space and requirements
- Interrelationships of people and functions within the space
- Special requirements and locations
- Future requirements
- Unusual circumstances affecting the design

c **Research :** The interior designer must follow all applicable Air Force instructions, policies, and pamphlets, as well as building, fire, and safety codes and regulations. The designer. A check of the user's satisfaction in help in making critical design decisions.

ii **Concept development :** As the user's requirements become clear, the interior designer begins to formulate solutions for the design. In the concept development phase, those ideas begin to take form through:

1 **Space Planning** - What happens within a space determines the perception and experience that the user will encounter. Some important considerations for space planning include:

a **Personal space** - Personalization of each user's space for display of personal items within limits is provided.

b **Functional relationships** different groups of people and their working relationships is considered.

c **Adjacency priorities** - Identify and prioritize which groups need to be located adjacent to each other.

d **People relationships** - relationships and interactions of individuals within a group is considered.

e **Status and function** - Identify special requirements for circulation, public/private space separation, V is considered.

f **Equipment usage** - Identify all equipment and its users within each facility or each area of the facility.

g **Efficient use of space** - Maximize the use of all spaces for their functions.

h **Flexibility within the space** - future modifications and function changes may

Required adjustments within a space so flexibility should be provided with in the space.

2 **Aesthetics and comfort:** Create an atmosphere that increases human comfort and efficiency (i.e., ergonomics) in a pleasing way should be provided.

a **Codes and regulations:** Life safety and fire codes and regulations must be followed in all designs.

b **Location influences:** There may be site specific factors which influence design solutions. It is the designer's responsibility to identify which factors need consideration and determine the best method of addressing each for instance, the local parameters determining a facility's exterior features will affect the size and type of windows, the ceiling heights, and to an extent, the materials carried into lobbies, foyers, and other internal spaces.

c **Availability of materials and resources:** Some materials are not readily available nor economically shipped to all locations. When designing a project for remote locations, consider cost and availability before specifying a product near to be done.

d **Special climatic and/or maintenance problems:** Some times the designer must take into account local climatic conditions when selecting materials and finishes.

- **Noise levels** - Proper acoustical design depends on the type of noise disturbance and function of the space will determine the adequate level of sound control.
- **Security requirements** - The user must provide any special security requirements that need to be included in the project.
- **Other factors** - Light consideration, room proportion, human comfort and colour concept is considered by a design.

C **Design Development :** At this point in the process, the interior designer should have a clear picture of the design intent. Through the design development process, the designer must complete the following:

- **Design Narrative** - Write an explanation to help the user understand the design and selections that have been made.
- **Design Illustration** - Provide floor plans, elevations, perspectives, and detail drawings.
- **Color Schemes and Material** - Provide finish boards or books to illustrate the color scheme.
- **Furnishings Selection** - Provide furniture and accessory boards or books to illustrate the color concept.

D **Concept Presentation** : Through the use of visual presentation materials, including renderings, floor plans, perspectives, finish and furniture boards, the user is given a clear understanding of the design.

The designer also has to develop creative alternatives to meet specific customer needs or desires.

Execution : The completed design must clearly convey the design intent. The contract documents provide the information necessary to implement the design. These documents include:

1 **Statement of Work (SOW)** - A brief but thorough description of the work to be performed by the contractor.

2 **Architectural Floor Plan** - Demolition plans, new floor plans, and reflected ceiling plans etc.

3 **Schedule and Color Legend** - This indicates which finishes are used on specific interior surfaces, and the list identifies each finish by pattern, color, number, brand and manufacturer.

4 **Finished Floor Plan** - A drawing used for the placement of patterns, borders, or combinations of floor finishes in an area.

5 **Elevations, Sections, and Details** - Drawings are used to clarify a design feature. Elevations are drawings which typically illustrate placement of wall covering as well as height of wall ceiling and other design features. Sections and details generally illustrate how a particular feature is constructed or attached to another surface or feature, and of what generic materials it is made.

6 **Miscellaneous Drawings** - Electrical layouts, enlarged floor plans of ceiling layout and construction drawings for built-in, furniture, ceiling layout etc.,

7 **Furniture Floor Plan** - Scaled layouts showing placement of existing and new furniture's.

- **Furnishings Specifications** - Technical product information, including as necessary item name, size, color, fabric or finish, brand and manufacturer, source, quantity, photo or catalog cut, and cost.
- **Furnishings Cost Estimates** - Line item extensions of item costs may need to be separated by item category or by room or area for phased purchasing.
- **Furnishings Order Forms** - The actual forms required by the user to order the items.

Design Objectives : Integrate engineering, architectural, and interior design considerations to create a "seamless" interior. The structural, electrical, and mechanical systems enhance the architectural and interior design features and vice versa. The goal is to create a fully integrated environment where the occupant loses sight of "how" and "why" the facility works and simply enjoys being there.

A **Function :** Functional interior design ensures that each aspect of the interior environment performs efficiently for the user. A good working relationship between the user and designer will help accomplish this goal.

B **Cost effectiveness :** All interior selections must reflect the aesthetic value and life-cycle costs.

Inexpensive, short-term solutions do not necessarily produce cost savings over time.

C **Durability :** Durable designs and finishes help facilities pass the "test of time." The designer must be concerned with material durability and wear as well as cost.

D **Maintainability :** The use of easily maintained finishes is critical. It is critical to be familiar with finishes that wear well with low maintenance requirements.

E **Compatibility :** The designer must be familiar with the base's architectural and environmental compatibility plans to achieve a unified sense of scale, tradition, and compatibility. The design team needs to understand that occasionally conditions exist which may limit the ability to meet the compatibility standards.

F **Design :** Designer must meet as many "human" needs at as many levels as possible, especially the need to feel good about one's surroundings.

- **Creativity :** Budget constraints increased importance on design creativity. Proper planning and research of innovative design features will help the designer provide interiors within restricted budgets.
- **Flexibility :** Flexible designs are essential to meet the requirements . While the primary function must be the priority, the designer must keep in mind that functions evolve, and spaces may require future modifications. Flexibility within will reduce the amount of time and money required for future alterations.
- **Timelessness :** A sense of time in design will extend the life and usefulness of design projects. Interiors should be creative but not extreme, it should reflect quality but not opulence.

Importance of trade in industry

Objectives: At the end of this lesson you shall be able to
- **describe importance of interior designing trade in industry**
- **explain IIID for practicing interior designing in all spheres of life organisation for interior designing in India.**

Introduction to Indian standard Association and importance of trade : Human behaviour has to be regularised for the smooth functioning of the society and the members who err, (do mistakes) are disciplined (policed) or forced out (court of law),likewise for smooth functioning of profession, a code of professional conduct is established by its practitioners. And its important that all the practitioners of that profession, know, understand and adhere to it.

The groups that investigate and quality interior design programs and that develop educational standards varies from country to country.

As, in America, we have the following organisation to name a few.

- NCIDQ - (National Council for Interior design qualification)
- FIDER - (Foundation for Interior Design Education Research)
- ASID - (American Society of Interior Designers)
- IIID : In India we have INDIAN INSTIUTE OF INTERIOR DESIGNERS, on becoming a professional member of it, an individual agrees to uphold this CODE OF CONDUCT and the BYE LAWS of the INSTITUTE and is thereby required to conduct his or her professional practice in a manner that will command the respect

IIID Rules and Regulation

1 The Indian Institute of interior designers is on profession in India and for the establishment of good professional and trade practices and ethics among its members.

2 Indian Institute of interior designers is dedicated to highlighting and enhancing the image of the interior design profession not only in India but also foreign.

3 The membership of IIID is open to interior designers, manufacturers of materials used in interior furniture makers, interior furnishing contractors and dealers of materials used in interior furnishing jobs. IIID brings the interior designer on one hand and the manufacture and dealers of interior furnishing product and material furniture makers of the interior furnishing contractors on other hand on a common platforms thereby tends to enhance the art and image of the profession not only among the clients and the customers of interior designer and the executors of interior furnishing jobs, but also on a national level.

4 Indian Institute of interior designers is one of its kind and the only one in India. It has membership of over 1500 of all India basis.
   - IIID provided services which will assist the interior designer in the practice of his/her profession and enhance the growing recognition of Interior design as a profession.
   - IIID brings the Interior designers, manufacture of materials, furniture makers and Interior furnishing contractors on the platform and officers them an opportunity to interact, understand the new innovation and have up-to-date information about the Trade and Interior designing.
   - IIID will encourage the imparting of specialised education through eminent and distinguished Interior designers to students opting for Interior design as career and with that object will pursue the setting up of improved courses in interior design in educational institution in the country.
   - IIID will help lay down general conditions of contract and prepare standard forms of agreement for interior furnishing contractors to include escalation mode of measurement defects, liability and arbitration.
   - IIIID will organise various competitions like 'Interior of the year' yearly competition for the Interior designers. 'Best Interior' job of the yearly competition for the Interior furnishing contractors and 'Best product of the year' yearly competition for the manufactures and yet suitable awards.
   - IIID will organise seminars and exhibition in India on works done by Interior designers and of material produced by manufacturers, IIID invite foreign Interior Designers to participate in seminar and foreign manufactures of materials to exhibit their products may be produced in the country.
   - IIID will give its members the privilege of using IIID appellation the symbol of qualified. Professional Interior designer, manufacturer of products and a contracting firm bound by its code of ethics.
   - IIID is planning to have chapters at various places wherever they have minimum 20 Associate members in order to promote the activities Institute.

Membership Qualification : Membership of the Institute will be granted to an individual or a firm under any of the following categories provided the individual or the firm fulfills the qualification requirement as outlined against such category is scrutinised by the Scrutiny Committee and approved by the Executive committee of the Institute.

Classification of Members

1 Associate Member	2 Fellow Member
3 Trade Member	4 Life Member
5 Licentiate Member	6 Student Member
7 Honorary Member	8 Affiliate Member
9 Press Member	10 Education Member
11 Donor.	

Interior Designer as a profession and its features

Objectives: At the end of this lesson you shall be able to
- **explain responsibility of interior design**
- **describe interior design as a profession and job function of interior designer**
- **state modern interior design features**
- **explain importance of trade and design phases for interior designer.**

Responsibility of an Interior Designer : An individual as an interior designer has responsibility towards his

- Profession
- Client
- Contractor
- Suppliers
- Society in General

Interior design as a profession : The social and economic situation during 20th century increased the importance of an interior decorator, interior decoration. Still remains a luxury available only to the upper classes of the society. Certain status is attached in the society in or work place. The role of interior decorator of the work. It is one of the professions in which women did very well. In America, women tried to establish economic independence through interior decoration of existing buildings or rooms. Interior decorators were mainly responsible for selecting suitable textiles, floor and wall coverings, furniture, lighting and colour schemes for the room. Interior decoration is rarely responsible for structural alternations. It is regarded as a branch of fashion design because in interior decoration very few scheme remain together for a long time. Interior decoration gained importance with the publication of the book, the decoration of houses by novelist Edith Wharton and architect Ogden Codman in 1897.

Summary of Job function of Interior Designer feature

A Make analysis of forms size and location of doors and windows of the functional area.

B Find the purpose and number of persons to be accommodated.

C Study the furniture groupings and minimum clearance required.

D Study the inner-circulation space for comfortable operations.

E Study the possibilities for modular furniture one must prepare modular furniture because it is the most versatile and flexible in arrangements.

F Furniture must be according to the function.

G Minimum clearance should be observed.

H There must be provision of adequate floor and wall space for furniture grouping.

I There must be proper segregation of traffic ways from centres of activity.

J There must be ease of access.

K There must be maximum flexibility in space.

L Sizes and types of furniture must be studied before selection.

M There must be sufficient provision of storage space.

N Furniture must be proportion to the room.

O The total and overall composition must be balanced.

P Composition must have the importance of comfort and convenience with pleasing look.

Q Selection of finishing materials, colour and texture for physical and mental comfort, look with specified budget and durability.

R Composition must be aesthetical.

S Use of indoor plants is possible or not.

T Use of indoor plants elements outside and inside.

U Selection of light in terms of minimum lumens for various functions for day as well as night, light can be used to give due important to various elements.

V Selection of proper colour schemes with respect to surrounding as well as the type of environment which it is to produce.

W Selection of proper texture in terms of various elements furniture, curtains, materials etc., increase effect on environment.

X Selection of proper ventilation and air-circulation process through doors, windows and ventilators or mechanical process.

Y As far as possible all the elements of decoration must create unity among themselves and create dynamic feeling in the environment.

Z There must be sufficient flexibility to change some element of the composition to get new effects for a change.

Modern interior design features

– simple uncluttered, spaces with clean lines using colors to evoke lines various moods.

– various texture and materials.

– form and function of space and furniture is followed.

– local materials are used.

Modern design refers to past era particularly period between 1920's to 1970's.

- Emphasis on horizontal and vertical lines with fewer curves.

Importance of trade in training : Interior design, like film making is a sum total of all the arts. An interior designer should have knowledge of architecture, construction, carpentry, planning, circulation ventilation, weather patterns, air conditioning, insulation, plumbing, sanitation, electric wiring, furnishing, painting furniture, polishing, art movement, sculpture, relief plastering, flower arrangement, electrical gadgets, household utensil aesthetic criteria, ritual practices.

A very common belief prevalent among people is that all architects know interior designing, nothing can be more incorrect. The reason is that an architect basically designs on a grand scale unlike an interior designer concerns himself with intimate details like for e.g., planning microwave oven, bed etc., whereas an architect is concerned with general details like placing of kitchen and bedroom etc., Hence interior designing is very important among trades in field of construction.

It may vary based on the scale of the project and time schedule		
Programming 2 Weeks	**Conceptual Design 3 Weeks**	**Design Development 6 Weeks**
• Negotiate a contract. • Develop a project schedule. • Survey and document existing conditions. • Determine design objectives and spatial requirements. • Document project goals. • Identify additional consultants that may be required.	• Prepare graphic materials to describe each design concept. • Review design concepts with client. • Identify life-safety and building code issues. • Evaluate and select a design concept to be developed.	• Develop the approved design concept. • Prepare drawings, including plans, reflected ceiling plans, interior elevations, and details. • Develop art, accessory, and graphic/signage programs. • Engage a contractor or estimator for preliminary pricing of design.

Project phases defined

1 **Programming:** Identification, analysis and documentation of the client's needs and goals in a written document. This becomes the basis for evaluating design solutions in the subsequent phases.

2 **Conceptual design:** Brainstorming phase of the design process, where many options are considered and evaluated. The goal is to gain client approval for a single design concept that will be further developed as the project progresses and to agree on a direction for the character and aesthetic intent of the project.

3 **Design development:** Most design intensive phase of a project. In which all design elements are developed, including the partition and furniture layout; wall, window, floor and ceiling treatments; furnishings, fixtures.

Introduction of tools, equipments and instruments and raw material uses

Objectives: At the end of this lesson you shall be able to
- **describe tools and equipments**
- **explain drawing instruments, equipments and raw material**
- **illustrate layout of drawing sheet and title block.**

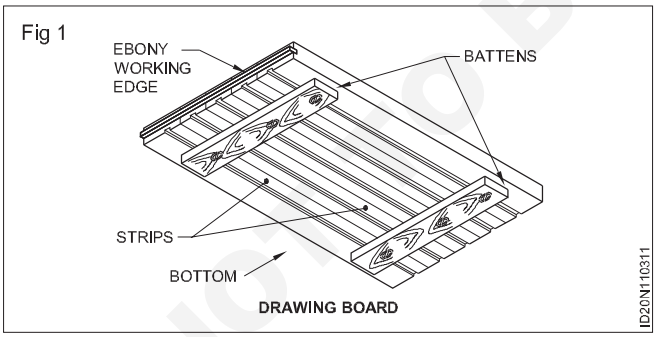
Introduction to drawing material : Drawing material can be divided into two types stationery and instruments. The materials on which drawings are made are stationery and the materials by which drawings are made are instruments.

Purpose of drawing materials : To get the correct concept of a project, correct and neat drawings are necessary. For this, you will require good quality materials. For instance, if you use poor quality paper, the ink will spread on it, or it will tear easily while rubbing, or if you employ faulty compass to draw a circle, it will be inaccurate and sharpness will be missing from the lines.

Source of light : Natural light is best for drawing and its optimum use should be made. Where or when this is not possible, fluorescent light can be employed because, it does not cast sharp shadows. But fluorescent light does not show colours in their proper hue, incandescent light is better for that. So the ideal light should combine both. While drawing, the light should fall from the left front so all the shadows fall behind you and when for drawing you move your hand from left to right, the drawn element remain in light.

1 **Drawing board (Fig 1) :** A drawing board, made of highly seasoned lightweight wood or plastic is available in various sizes to accommodate various sizes of drawing paper sheets.

Fig 1



A good board has these two essential features:

a It has a precise ebony edge for the T-square to slide on for producing perfect parallel horizontal lines.

b It is fastened to its battens with screws to allow seasonal expansion and contraction of the board as a safeguard against damage to it.

2 **Drawing Paper :** Depending on their thickness and visibility, paper can be divided into four categories:

Name of paper	Thickness	Visibility
Tissues	Very thin	Transparent
Cartridge sheets	Thin	Translucent
Cards	Thick	Opaque
Boards	Very thick	Opaque

These are used for presentation drawings and other purposes

These are of two types of drawing paper:

1 Hand -made paper

2 Mill- made paper

Hand -made paper: Hand-made papers have rough surfaces, pale in colour and not used for regular work, but meant for charts.

Mill- made paper: Mill-made papers are most commonly used for regular work, and are available in different sizes and rolls. They are specified by their weight in kg per ream or density in grams per square meter.

Size of drawing sheets (in mm) : While working or handling, the papers are liable to tear on the edges. So slightly large size (untrimmed) sheets are preferred. They are trimmed afterwards. IS:10811:1983 lays down such as designation of preferred trimmed and untrimmed sizes.

The basic principle involved in arriving at the sizes of the drawing paper is as under. The area of the biggest size (A0) is 1m2 and its length and breadth are in the ratio 1:. Let x and y are the sides of the paper. The surface area of A0 is 1m2, then the side are x = 0.841 m and y=1.189m. (Fig 1)

Two series of successive sizes are obtained by either halving or doubling along the length. The area of the successive sizes are in the ratio of 1:2.

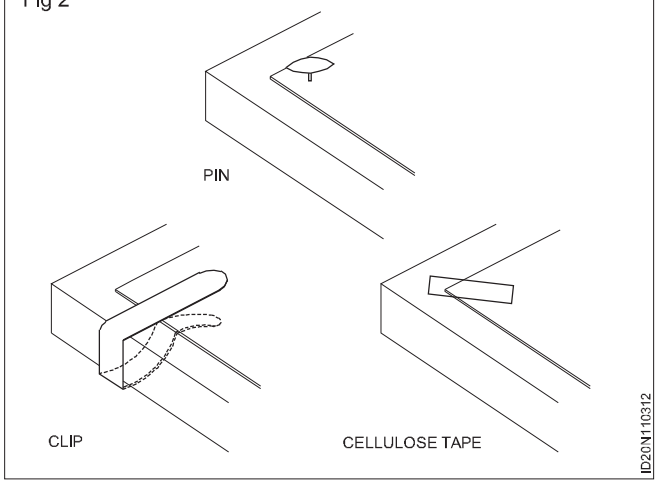
Designation of sheets: The drawing sheets are designated by symbols such as A0, A1, A2, A3, A4 and A5. A0 being the largest. Table 1 below gives the length and breadth of the above sizes of sheets. (Trimmed and untrimmed)

The relationship between two sides is same as that of a side of a square and its diagonal.

3 Holding of paper (Fig 2)

The accuracy of a drawing depends on the immovability of paper while drawing. To secure this pins, clips and cello tape are used.

Fig 2



Pins though most handy, are not advisable as they make dents in drawing paper, backing paper and drawing board. Clips are safe and clean but they tend to get loose after some use. Cello tapes are most convenient, most neat and least cumbersome but they require plastic sheets as the backing sheet to avoid tearing of paper.

Table 1

Designation	Trimmed size	Untrimmed size
A_0	841 x 1189	880 x 1230
A_1	594 x 841	625 x 880
A_2	420 x 594	450 x 625
A_3	297 x 420	330 x 450
A_4	210 x 297	240 x 330
A_5	148 x 210	165 x 240

4 **T square (Fig 3) :** A T square, made of seasoned wood is used to draw horizontal lines by sliding it along the ebony edge fixed on the left side of the drawing board. It should be hung when not in use to keep it straight.

5 **Parallel motion rollers (Fig 4) :** A T square can be replaced with parallel motion rollers which also slide like the T square but with the help of string and pulley, and for that reason are more convenient than T square. The boards attached with these do not require ebony edge.

6 **Set Squares (Fig 5) :** Set squares are transparent right angled triangles with 450 - 450 and 300 - 600 angles. They are used to draw vertical lines by sliding along T-square. They are also helpful in drawing lines inclined at 600, 450 and 300 angles. Also adjustable set square is also available where in you can adjust any angle.

7 **Flexi curve and French curves (Fig 6 & Fig 7) :** Now a days, for drawing of curves, a flexible curve is available. The basic advantage of a flexible curve/ any type of curve or shape unlike French curves is that you need just one curve to shape it to draw where you require quite few. Another advantage is that this one is marked with divisions and facilitates measuring even curved line, not possible with French curves.

Fig 3

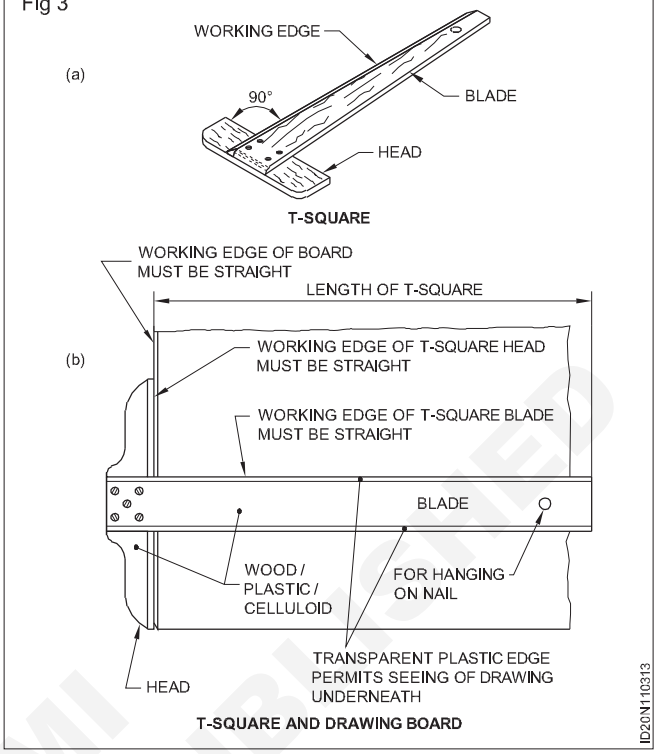


Fig 4

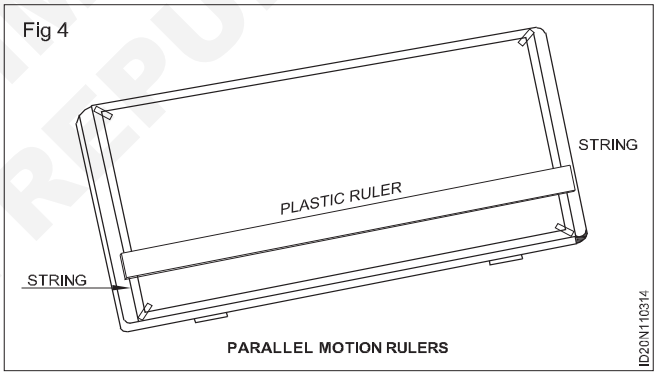


Fig 5

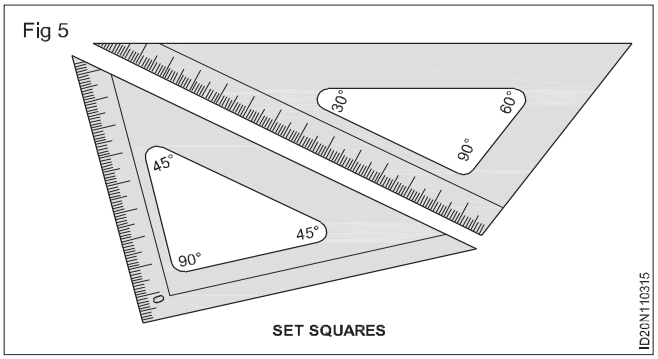


Fig 6

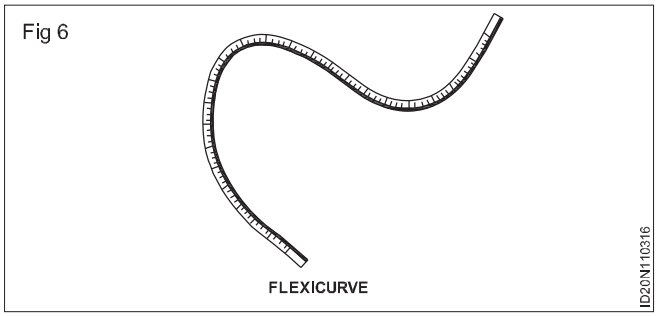
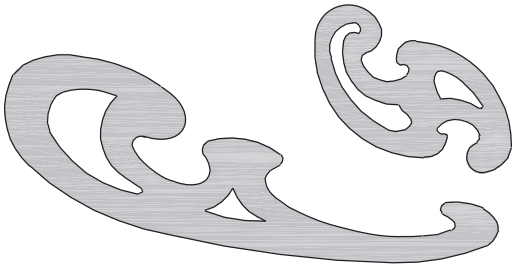


Fig 7



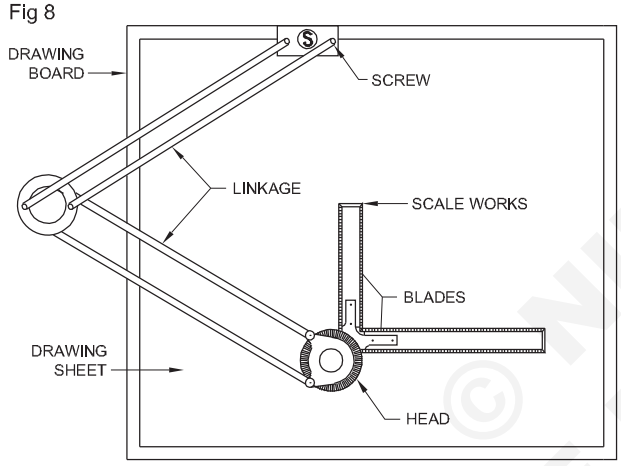
FRENCH CURVES

ID20N110317

8 Mini drafter

Drafting machine (Fig 8) : The uses and advantages of the T-square, set-squares, scales and the protractor are combined in the drafting machine. Its one end is clamped by means of a screw, to the distant longer edge of the drawing board. At its other end, an adjustable head (H) having protractor markings is fitted. Two blades (B) of transparent cellular accurately set at right angles to each other are attached to the head.

Fig 8



MINI DRAFTER

ID20N110318

The machine has a mechanism (M) which keeps the two blades always Pencils, always parallel to their original position, wherever they may be moved on the board.

The blades have scales marked on them and are used as straight edges.

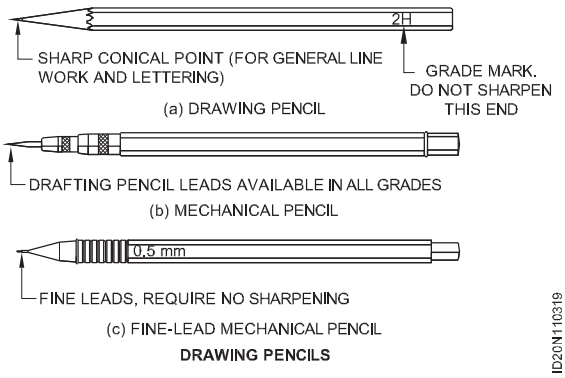
In some machines, the blades are removable and hence a variety of scales can be used. The blades may be set at any desired angle with the help of the protractor markings.

Thus, by means of this machine, horizontal, vertical or inclined parallel lines of desired lengths can be drawn anywhere on the sheet with considerable ease and saving of time. Drafting machines are now commonly used by the college students and draughtsman.

9 Pencils (Fig 9): In drawing office, standard pencils (lead encased in wood) and semi-automatic pencils are made use of. Pencil leads are made of graphite with kaolin (clay) of varying amount to get the desired grades. More the kaolin higher the hardness.

Grades of pencils: Pencils are graded according to the hardness or softness of the lead.

Fig 9



DRAWING PENCILS

ID20N110319

Hardest pencil is 9H grade and softest pencil is 7B grade. Selection of grade of pencils depends on the type of line work required and paper on which it is used.

Softer lead pencils are used to produce thicker and darker line work, but they wear out quickly. Medium grade of H, 2H are used for general line work as well as for lettering.

Harder grade leads produce lighter and thinner lines. Most construction line work is done with 4H, 5H and 6H pencil leads, producing thin but also sufficiently dark by exerting pressure. Depending upon the individuals touch and the style of writing, right pencil may be selected.

For any drawing on drawing paper or tracing paper, lines should be black, particularly drawings to be reproduced. For this purpose, the pencil chosen must be soft enough to produce jet black lines as well hard enough not to smudge easily. The point should not crumble under normal working pressure. The pencils should not be hard and cut grooves on the paper while drawing with normal pressure, Pencils H, 2H or 3H depending upon the paper (quality) and weather conditions are selected.

In summer the pencil leads become softer due to rise in temperature, so slightly harder pencils can be made use of softer grade pencils are used on smooth surfaces for lettering and arrow head. During rainy season or when humidity is more, the drawing paper expands and wrinkles form, pencil leads become harder. So softer pencils are to be used. Whatever may be grade of pencil you use, always prefer quality pencils/leads viz., Venus, Kohinoor, apsara etc.

For better line work, i.e., dense black lines, prefer paper which is not having too much teeth (roughness).

Selection of pencils: Pencil grades vary from one brand to another brand. Select the grades of the pencil depending upon the type of line work. For construction lines, you can choose 2H or 3H, for lettering and object lines grade H pencils. In general H, HB and 2H are used.

H medium hard

HB medium soft

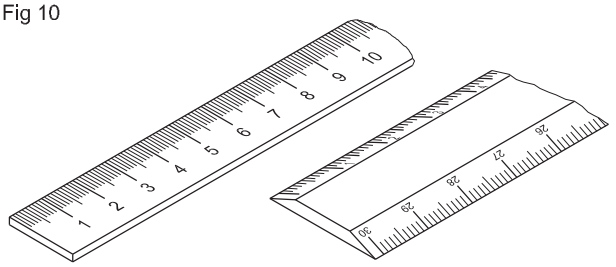
2H hard

Pencils used for drawing are always hexagonal in cross sections as they do not roll easily even when they are placed on slope surfaces. Its cross section helps in rotating the pencil, while drawing lines, to give uniform line thickness.

Now-a-days automatic (Mechanical) pencils or clutch pencils are available in different sizes (lead dia 0.3, 0.5, 0.7 or 0.9 mm). They are easy to handle as there is no reduction of holding length pencil leads can be replaced, as per required grade of hardness. They produce lines of uniform width without sharpening.

10 Scales (Fig 10) : Drawings are made in 1:100, 1:50, and 1:25 etc scale. For this purpose, flat or triangular rulers in wood or plastic are available. The flat ruler is not fully flat. In section it is beveled on both edges to allow proper holding while marking because it is held at an angle touching the paper to obtain precise marking. The triangular ruler does not require holding while marking. The flat ruler comprises 8 different scales while the triangular ruler comprises 12 different scales.

Fig 10



STEEL RULE WOODEN SCALE

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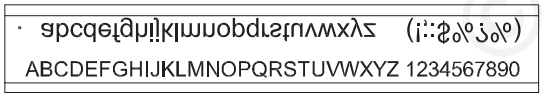
Stencils (Fig 11) : For quick and finished accomplished of written matter, lettering stencils in various sizes are available. Their working, use and advantages are same as those of the templates.

Fig 11



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Templates (Fig 12,13,14,15) : To draw various shapes and symbols in various sizes and scales, finished templates are available. Just keep the desired shape at the desired place and outline with a pencil or pen. Apart from regular shapes like circle, oval, square, triangle, polygons, the figures of furniture items, sanitary fittings, electrical symbols, plants / trees in plan are also available.

B Drawing Instruments

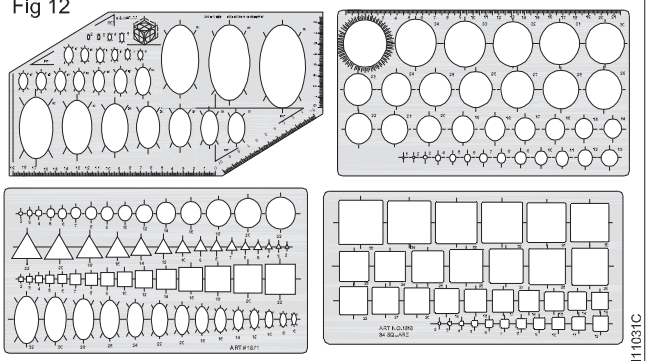
Features and their uses : The quality of a good drawing does not only depend on the talent of the draftsmen but also on the quality of instruments he uses.

Drawing instruments are generally sold in sets in boxes, but they are also available separately. The main parts of high grade instruments are generally made of nickel or brass. They must be rust proof. Tool steel is used for making the blades of the inking pen, bow instruments and various screws.

An instrument box contains the following: (Fig 16 a to h)

Large compass (with attachment facility), large divider, bow compasses / bow divider, beam compass, ink pen / linear / reling paper, lengthening bar, Screw driver, Lead case and proportional divider.

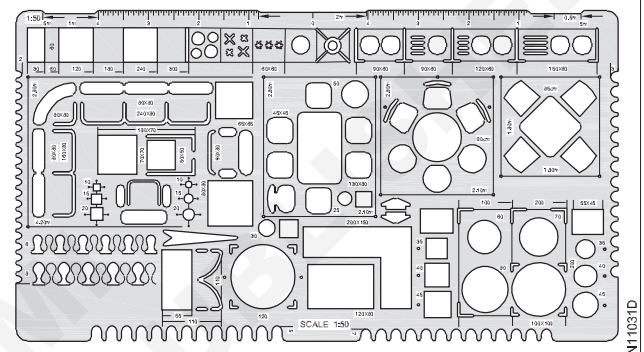
Fig 12



SHAPE STENCILS

ID20N11031C

Fig 13



FURNITURE TEMPLATE

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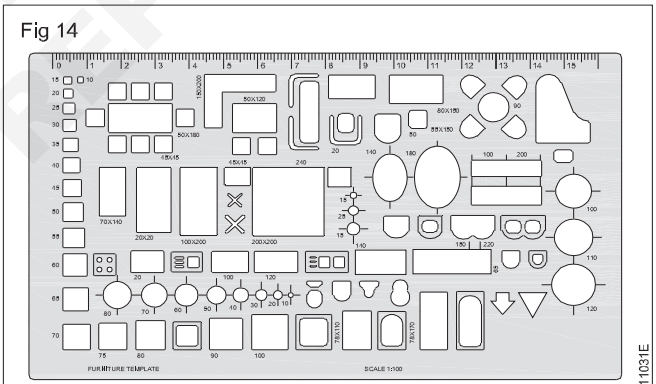
Fig 14



FURNITURE TEMPLATE

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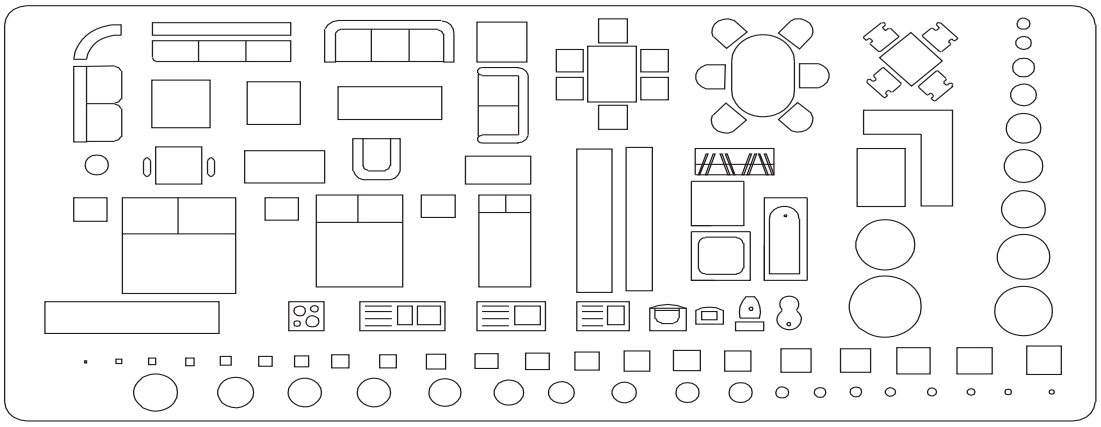
1 Large compass (Fig 17) : It has a knee joint in one leg that permits the insertion of pen or pencil point or attaching lengthening bar with pen or pencil point attached to it. It is used for drawing large circles/arcs also for taking large measurements. The pin on the other leg can be swiveled to vertical position when drawing large circles, while drawing the circles of arcs it should be held in such a way that the needle point leg and pencil point leg should be bent so as to make perpendicular to the paper.

As a rule while drawing concentric circles, small circles should be drawn first before the centre hole gets worn.

2 Large divider (Fig 18) : It is used to transfer dimensions and dividing lines into a number of equal parts. Divider with adjustable joints is preferable rather than plain legs. (Fig 18)

Fig 15



FURNITURE TEMPLATE

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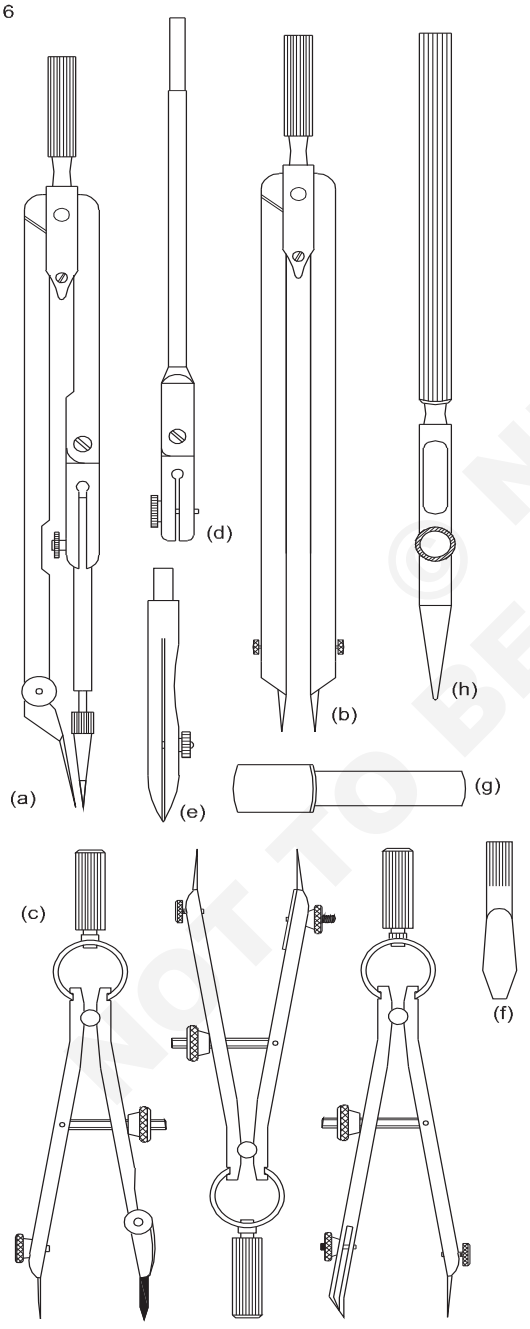
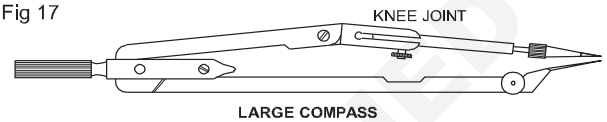
Fig 16



DRAWING INSTRUMENTS

ID20N11031G

Fig 17



LARGE COMPASS

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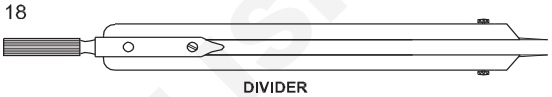
Fig 18



DIVIDER

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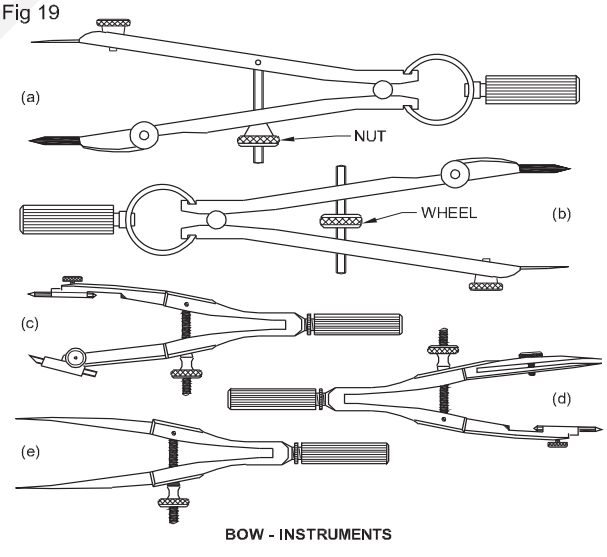
3 Bow instruments (Fig 19) : Bow pencil and bow pen compass are used for drawing circles of approximately 25 mm radius. Bow divider is used for marking or dividing smaller spaces. There are two types (i) Integral legs with spring action (4e) (ii) two legs held with a curved spring on top with handle on it.

Fig 19



BOW - INSTRUMENTS

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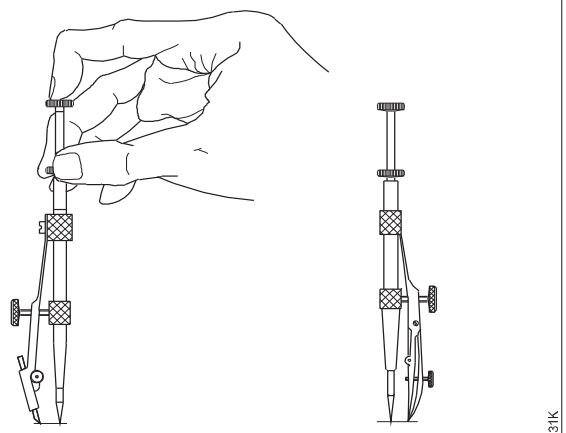
Bow instruments may have adjusting wheel and nut. To draw circles, it is better to mark the required distance separately and set the instruments and check. Then only the circles or arcs should be drawn on the drawing.

Different types of bow instruments : Adjustment should be made with the thumb and middle finger. The instrument is manipulated by twisting the knurled head between the thumb and finger.

Drop spring bow pencil and pen (Fig 20) : Drop spring bow pencil and pen are designed for drawing multiple

identical small circles. example rivet holes drilled/reamed holes. The central pin is made to move freely up and down through the tube attached to the pen or pencil unit. It is used by holding the knurled head of the tube between thumb and middle finger while the index finger is placed on the top of the pin. The pin point is placed on the centre point of the circle to be drawn (Fig 5) and pencil or pen is lowered until it touches paper. The instrument is turned clockwise and the circle is drawn.

Fig 20

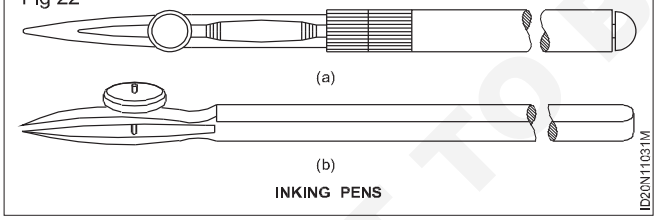


DROP SPRING BOW INSTRUMENT

4 **Beam compass (Fig 21) :** It consists of a beam made of steel rod or wood. The steel point is used as centre, and by adjusting the compass point (Pencil/Pen), very big circles and arcs are drawn. The divider point and the pencil point are replaceable to the adjustable holders. These pens have provision for varying the thickness of lines.

5 **Inking pen or liner or ruling pen (Fig 22) :** It is used to ink the straight lines drawn with the instruments but never for free hand lines or lettering.

Fig 22



INKING PENS

6 **Lengthening bar (Fig 23) :** To draw larger circles, it is fitted to the compass. The pencil point or pen point is inserted to its end.

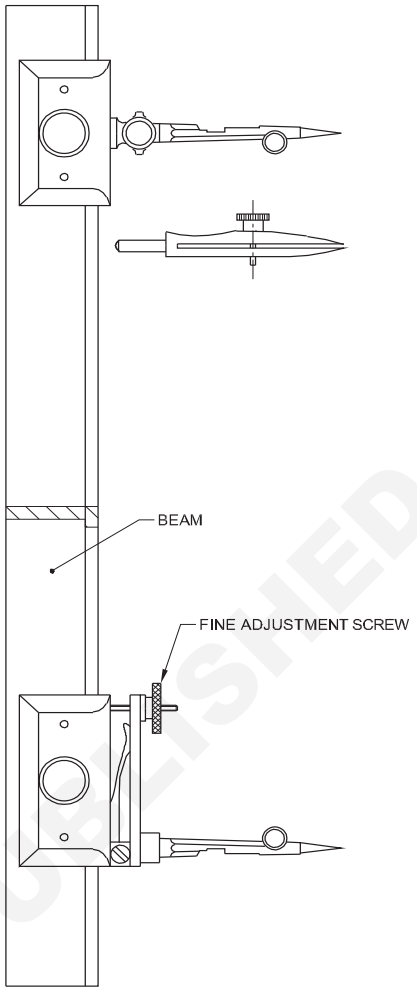
Pencil, pen and needle points are replaceable spares attachable to compass.

7 **Screw driver (Fig 24) :** Used for adjusting the screws of the instruments.

8 **Lead case (Fig 25) :** Lead case is the box for holding the pencil leads.

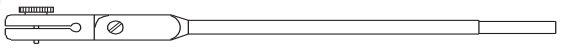
9 **Proportional divider :** For enlarging or reducing drawing, dividing a line into a number of equal parts, proportional divider is used. It is best suitable for percentage reduction with the help of graduation marked on the instrument. (Fig 26)

Fig 21



BEAM COMPASS

Fig 23

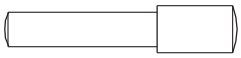


LENGTHENING BAR

Fig 24

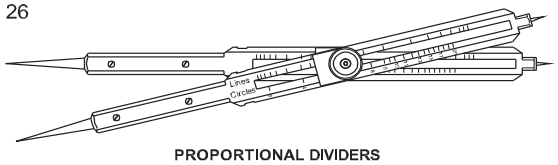
SCREW DRIVER

Fig 25



LEAD CASE

Fig 26

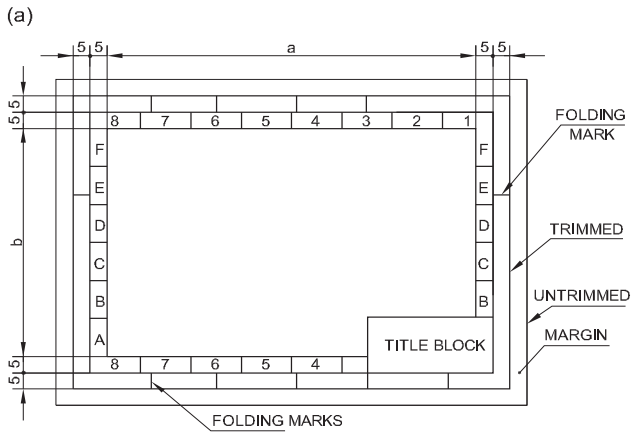


PROPORTIONAL DIVIDERS

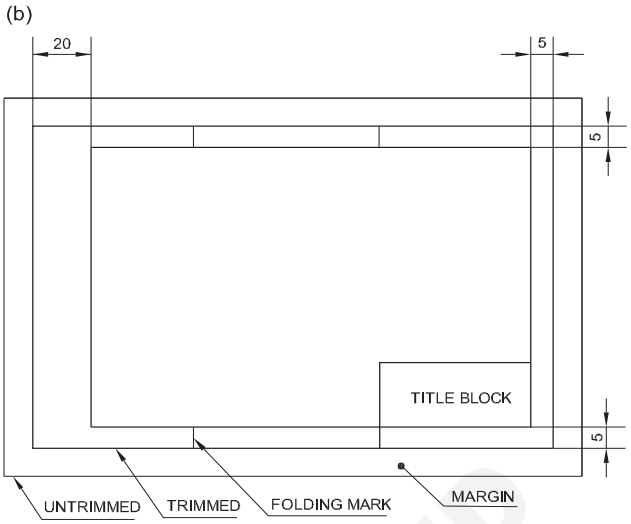
C Layout of drawing sheets and title block

Layout: Layout is standard arrangement of placing margin, title block etc for a particular size of drawing paper. It was explained earlier that the size of drawing sheets were standardized and designated as A0, A1, A2, A3, A4 & A5. Different layout styles for drawing papers from A0 to A5 sizes as per IS:10711-1983. (Figs 27 & 28)

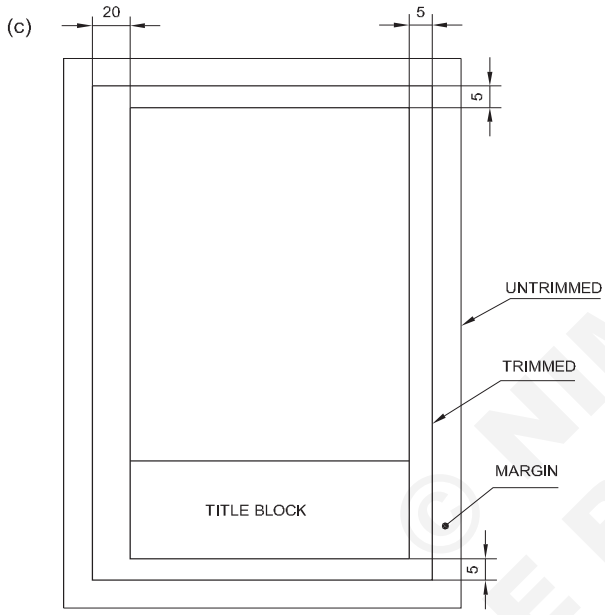
Fig 27



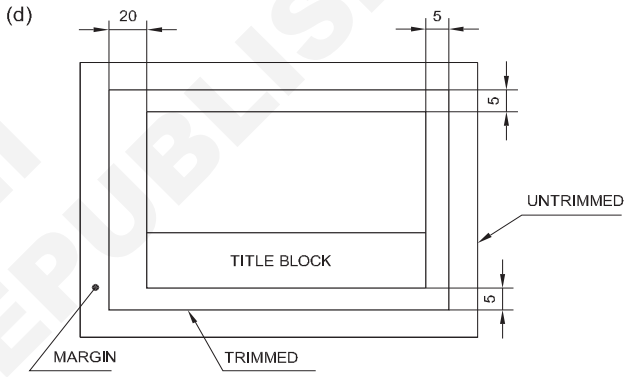
A2 SHEET LAYOUT



A3 SHEET LAYOUT



A4 SHEET LAYOUT



A5 SHEET LAYOUT

ALL DIMENSIONS IN mm

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Margin: Margin enables the prints to be trimmed. After fixing the drawing paper over the drawing board, before commencing the drawing, the layout is to be drawn. The drawing should be drawn within the layout boundary. The layout lines are called borders. `Borders' are enclosed by the margins from edges of the trimmed size of sheet.

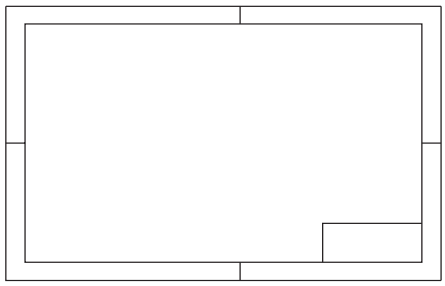
It is recommended that within the borders on the left side have minimum width 20 mm for the sheet sizes A0, A1 and 10 mm for the sheet sizes A2, A3, A4 & A5 for the space for filling. (Refer Figs 27 & 28)

The sheet may be taken horizontal or vertical depending upon the nature of the drawing sheet as type `X' and sheet type `Y'. (Figs 29 & 30)

Frame: The frame limiting the drawing space should be executed with continuous thin line of 0.5 mm.

Centering marks: When the drawings on the drawing sheet are to be microfilmed (preserving by taking negatives) centering marks to be provided. (Fig 31)

Fig 29



HORIZONTAL SHEET TYPE X

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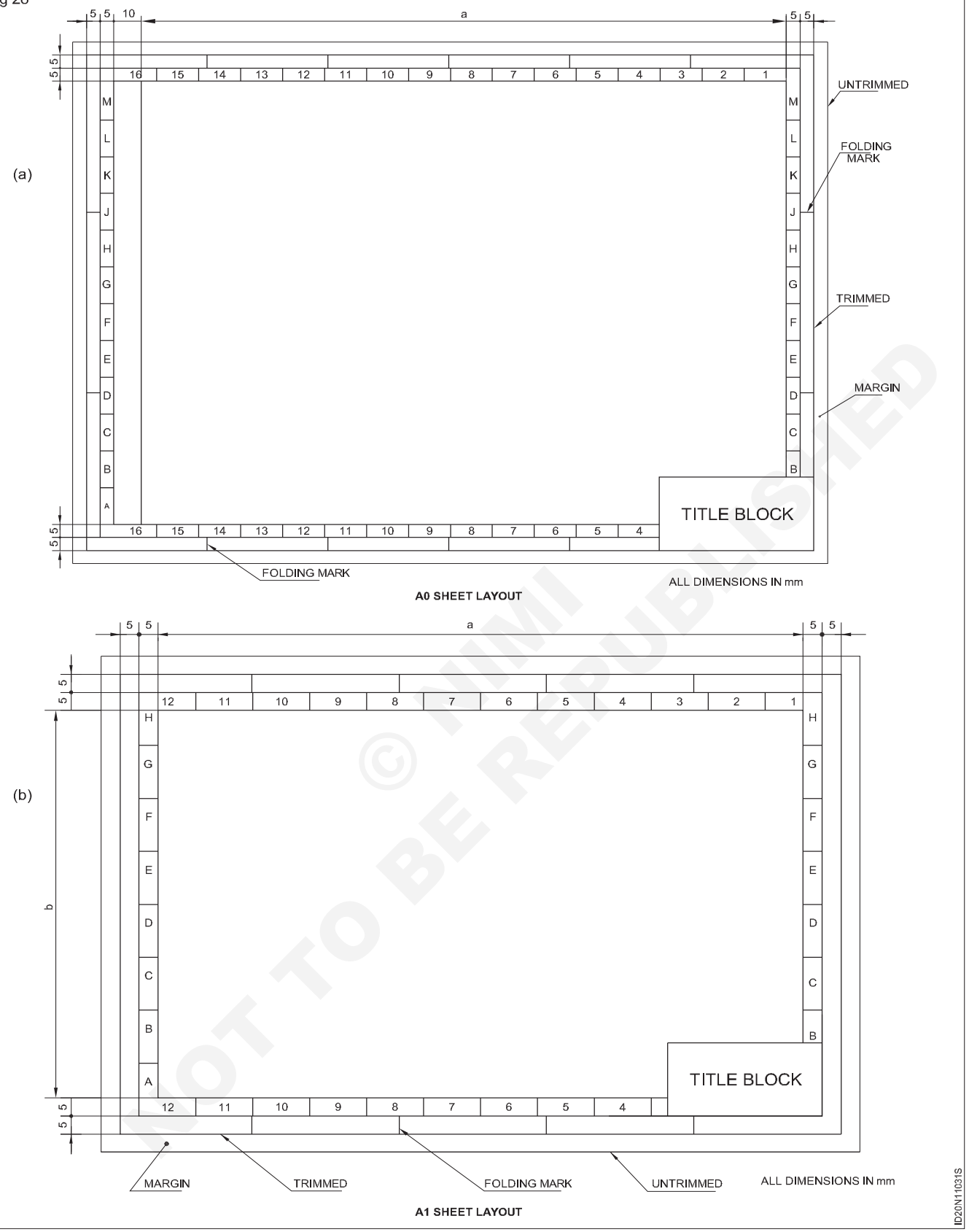
These marks shall be placed at the ends of the two axis of symmetry of trimmed sheet. It is executed with 0.5 mm minimum thick stroke, starting from the edges of the trimmed sheet. It shall extend approximately 5 mm beyond drawing frame.

Orientation marks: Orientation marks are used in order to indicate the orientation of the drawing (arrow head) sheet on the drawing board. These marks consist of arrow heads and should be placed across the frame one at shorter side and one at longer side coinciding with the

Fig 28



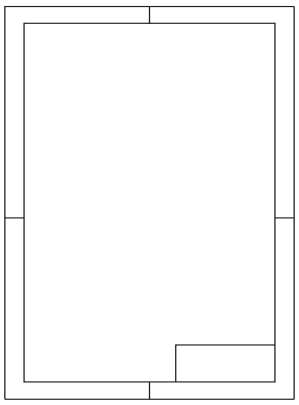
centering marks. One of the orientation marks always points towards the draughtsman. (Fig 32)

Metric reference graduation: It is shown only on drawings without (metric) dimensions. It shall have minimum 100 mm long divided into 10 equal intervals max. width 5 mm. It should be executed with thin continuous line (0.5 mm) disposed symmetrically about a centering mark. (Fig 33)

Grid reference: In order to facilitate easy location of features on large drawings (assembly) grid reference system is recommended. It is similar to lines of latitude and longitude on a map. The number of divisions shall be

divisible by two. The length of any side of the rectangle of the grid shall not be less than 25 mm and not more than 75 mm along the frame. These are the special requirements for production of assembly drawings. (Fig 34)

Fig 30



VERTICAL SHEET TYPE Y

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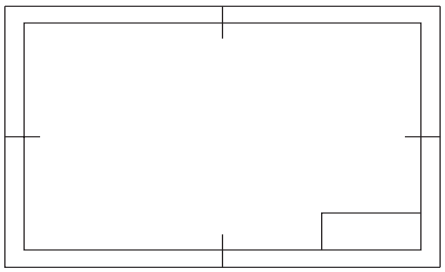
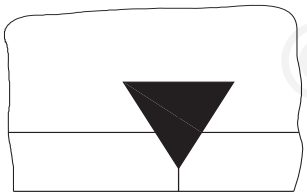
Fig 31



CENTERING MARKS

ID20N11031V

Fig 32



ORIENTATION MARKS

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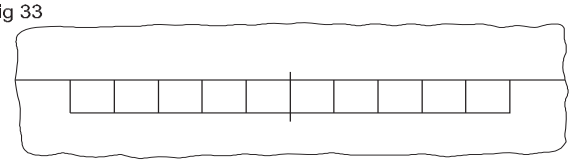
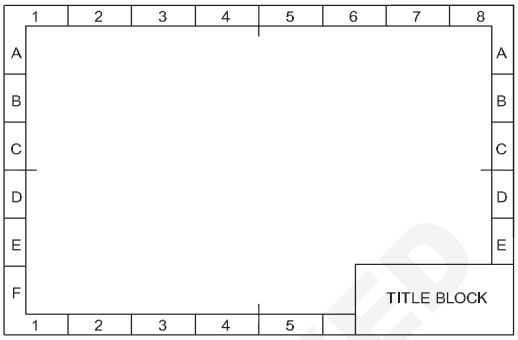
Fig 33



METRIC REFERENCE GRADUATION

ID20N11031X

Fig 34



GRID REFERENCE SYSTEM

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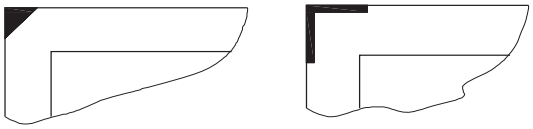
Trimming marks (Fig 35): These marks are required for the sheets which require trimming. Example printed copies of drawings. In such cases the trimming marks are drawn on the drawing tracing sheet.

Title block: (Fig 36): This is the block in which the particulars of the organization. Name of the drawing and other particulars are printed. It is situated in the bottom right hand corner of the drawing sheet. Figs 1 & 2 shows the position of the title block. Contents of the title block and their relative position vary to suit individual concern.

Fig 35



TRIMMING MARKS

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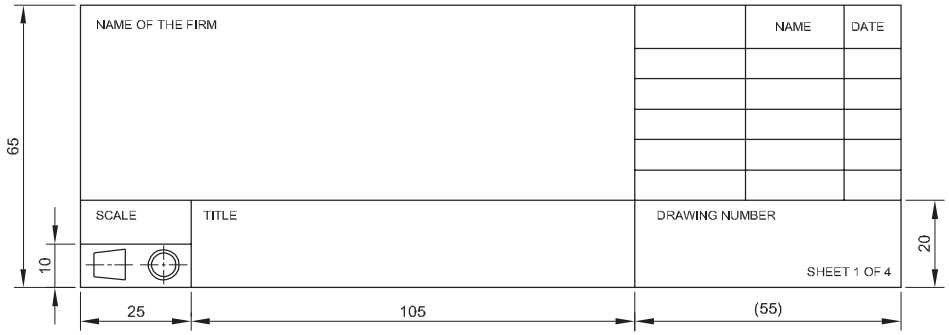
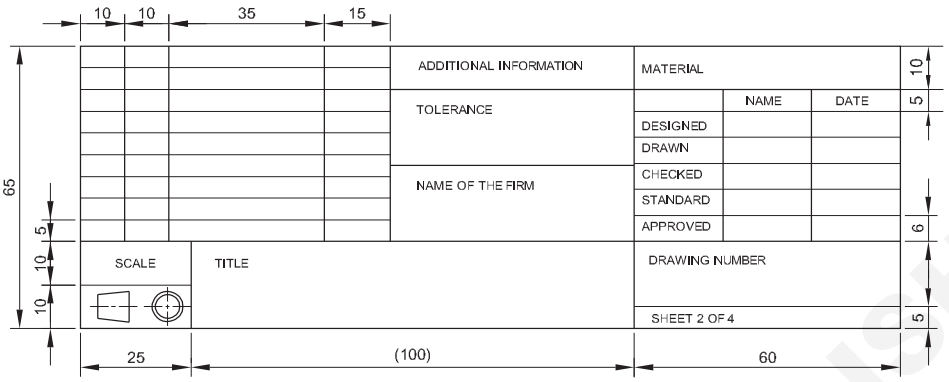
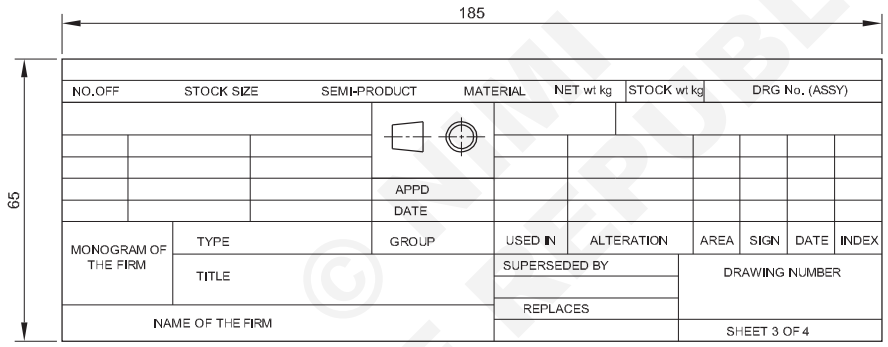
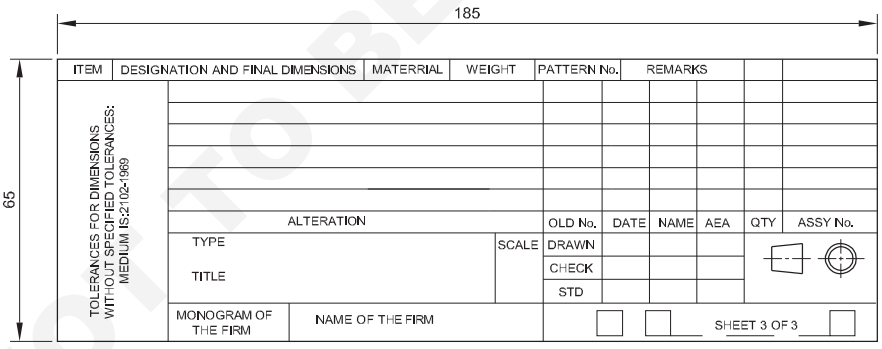
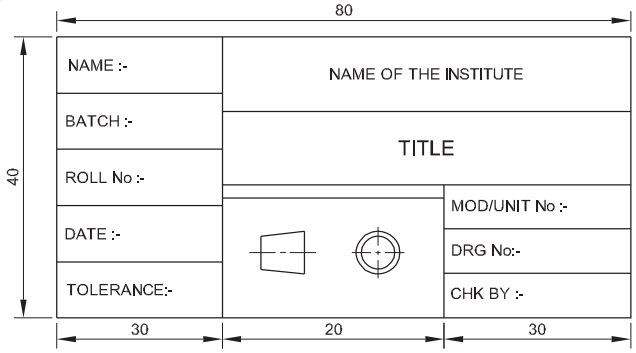
Fig 36











TITLE BLOCK TYPICAL LAYOUTS

ID20N11031AA

Importance of lettering

Objectives: At the end of this lesson you shall be able to
- **describe lettering methods and types of lettering.**

Introduction

Lettering : Letters and numerals are used in different drawings to specify the measurement of object and description of that object. H and HB pencils are used to write letters and numerals.

Writing Method : These are basically three types of letters normally used they are:

Block letters such as A, B, C, D

Small letter such as a, b, c, d

Numbers such as 1, 2, 3

Technique of lettering requires (Fig 1) : Knowledge of order of stroke and direction of stroke used in making them

Knowledge of the ruler for combining letters into words and words into sentences.

Fig 1

ID20N110321

Writing of titles, dimensions, notes, and other important particulars on the drawing is called lettering. It is an important part of drawing. Lettering should therefore be done in clear, legible and uniformed styles that it could be done free hand and speedily.

Styles of lettering: Many styles of lettering are in use till date. However, a few styles which are commonly used are shown in Fig 2.

Fig 2

ID20N110322

The width of different letters in terms of "d" is as follows for Uppercase and Lowercase: Table 1 & 2

Standard heights/Width: The standard heights recommended by BIS SP: 46-2003 are in the progressive ratio of "square root 2". They are namely 2.5 - 3.5 - 5 - 7 - 10 - 14 and 20 mm. The height of lower case letter (without tail or stem) are 2.5, 3.5, 5, 7, 10 and 14 mm.

There are two standard ratios for the line thickness "d". They are A & B. In A = line thickness (d) is h/14 and in B=line thickness (d) is h/10.

The width of different letters in terms of stroke (line) is as follows : Lowercase means small letters, as opposed to capital letters. is for example, For example the word yes, in lowercase, while the word YES is in **upper case.**

All the lettering should be printed, so that they are read/ viewed from the bottom of the drawing.

Table 1

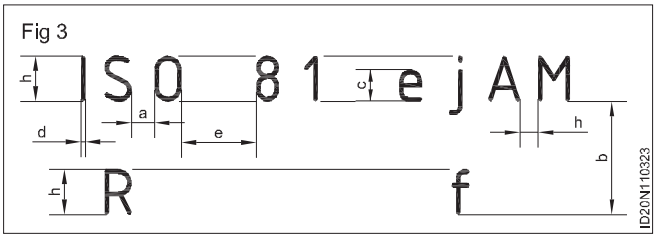
Width	Capital letters	Width
1	I	1d
5	J,L	5d
6	C,E,F	6d
7	B,D,G,H,K,N,O,P,R,S,T,U & Z	7d
8	A,Q,V,X,Y	8d
9	M	9d
12	W	12d

Table 2

Width (W)	Letters/Numerals	Width
1	i	1d
3	j,l	3d
4	f,t,l	4d
5	c,r	5d
6	a,b,d,e,g,h,k,n,o,p,q,s,u,v;3;5	6d
7	a,0 (zero), 2,4,6,7,0,8,9	7d
9	m	9d
10	w	10d

Spacing of letters: Recommended spacing between character, minimum spacing of base lines and minimum spacing between words as per BIS SP: 46-2003 is given below in Fig 3.

Fig 3



ID20N110323

Uppercase Lettering

Width (W)	Capital letters
1	I
4	J
5	C,E,F,L
6	B,D,G,H,K,N,O,P,R,S,T,U & Z
7	A,M,Q,V,X,Y
9	W

Lowercase letters and numerals

Width (W)	Letters/Numerals
1	i
2	l
3	j,l
4	c,f,r,t
5	a,b,d,e,g,h,k,n,o,q,s,u,v,x,y,x
	0,2,3,5 to 9
	0,2,3,5 to 9
6	a,4

Types of lettering

The two types of lettering are:

1 Double stroke lettering.

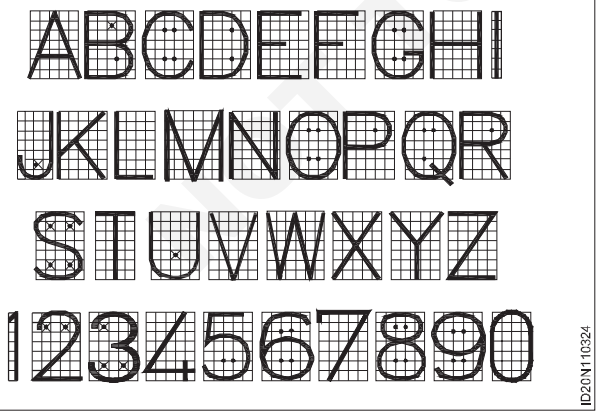
2 Single stroke lettering.

1 Double stroke lettering : In double stroke lettering the line width is greater than that of single stroke lettering.

Double stroke lettering is further divided into:

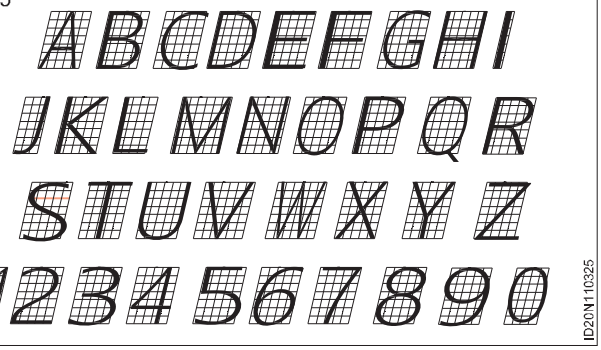
a Double stroke vertical gothic lettering : Vertical letters, drawn by double stroke of pencil with uniform thickness between these strokes are called double stroke vertical gothic lettering. (Fig 4)

Fig 4



b Double stroke inclined gothic lettering : Double stroke inclined gothic lettering is inclined an angle of 75°. (Fig 5)

Fig 5



Note: The style of lettering we commonly use is single stroke gothic lettering.

Notice that only capital letters are demonstrated, since we will use only capital letters on drawings.

Inclined letters are drawn at an angle of 15° towards right side, the proportion being the same as of vertical lettering.

Recommended sizes of letters

Main titles - 6mm, 8mm, 10mm, 12mm.

Sub titles of heading - 3mm, 4mm, 5mm, 12mm.

Notes, schedules and materials - 2mm, 3mm, 4mm 5mm.

Spacing in lettering : Uniformity in spacing of letters is a matter of equalizing spaces by eye.

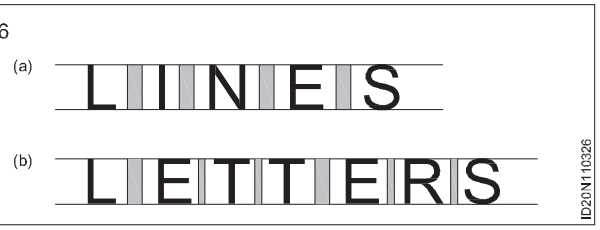
The background area between letters, not the distance between them, should be approximately equal.

Words are spaced well apart, but letters within words should be spaced closely.

For either upper case or lower-case lettering, make the spaces between words approximately equal to a capital O. (Fig 6a)

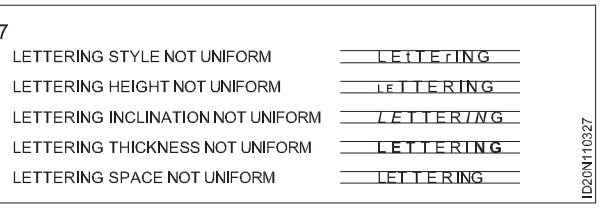
Avoid spacing letters too far apart and words too close together (Fig 6b)

Fig 6



Examples of common mistakes in lettering (Fig 7)

Fig 7



Introduction to Indian standard institutions

Objectives: At the end of this lesson you shall be able to
- **describe different type of scales MKS, FPS.**

Drawing scales : Drawing cannot be prepared in full size always. It can be drawn proportionately smaller or larger. i.e. in a reduced scale or enlarged scale. When drawings are made smaller than the actual size as in buildings furniture's etc, the scale is said to be a reduced scale. When some details on furniture parts etc. are drawn proportionately larger in size then the actual size it is said to be drawn in an enlarging scale.

In older days different parts of the hand were used as mean of measurement. Indian used ungal (derived from ungali): Length of finger, baalist (refers to the span of the open palm i.e. is a span between little finger and thumb). Hasta (referred to the length of the hand). and purusha (person height).

MKS and FPS system : England had a foot pound system of measurement, and as the queen ruled half the world the system of measurement prevailed. However, France and other western European countries followed a system based on meter, the word coming from Greek root matron meaning measurement. This system was called the metric systems. Metric system became popular, it was decided to standardize the various types of system international D units.

However, in India even now the two different units are commonly used. One is F.P.S system i.e. the foot pound scale on the other in the M.K.S system i.e. meter kilogram scale. Representative fraction (i.e. R.F). When a 1cm ling in a draw represent 1m length of the object, the R.F is equal to 1cm./1m. = 1/100 and the scale of the drawing will be 1:100 or 1/100 full size. If the R.F of a drawing is greater than unity then it is drawn in any enlarging scale e.g. When a 2mm. long edge of an object is shown in the drawing line 1cm. long, the R.F is 1cm/2mm.=5. Such a drawing is said to be drawn on a 5:1 scale or 'five times full-sizes.

Type of scale recommended for drawing M.K.S. F.P.S.

Block location plan 1:2000 1" to 80', 1:1000 1" to 100'

a Site plan 1:500 1" to 40', 1:200 (1/32" to a ft).

b Plans, section, elevations 1:100 1/8" to a ft. 1:50 (1/4" to a ft. 3/8" to a ft).

c Furniture 1:20 1/2" to a ft. 1:10 1" to a ft. detail 1:5 (3" to a ft. 1:1 6" to a ft).

Choice of scales: Careful consideration should be given to the choice of suitable scales in building drawings.

1 They need to communicate both actually, and adequately the information necessary to carry out the intent of the design.

2 The need to achieve economy of effort and time in the preparation and interpretation of drawings.

3 The character and size of the drawn subject, (eg. House plan are generally drawn to the large scale than plans of commercial buildings).

4 Desirability of keeping the drawing sheet for the project to one size.

Conversation

1cm = 10mm = 0.394"	1sqcm =100sqmm- 0.1550sqin
1m = 100cm = 3.28' =1.0936yards	1sqm = 10000 sqcm 10.76 sqft = 1.960sqyd
1km = 1000m =0.6214miles	1sqin =6.451sqcm
1" =2.54cm =0.0833'	1sqft =0.093sqin=0.111sqyd
1' =30.48cm, 12" =0.33yards	1sqyd =1296sqin=9sqft
1yard =36" =3" =0.9144m	1hectare=1000sqm=2.471 lacres
1 mile =1760yards =1.6093km	1acre =4046.86sqm=4840sqyd
2"=0.166' 5"=0.416' 3"=0.25' 6"=0.5' 4"=0.33' 7"=0.58'	8"=0.66' 11"=0.916' 9"=0.75' 10"=0.83'

Code of practice for Interior Design

Objectives: At the end of this lesson you shall be able to
- **describe code of nature for general interior drawing.**

Code of Practice for general Interior design

A brief outline of professional conduct from IIID has been given below.

1 The designer shall to undertake any execution work or sale of furniture or any other items. This indulgence will to allow him to justify his profession and business points (profit and low) will disturb his designing ideas.

2 The designer is remunerated solely by his professional fees payable by his client or by a salary payable by his employer. He is debarred from any other source of remuneration in connation with the works and duties entrusted to him. It is the duty of the designer to uphold and apply the scales of professional charges adopted by (IIID)

3 The designer must not accept any work which involves the giving/receiving of discounts or commissions; nor must he accept any discounts, gifts or commissions from contractors or tradesmen, whether employed upon his work or not.

4 The designer must not carry on or act as a principal/ partner/manager of any firm/company dealing in any business of furniture/material/labour.

5 The designer may act as a consultant/advisor/assistant to furniture contractor/architects/manufacturers/house and estate agents/development firms or companies/ firms or companies trading in materials used in/mass production of any item of furniture/firms or companies whose activities are otherwise connected with the interior, provided that he does not, either directly or indirectly, solicit orders for the firm/company.

6 The designer must not advertise/offer his serious by means of circulars or otherwise, nor may be make paid announcements in the press, except that for professional appointments required/change of address/change of telephone or telex.

7 The designer may exhibit his name outside his office and near the project under execution.

8 Incase of dispute between the client and the contractors the designer must act in an impartial and unbiased manner.

9 The designer must always be on the best of his behaviour and conduct and physical appearance and shall never loose temper.

Introduction and importance of lines

Objectives: At the end of this lesson you shall be able to
- **explain importance of lines and line types with its significance**
- **describe types of lines based on position and shape.**

Importance of line : The line is direct intimate contact between the designer and his ideas, between the first sketch and the finally executed work.

Infact, line shows the style of the designer. Even a child draws a line before being aware of the existence of the point.

The line which is the visible trace of a moving point, hence reveals the visual training of the designer and his knowledge of the theory because the line can suggest anything.

The simplest configuration of lines is the grid of vertical and horizontal lines.

A line is basically divided into two types

1 Position wise

Vertical, horizontal and diagonal

a Vertical lines increases the apparent height

b Horizontal lines increase the apparent width of an object.

c Diagonal lines makes an object look inclined

2 Shape - Wise: Straight, curved and compound

Curved lines has two types - Regular and Irregular

a Straight lines vary only in length and therefore all least ornamental.

b Curved lines, vary in degrees of curvature as well as length, to be ornamental.

For a typical drawing the types of lines recommended by BIS (Bureau of Indian Standard) Based on thickness of the line, according to the type and size different types of lines are used for eg., For electrical and sanitary pipe lines thickness of lines varies from .2 - 0.35 etc.

Different type of lines divided on conventions used in drawings are as follows:

1 Continuous lines

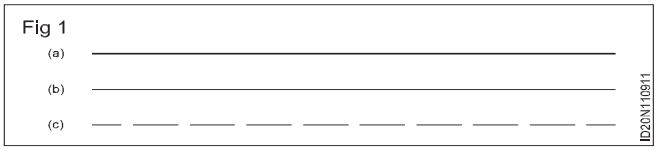
a Thick (Solid lines) b Thin

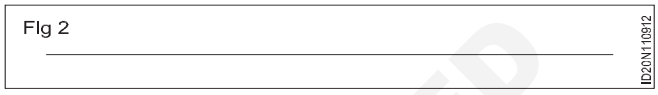
a Thick continuous line (Fig 1a): Thick line continuous used to highlight visible edges and the surfaces boundaries of an object, known as object lines or outlines. It is used to indicates visible objects that can be seen in plan, elevation or views.

b Thin continuous line (Fig 1b): Thin line continuous used for the dimension, extension, leader or pointer, construction and hatching. To depict imaginary lines of intersection outlines of revolving lines etc.

c Dashed thin lines (Fig 1c) : Dashed thin lines used to define limits or boundaries of partial interrupted. These are drawn as continues thin wary free hand lines to represent as mentioned. Hidden objects or edges or drawn with this lines.

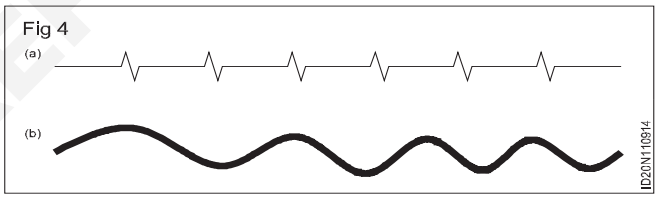
2 Medium light line: Used to denote secondary objects such as doors, furnishing, windows etc. (Fig 2)





3 Cutting plane lines (Fig 3) : Thick and thin cutting plane lines. These are long chain lines thickened end and thin else well with alternative long and short dashed of proportion 6:1 or 4:1 and evenly spared the corners where the section plane has to be cut. These are used to indicate direction or movement.

4 Long and short break line (Fig 4 A & B) : Used to represent breaks when the extent of a drawing cannot fit the paper.



A (Thin) Long break line

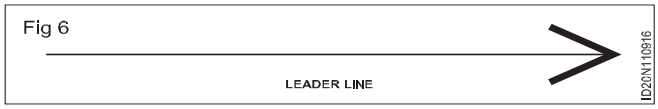
B (Thick) Short break line

Long breaks lines are indicated by thin ruled lines with short zig-zags placed at convenient distance short break lines are indicated by thin continuous wary line.

5 Chain thick line (Fig 5) : It is used for indicating special treatment on surface.

This line indicates that surface will need to comply with, special requirements such as pipelines, drain.

Leader line (Fig 6) : Leader lines are used to connect notes are references to objects or lines in a drawing. They start as solid line an end in an arrow. It may be drawn at an angle or curved.



Basic knowledge of geometrical shapes and lines

Objectives: At the end of this lesson you shall be able to
- **illustrate points, lines and angles**
- **describe different type of geometrical shapes and its significance**
- **describe types of lines based on position and shape.**

Points, lines and angles (Fig 1)

Point: It represents a location in space, having no width or height. It is represented by drawing intersection of lines or a dot.

Line: It is the path of a point when it moves. It has no thickness.

Types of lines

Straight line: It is the path of a point when it is moving in a particular direction. It has only length and no width. Also a straight line is the shortest distance between two points. Straight line, depending on its orientation are classified as Horizontal, Vertical and Inclined or Oblique line.

Horizontal line: Horizontal lines are those which are parallel to a horizontal plane. Example of horizontal plane is the surface of a still water.

Vertical line: Lines which are perpendicular to horizontal lines are called vertical lines. It can be treated as a line along the plumb line of the plumb bob or parallel to a plumb line

Inclined line or Oblique line: A straight line which is neither horizontal nor vertical is called an inclined line

Curved line: It is the path of a point which always changes its direction. Examples of curved lines Parallel lines: They are the lines with same distance between them. They may be straight lines or curved lines. Parallel lines do not meet when extended.

Perpendicular lines: When two lines meet at 90°, the two lines are said to be perpendicular to each other. One of this line is called as reference line.

Circle: Circle is a plane figure bound by a curve, formed by the locus of a point which moves so that it is always at a fixed distance from a stationary point the “Centre”.

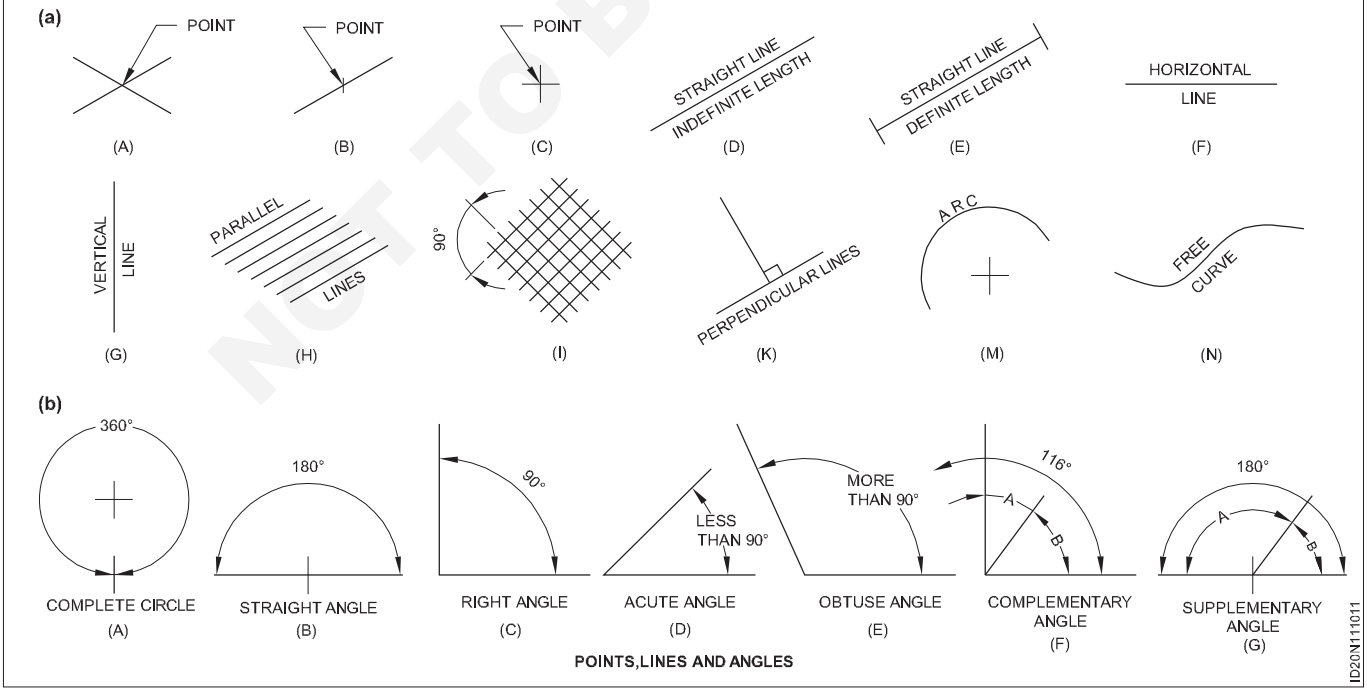
Concept of a degree: When the circle is divided into 360 equal parts and radial lines are drawn through these points, the inclination between the two adjacent radial lines is defined as one degree. Thus a circle is said to contain 360°.

Acute angle: If an angle which is less than 90° is called an acute angle.

Right angle: Angle between a reference line and a perpendicular line is called right angle.

Obtuse angle: This refer to an angle between 90° and 180°.

Fig 1



POINTS,LINES AND ANGLES

Straight angle: This refers to an angle of 180°. This is also called as the angle of a straight line. Complementary angles: When the sum of the two angles is equal to 90°,

Supplementary angle: When the sum of the two adjacent angles is equal to 180°.

Basic knowledge of geometrical shapes of lines

There are three geometrically organised basic shapes which are known as regular shapes.

1 Square (rectangle is only its variation)

2 Triangle

3 Circle.

All other shapes are based on it.

As previously discussed lines can be divided into three types based on shaped.

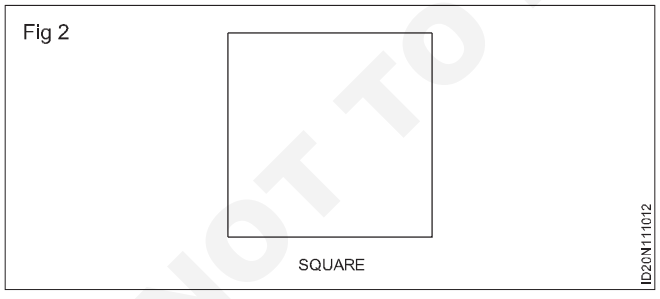
i Straight

ii Curved - regular and irregular

iii Compound

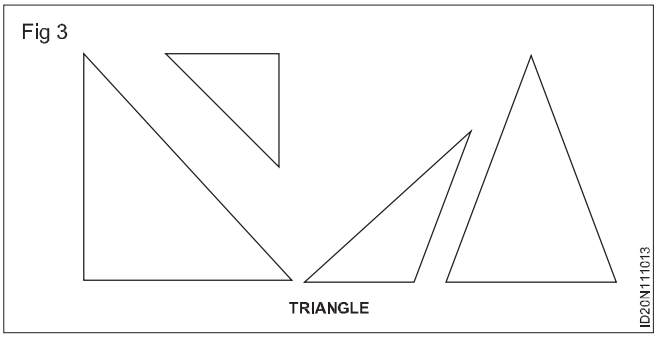
Among the three types regular/geometrical shape plays significant role.

1 **The Square (Fig 2) :** Square is a shape comprising four sides comprising at right angles. In three dimensions, square becomes cube, a solid with six square sides without which we cannot imagine our visual design paraphernalia, including architecture and interior design. This was the reason why convenient. Egyptians considered the right angle sacred, Fill elements of architecture are dependent on the right angle it is also significant to note that the sun worshipping cultured the Egypt. Greece preferred right angle based trabeated architecture while moon worshipping or moon dominated cultures hesopotomic. Byzantium end Islam, went for circle based domed and routed architecture and interior.



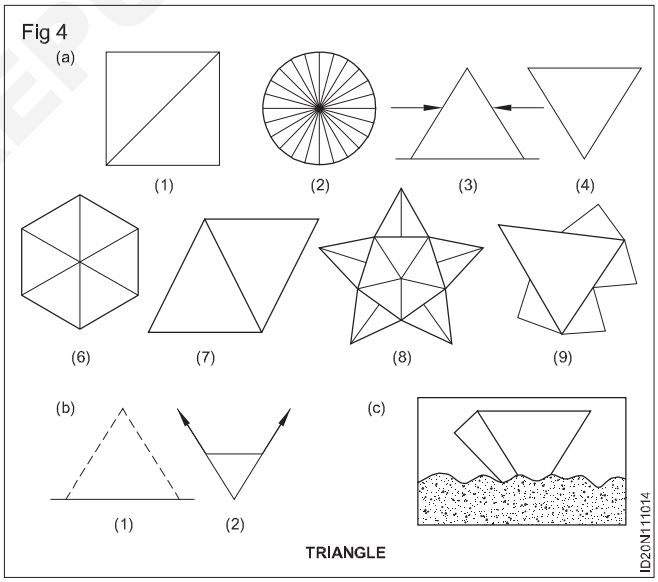
Relation between Square and Circle : Strictly speaking, there are only two delivite constant shapes, squares and circle. In all the cultures versed in the use of spiritual metaphor the square symbolises the earth of matter and nationalism, while the circle as its shape suggests,symbolises the encompassing world of spirit, heart and feeling. So it is no wonder that primitive cultures instinctively build circular dwellings, the wigwam, igloo, etc. While developed for cubical structure. It is this duality which to reconcile in our life. Thus the squaring of the circle was the architectural well as philosophical pursuit of the consent cultures.

2 **The Triangle (Fig 3) :** When use described the circle and square definite, we meant they have constant proportion, while a triangle can be of various proportion, with variations of sides and angles. (Fig 3)



Triangles the mother of all shapes (Fig 4 A) : If you look at a square, you will realize that it is formed of two triangles (i). If you look at a circle, it seems to be formed of several triangles, in fact, infinite(ii). Take any regular shape, and it seems to be formed of triangle (iii, iv, v).Even, if you take on irregular shape, you will realize that it is basically triangles which accurately define it . So it is no wonder that the triangle is recognised as the mother of all shapes; the origin. For this reason, famous scholar Plato has said that all plain surface is made of triangles.

(Fig 4B Depicts triangle upwards indicating stability, and triangle downwards indicating instability) (Fig 4C) indicates art museum in triangular shape.



Characteristic of Triangle

Formed of minimum number of lines

has variety of sides, angle

most excellent shape.

most stable shape

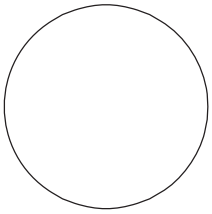
Monuments like pyramid, Ziggurats, Gopurams are

based on triangular form.

3 **The circle (Fig 5) :** The circle in a way is an enlarged point and if point is beginning, so is the circle. A circle

has no beginning or end, and so it symbolises divine. Like, a point a circle, objects the attention of the viewer immediately.

Fig 5



CIRCLE

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The perfect shape : Circle is termed as perfect shape because its existence from the centre to its circumference in equal everywhere. Since it has no angle. It denote, emotions and initiation unlike the angular shapes which denoted rationality and logical reasoning.

From all those reasons it is used sparingly in enliven, mostly on a mini scale as on a bigger scale only when it is to be media focus. Usually you fine circle in rounding the corners of shapes or edges in lighting fixture.

(A-C) depicting various shaped such as geometrical in form of circles, square, rectangle, triangle etc. (Fig 6)

4 Other regular shapes (Fig 7) : All other shapes are composed of basic regular shapes. Of some might call them distorted versions of the basic shapes. Like when your distort a circle an ellipse is formed and when you distort a square a rectangle is formed. And distort a rectangle and you have a whole range of shape Parallelogram, rhombus, trapezium trapezoid, etc.

Fig 7

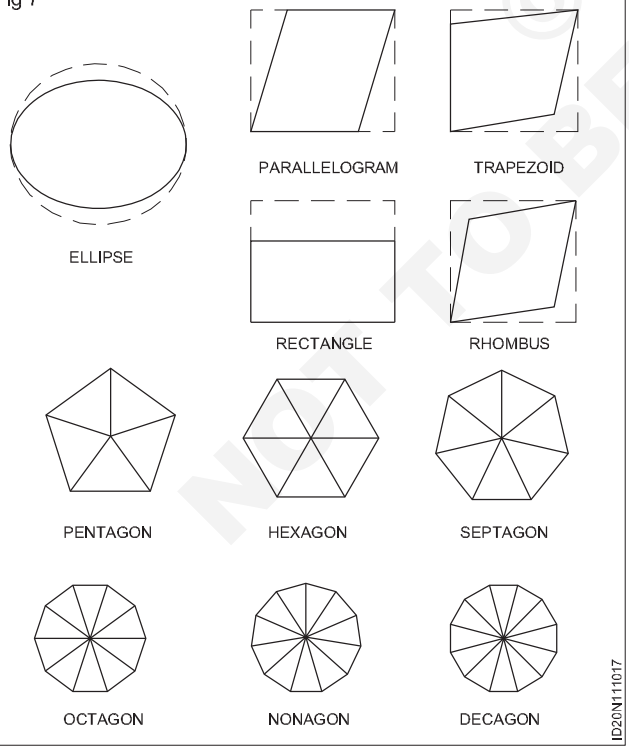

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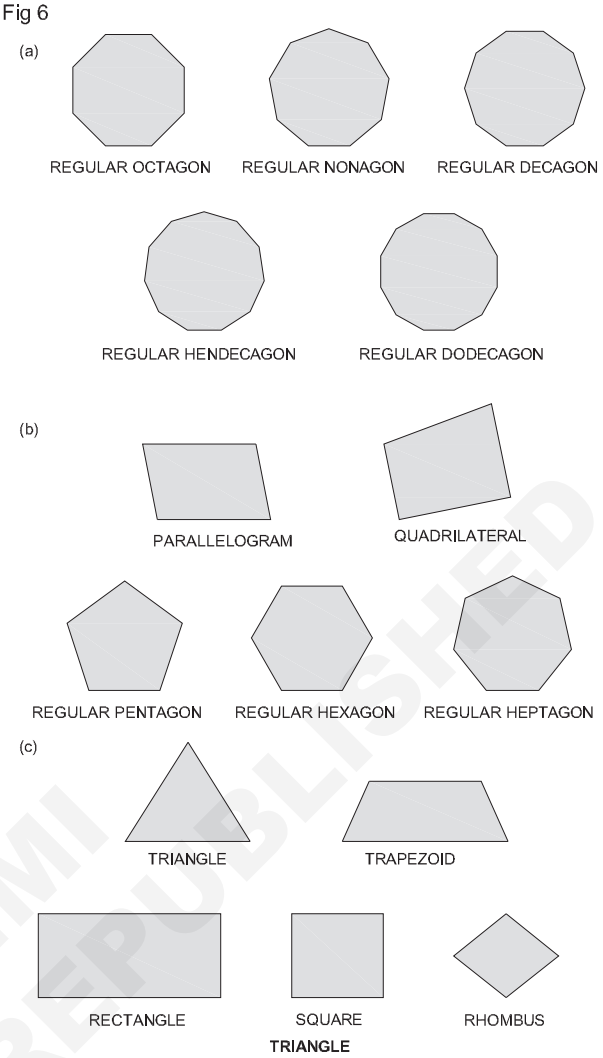
Fig 6



TRIANGLE

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Then a course of there is a whole range of shapes starting from pentagon to infinite number of sides. Find as you can see, they one formed of basic triangle shapes.

Definition of projection and its types

Objectives: At the end of this lesson you shall be able to
- **describe types of projection**
- **parallel projection**
- **types of parallel projection**
  i oblique
  ii orthographic.

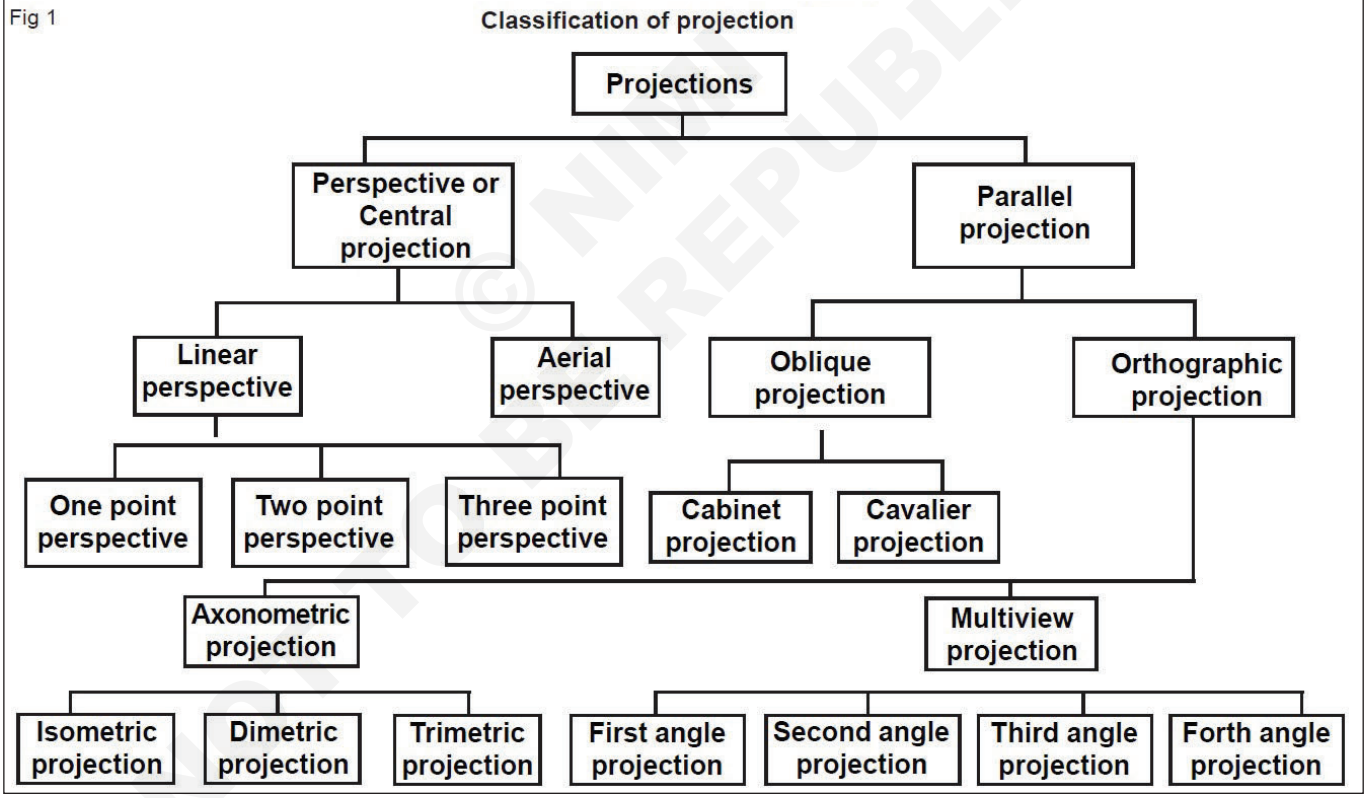
Introduction to projection

Definition of projection : A projection is a drawing that represents a three-dimensional object on a two-dimensional surface. The plane on which the projection of an object is taken is called the plane of projection or picture plane. The lines from the object to the plane are called projectors or projection lines.

Parallel projection : A parallel projection is a projection of an object in three-dimensional space onto a fixed plane, known as the projection plane or image plane, where the rays, are parallel to each other. The projection is called orthographic, if the rays are perpendicular (orthogonal) to the image plane, and oblique or skew if they are not perpendicular.

In parallel projection, we specify a direction of projection instead of center of projection. In this projection, the distance from the center of projection to project plane is infinite. These projections are less realistic, but they are good for exact measurements.

Fig 1



Types of parallel projection (Fig 1)

Oblique projection (Fig 2&3) : Oblique projection is a method of drawing objects in 3 dimensions. In this projection the direction of projection is not normal to the projection of plane. It is quite a simple technique compared to isometric or even perspective drawing. However, to draw accurately in oblique projection traditional drawing equipment is needed (see fig 3&4 for better understanding).

Types of oblique projections

a Cavalier projection (Fig 4)

b Cabinet projection (Fig 5)

a Cavalier: The cavalier projection makes 45° angle with the projection plane. The projection of a line perpendicular to the view plane has the same length as the line itself in cavalier projection. In a cavalier projection, the foreshortening factors for all three principal directions are equal. (Cavalier projection is an oblique drawing where in receding size is scaled in actual scale).

b Cabinet projection: The cabinet projection makes 63.4° angle with the projection plane. In cabinet

projection, lines perpendicular to the viewing surface are projected at 1/2 their actual length. (Cabinet projection is an oblique drawing where in the receding size is half the measurement of the actual size)

Fig 1

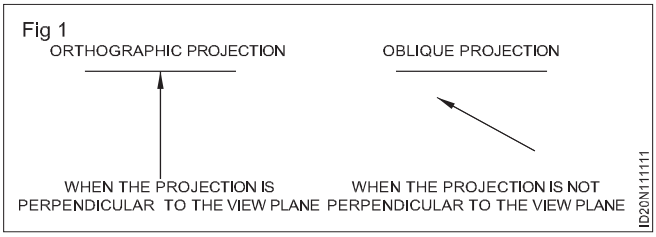


Fig 2

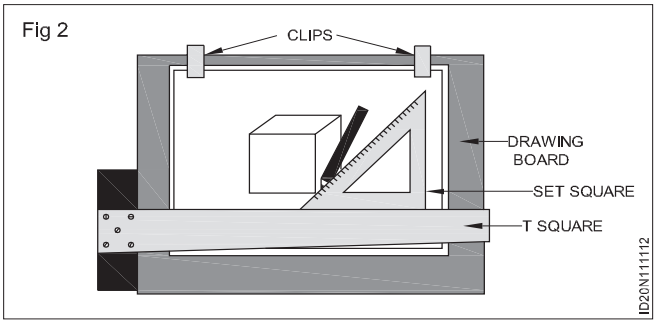


Fig 3

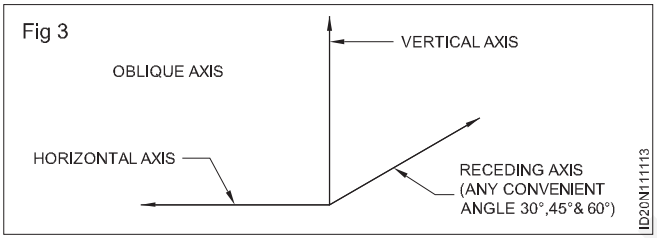


Fig 4

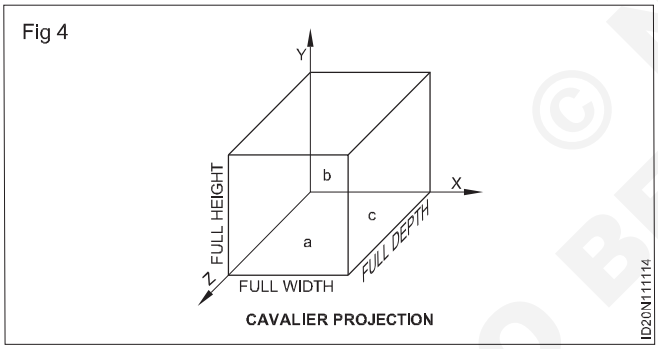
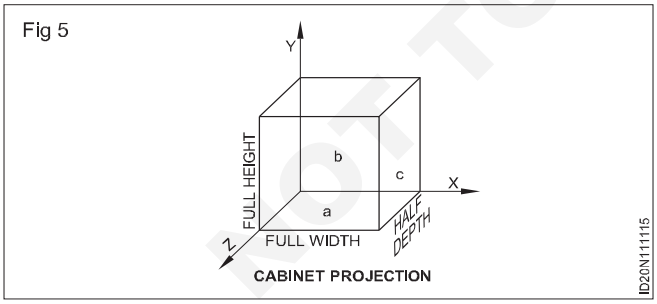


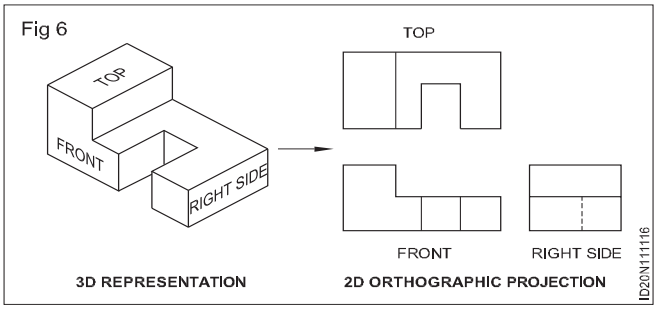
Fig 5



2 Orthographic projection (Fig 6) : An orthographic projection is a 2-D representation of a 3-D object. The 2-D drawing represent 3 different sides of an object. It is a form of parallel projection, in which all the projection lines are orthogonal to the projection plane, resulting every plane of the scene appearing in affine transformation on viewing surface.

Rule of orthographic projection : According to the rule of orthographic projection, to draw the projection view of a 3D object on 2D plane, the horizontal plane is rotated in the clockwise direction.

Fig 6



Types of orthographic projection

a Axonometric projection

b Multiview projection

a Axonometric projection: Orthographic projections that show more than one side of an object are called an axonometric projections. Axonometric means “to measure along axes”. It is a type of projection used to draw an object when it is rotated along one or more of its axes relative to the plane of projection.

There are three types of axonometric projections they are:

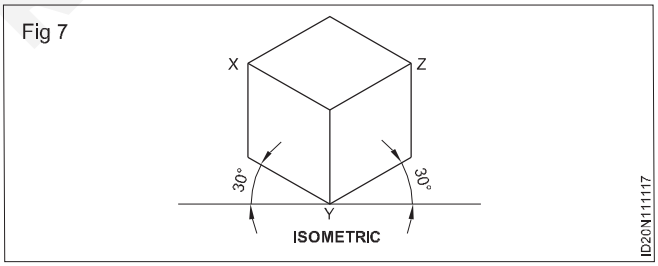
i Isometric

ii Dimetric

iii Trimetric

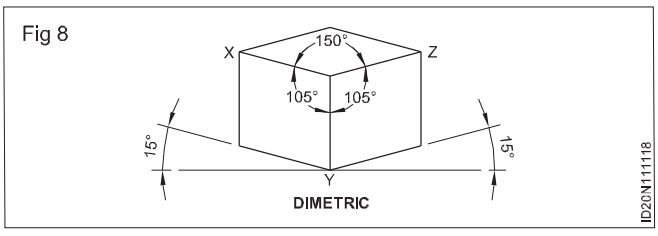
i Isometric (Fig 7) : The way to draw three dimensional view of an object in which the horizontal edges are drawn on the 30° angle and verticals are perpendicular from horizontal base. Here all three angles are equal. (All isometric dimensions are in the same scale).

Fig 7



ii Dimetric (Fig 8) : A way to project the object such that its two faces are equally inclined then the third one. Here only two axes use the same scale. (Dimetric - di =2; 2 axes dimensions fore shortened).

Fig 8



iii Trimetric (Fig 9) : It is the one in which the angles between the three projections are unequal. Thus a separate scale is need to draw trimetric projections. Here all three axes use different scales. (Trimetric-tri=3; 3 axes/dimensions fore shortened).

b Multiview projections (Fig 10) : When more than one projection planes are used the result is a multiview

projection. In other words multiview drawings are those which are based on the principles of orthographic projections. It has the quality that these views are arranged in systematic manner, so that reader can conceptualize it easily. They are also called as 1st angle projections or 3rd angle projections.

Fig 9

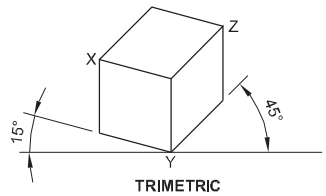
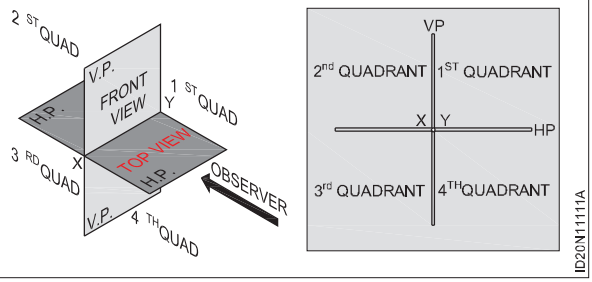
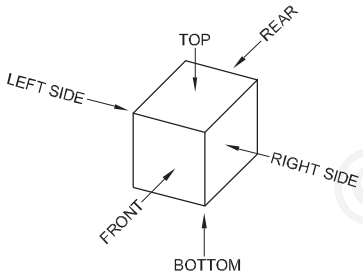


Fig 10



6 Principle views (Fig 11) : The 6 principle views are created by looking at the object straight or in the directions indicated.

Fig 11



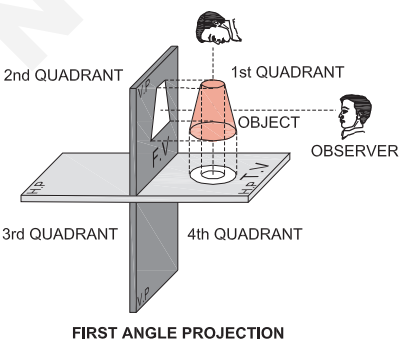
Types of multiview projection

i 1st angle projection ii 3rd angle projection

iii 2nd projection iv 4th angle projection

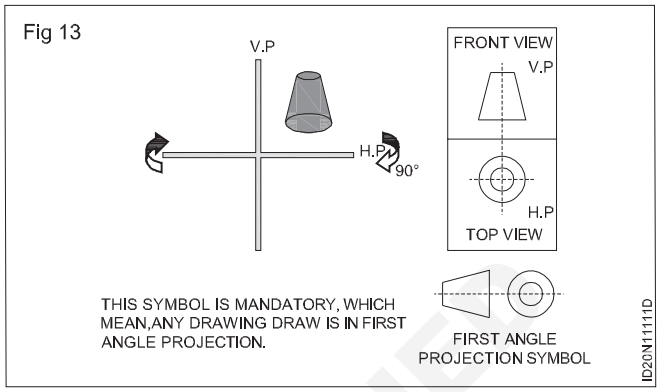
First angle projection (Fig 12) : 1st angle projection is a type of orthogonal projection system where the object is placed above the HP (Horizontal plane) and in front of the VP (Vertical plane) (i.e) the object is placed in the first quadrant such a way that it lies in between the observer and the plane of projection.

Fig 12



Drawing front and top views in first angle projection (Fig 13) : To draw front and top views, the Object's front and top views are projected on vertical and horizontal planes respectively. According to the rule of projection, the horizontal plane is rotated in the clockwise direction. Horizontal plane rotation brings the top view in the bottom of the projected front view.

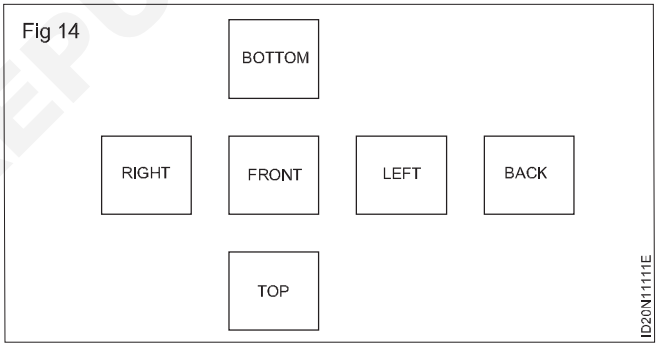
Fig 13



First angle projection is widely used in India, Canada, Europe and the rest of the world as a default projection system. In this projection, the plane of projection is assumed to be opaque (or) non-transparent.

Drawing right and left side views in 1st angle projection (Fig 14) : To draw right and left side views, the Object's right and left side views are projected on vertical left and vertical right planes respectively.

Fig 14



To bring right side view on a 2D plane, the rule of orthographic projection is followed. Left plane is unfolded towards the left side. Therefore the right side view is projected on the left side of the front view. Whereas the left side view is projected on the right side of the front view.

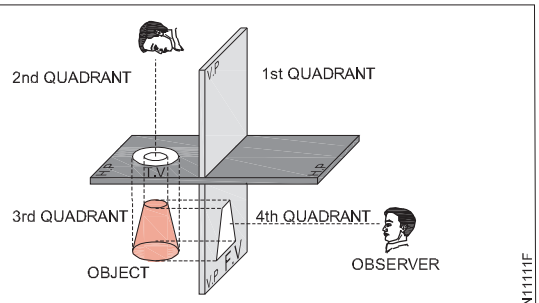
ii Third angle projection (Fig 15) : 3rd angle projection is a type of orthogonal projection system where the object is placed below the H.P and behind the V.P (ie) the object is placed in the third quadrant and the projection plane lies in between the observe and the object.

Drawing front and top views in 3rd angle projection (Fig 16): To draw front and top view, in 3rd angle projection. Object's front and top views are projected on vertical and horizontal planes respectively. As per rule of projection, the horizontal plane is rotated in the clockwise direction. This rotation bring the top view on the top of the projected front view.

Third angle projection is widely used in US and Australia as a default projection system for industrial design for product

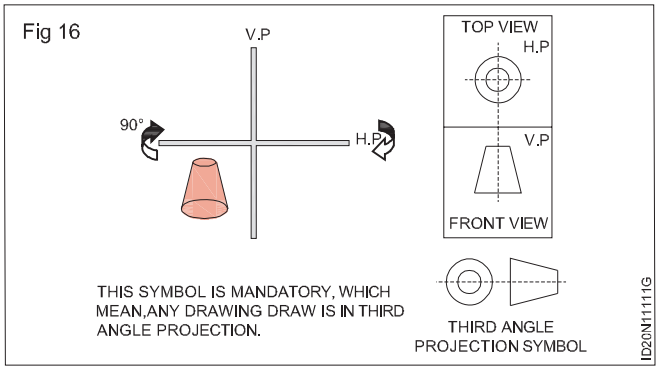
fabrication. in this projection, the plane of projection is assumed to be transparent.

Fig 15



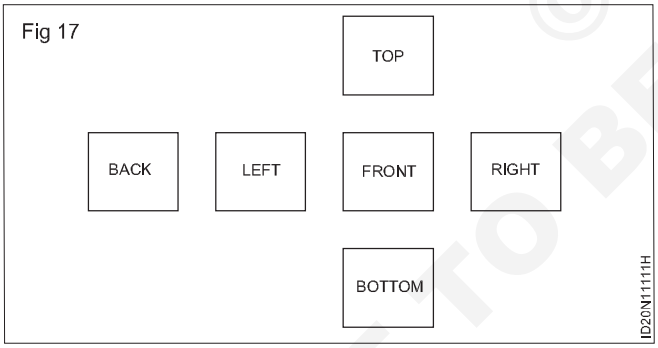
THIRD ANGLE PROJECTION

Fig 16



Drawing right and left side views in 3rd angle angle projection (Fig 17) : To draw the right and left side views on a 2D plane, Object's right and left side views are projected on vertical right and vertical left planes respectively. As per the rule of projection, right plane is unfolded towards the right side to draw the right side view on a 2D plane. Therefore right side view is projected on the right side of the front view.

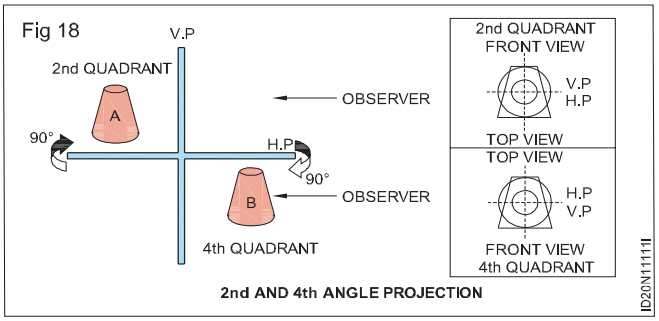
Fig 17



Similarly the left side view is projected on the left side of the front view. Bottom view is projected on the bottom plane and placed on the bottom of the front view.

iv 2nd and 4th angle projection (Fig 18) : 2nd and 4th angle projection systems are not much used because of the limitation of overlapping of projection views.

Fig 18



2nd AND 4th ANGLE PROJECTION

To understand why the 2nd and 4th angle orthographic systems are not used much we shall see the following example.

Let's consider rectangular parts "A" and "B" are placed in the 2nd and 4th quadrant respectively.

In the second quadrant, the vertical plane (VP) lies in between object. "A" and observer. Therefore the front view of object. A will lie on vertical plane whereas top view will lie on the horizontal plane. As per rule of projection when the horizontal plane is rotated 90° degree in clockwise direction, top and front view will overlap.

Overlapping projection views create confusion in the drawing, Therefore the 2nd angle projection system is not used much. Similarly when the object is placed in the 4th quadrant both top and front view will overlap. Therefore fourth angle projection is also not used.

Perspective projection : In perspective projection, the distance from the center of projection to the project plane is finite and the size of the object varies inversely with distance which looks more realistic.

The distance and angles are not preserved and parallel lines do not remain parallel. Instead, they all converge at a single point called center of projection or projection reference point.

Types of perspective projection

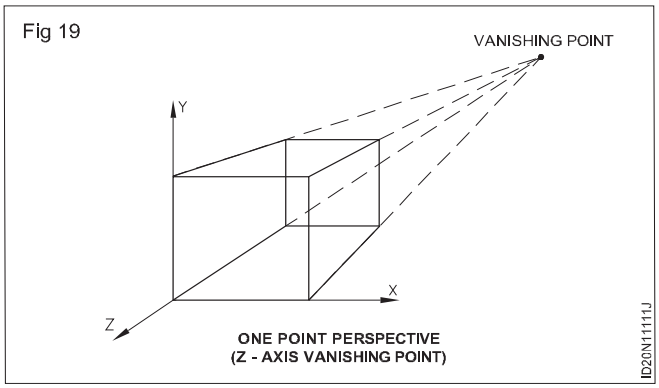
1 One point perspective

2 Two point perspective

3 Three point perspective

One point perspective (Fig 19) : One point perspective has a single vanishing point. one set of parallel lines (planes) that remain parallel to the picture plane. All vertical lines are parallel to the vertical edges of the picture plane and are truly vertical.

Fig 19

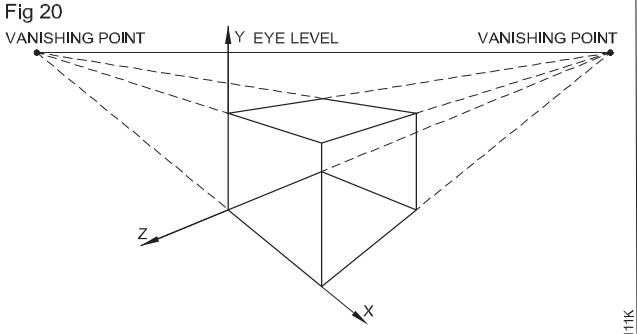


ONE POINT PERSPECTIVE
(Z - AXIS VANISHING POINT)

One-point perspective is useful in drawing interiors, street scenes and still-life arrangements. It is the simplest of the three types of perspective, but the results can be visual is dull and an interesting.

Two point perspective (Fig 20) : Two point perspective have two vanishing points for each object in the image, all on eye level. As in one point perspective, all vertical lines are parallel to vertical edges of the picture plane and are truly vertical.

Fig 20



TWO POINT PERSPECTIVE
(Z AND X - AXIS VANISHING POINTS)

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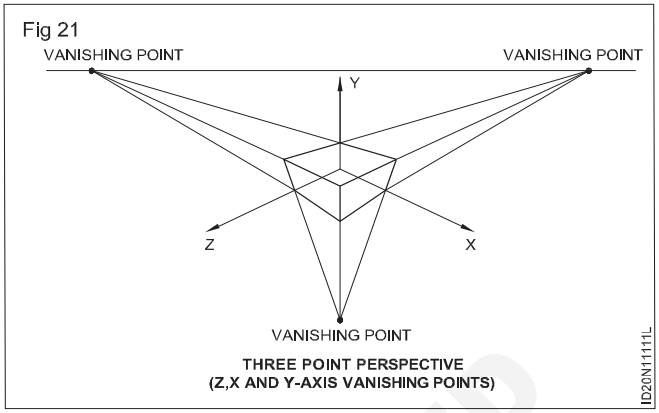
Two point perspective communicates more information about objects and spaces, and creates more natural dynamic drawings that are interesting than one-point perspective views.

Three point perspective (Fig 21) : Three point perspective have 3 vanishing points and all parallel planes are oblique or abled in relationship to the picture planes. we use three-point perspective to communicate extreme height or depth-objects and structures are for above or below eye level. It can result in highly dynamic images.

Fig 21



THREE POINT PERSPECTIVE
(Z,X AND Y-AXIS VANISHING POINTS)

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Layout of plan, elevation and sectional elevation

Objectives: At the end of this lesson you shall be able to
- **explain the terminology of plan, elevation and sections.**

i **Plan (Fig 1) :** It is a two-dimensional graphical representation of an object or a building seen in a horizontal plane viewed from above. Different types of plans can be drawn for a building like site plan, Foundation plan, Floor Plans, Furniture Plans, etc. It shows position of furniture which can be seen from top along with room wall thickness, doors, windows etc., It is made in consideration of human sizes, movement, comforts and habits.

ii **Elevation (Fig 1) :** A drawing showing the vertical elements of a building exterior or interior, as a direct projection to a vertical plane. Elevation can be drawn for all the sides of the building. (Interior as well as exterior).

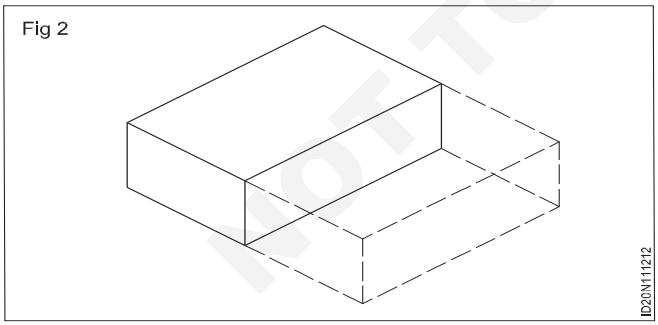
In interior design, elevation of rooms are titled based on direction in which viewer is looking (i.e) North, South, East and West, exterior elevation are reverse (i.e.) direction of elevation faces.

iii **Sectional elevation (Fig 1) :** It is a representation of an object as it would appear if cut by an imaginary plane, showing the internal structure, It is also sometimes called as cross- section. Sectional elevation is done for a particular room.

iv **Sections (Fig 1) :** A section is a view of an object when it has been cut straight through in (usually) either vertical or horizontal direction.

v **Longitudinal section (Fig 2) :** It is a type of section when a room is cut straight the vertically along the depth.

Fig 2



vi **Cross section (Fig 3) :** It is a type of section when a room is cut straight through vertically across the height.

vii **Horizontal section (Fig 4) :** It is a type of section when a room is cut straight through horizontally across height.

Working drawing (Fig 5) : Working drawings consists of floor plane, elevation, sectional elevation and details. It consists of scale in which drawing needs to the done. It is detailed drawing elevating functions, floors, walls.

Fig 3

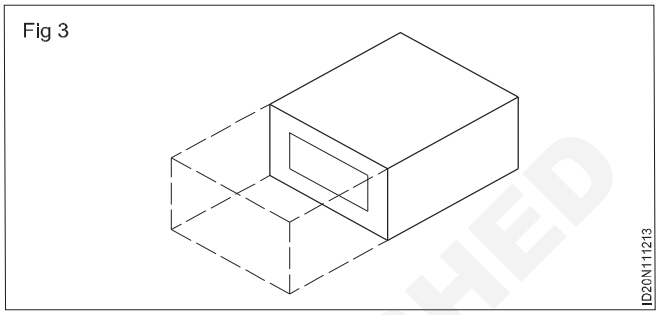
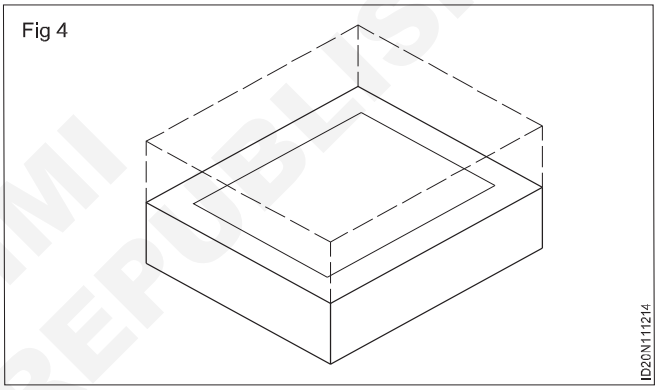


Fig 4



Mood board / Inspiration board (Fig 6) : Mood board are starting points in the creative design process. It helps us organize our minds and ideas.it enables visualization of space conceptual by how we feel and it makes easier to communicate with users,

It is mix of images, illustrations, colours, furniture, textures, patterns reference projects or anything that inspires you and that will help you define the concept of the project.

The goal is to create quick visualization of images and key words to prepare brain for the project, to start thinking creatively. The mood board helps as stay attached to ideas throughout the design process . Whether choosing colours fabric etc.it is a way of inspiring ourselves to know the objective of design by establishing aesthetic and functional guideline for project.by creating moodboard,we guarantee that our spaces will end up being how we imagined them. Hence its a strong visual language to communicate design.

It can be done in several ways-

- physical board- where images that inspire you are printed and organized on a paper and pasted on board to finish it.
- digitally it is done by software's like Photoshop Microsoft PowerPoint etc.

Fig 1

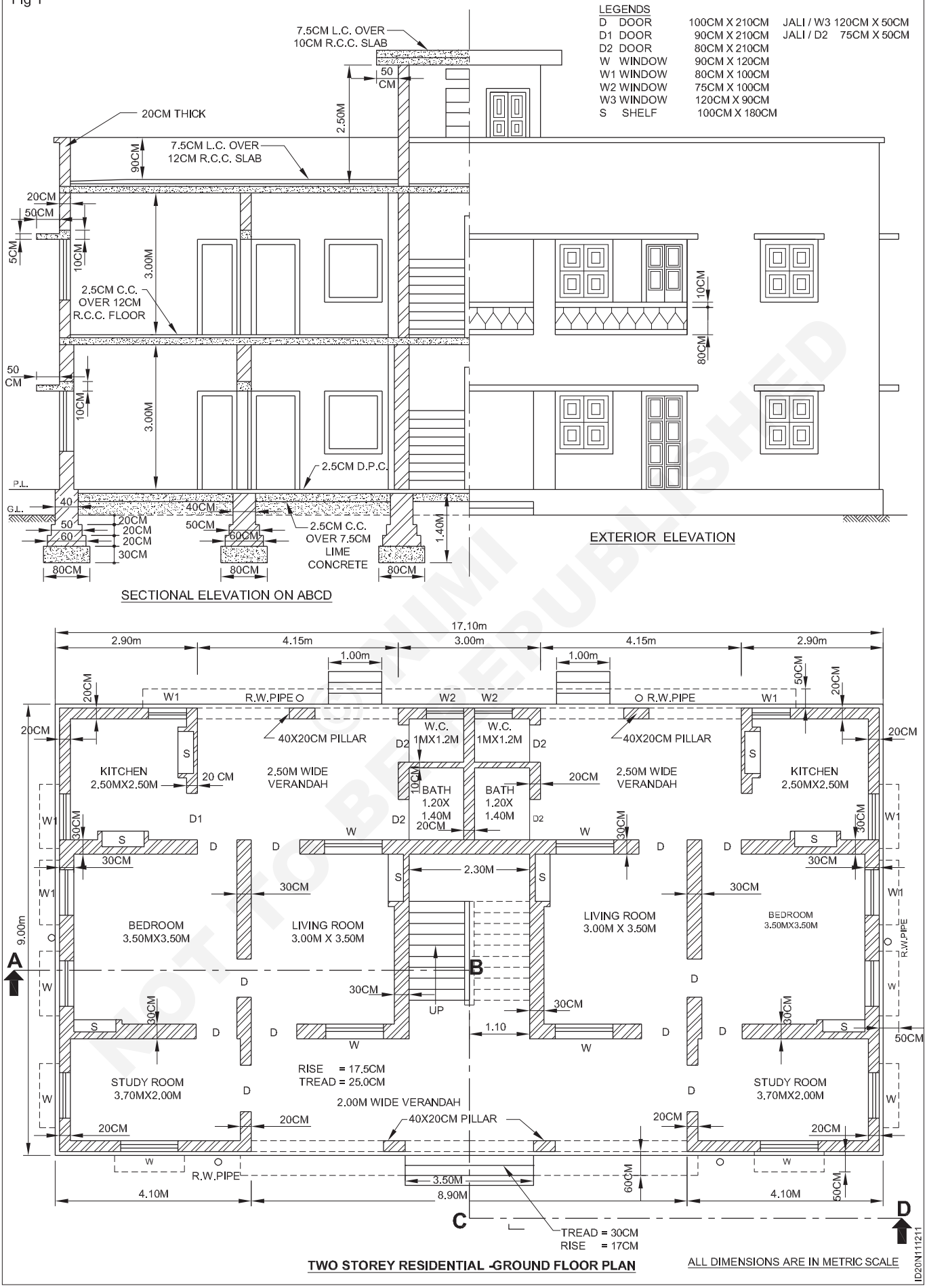
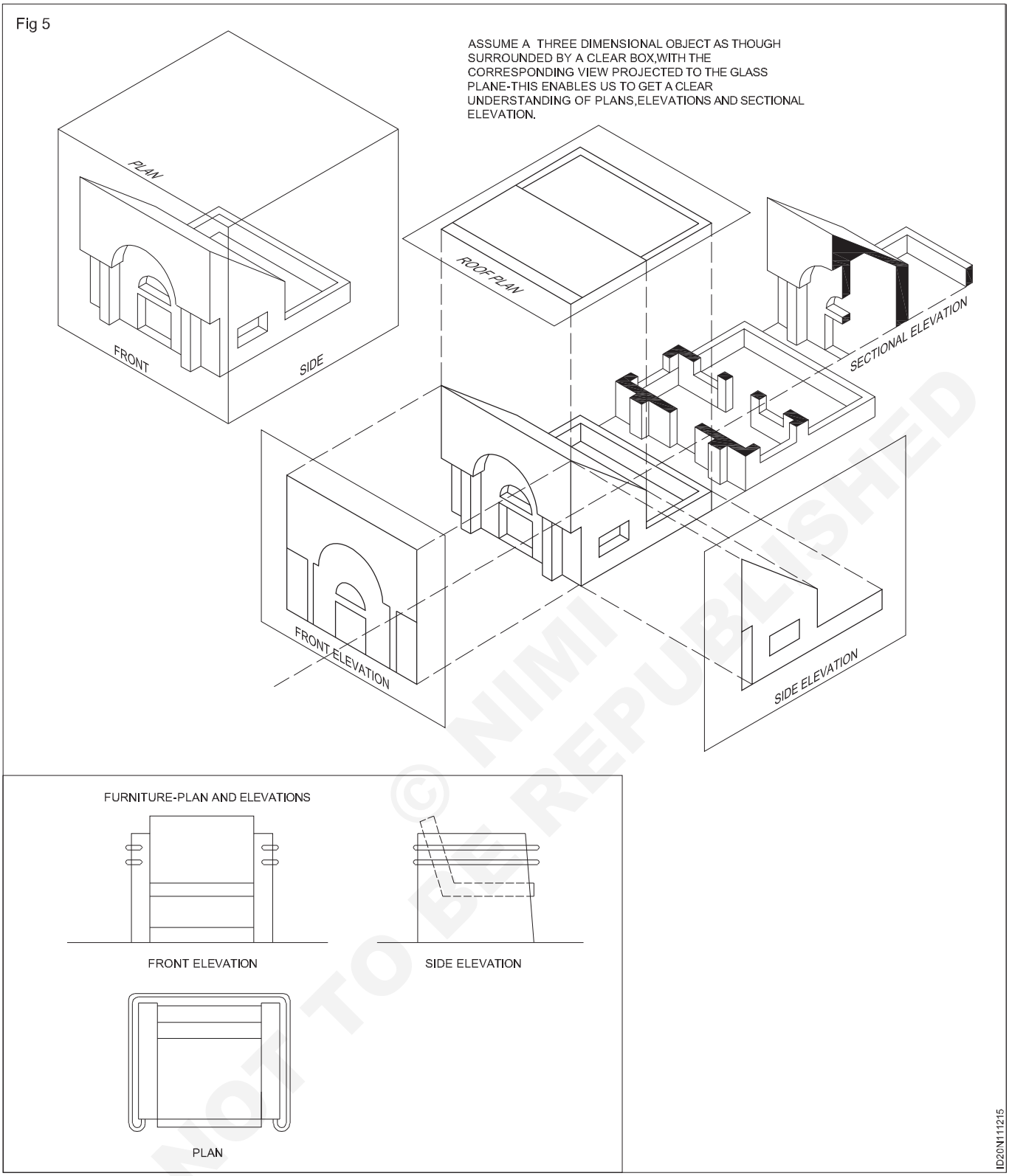


Fig 5



Typical wall cross sections

There are basically two types of building construction

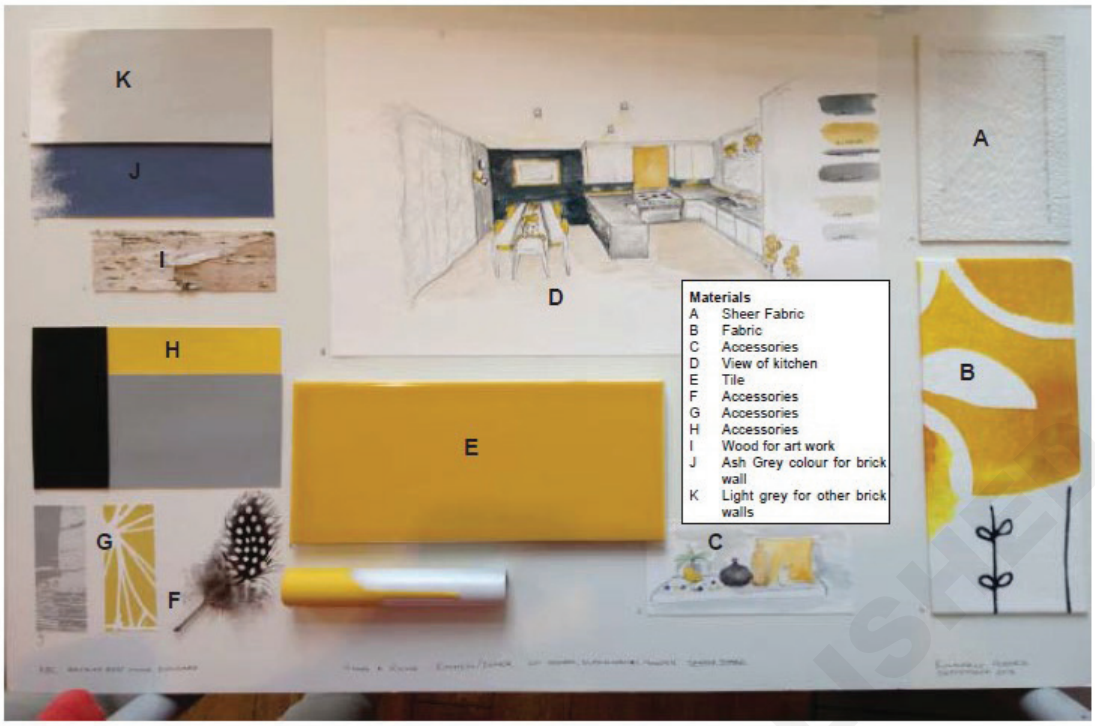
Load bearing wall construction: Residential and small buildings are constructed with load bearing walls for economy and easy construction.

Non-load bearing wall construction: Multi-strayed buildings and special buildings are constructed using column and beam structural system for safety, economy and easy construction.

Note: In interior design, elevation of rooms are titled based on direction in which viewer is looking (i.e.) north, south, east and west, exterior elevation are reverse (i.e.) direction of elevation faces.

Fig 6

Mood board for kitchen



Introduction of basic interior design

Objectives: At the end of this lesson you shall be able to
- **describe design process**
- **concept of design**
- **circulation chart (bubble diagram).**

Introduction

- The design process works with information and ideas simultaneously on many levels.
- Designing is a reciprocal action and reflection.
- One assembles the puzzle picture by searching for fits; piece after piece is picked up, tried, and found to be a misfit until, finally, the right piece steps into place, this is how the designers mind searches memory to find elements that meet their needs of the given problem.

Phases	Expected tasks (partial)
Pre-design	- Design objectives
	- Limitation and criteria
	- Site requirement
	- Space relations
	- Initial approximate facility areas and space requirement
	- Flexibility and expandability etc.
Site Analysis	- Site analysis and selection
	- Site development planning
	- On-site utility studies
	- Zoning processing. etc.
Schematic design	- Space layout or space schematizes
	- Conceptual site and building plans
	- Preliminary sections and elevations
	- Preliminary selection of building systems and materials
	- Approximate dimensions areas and volumes
	- perspective sketches, study models.

Steps based on design process

1 Briefing
- site selection, program formulation, data collection, examples,.

2 Analysis
- design and project data analysis
- identification of objectives

3 Synthesis
- formulation of concepts and alternatives
- communication of concepts

4 Evaluation
- review of alternatives
- selection of one alternative

5 Design
- design details
- communication media.

Concept: Concept is the basic idea of an interior designs. It can be presented in pictorial form or written form or both. Bothe the drawing and language should be simple and ideas. The concept is a mode of idea presented to the client to accommodate the news of client. The concept plan can be reused any number of times until client is totally consumed that the requirement is met. The concept leads to schematic plan than final plan.

Definitions of concept

Idea	• Image
Theory	• View
Notion	• Intention
Part (French) (sketches)	• Rough plan
Conception	• Fancy ideas
Opinion	• Thought
Abstraction	• Impression
Philosophy	• Hypothesis

Belief • Supposition

Inspiration • Design

Organisation (circulation) of space : It is very important in interior design, proper use of space for various activities leads to better functioning and aesthetic. Economic utilization is very important, there should be minimum circulation area and best used of available space for the function of the space.

For proper organisation of interior space the following points may be noted.

- Proper proportion and consistory in function
- Continuity of flooring by using same colors for flooring materials
- For spacious look – minimum number of doors and portion for free flow of space
- Selecting variety of colors, textures and patterns
- Providing adequate ventilation.

For circulation of space: "Interior activity diagram" should be drawn showing the division of interior space with people circulation. The activity diagram shows how a particular function/activity is performed within interiors.

Interior activity diagram is obtained by proximity / relationship chart which depicts adjacency of spaces. Then a diagram showing zoning of spaces obtained from proximity chart, then bubble diagram shows how spaces are connected to each other, then preliminary plan (initial) plan, then preliminary (schematic) plan and final presentation plan is done. Usually the final presentation consists of working drawings.

Fig 1

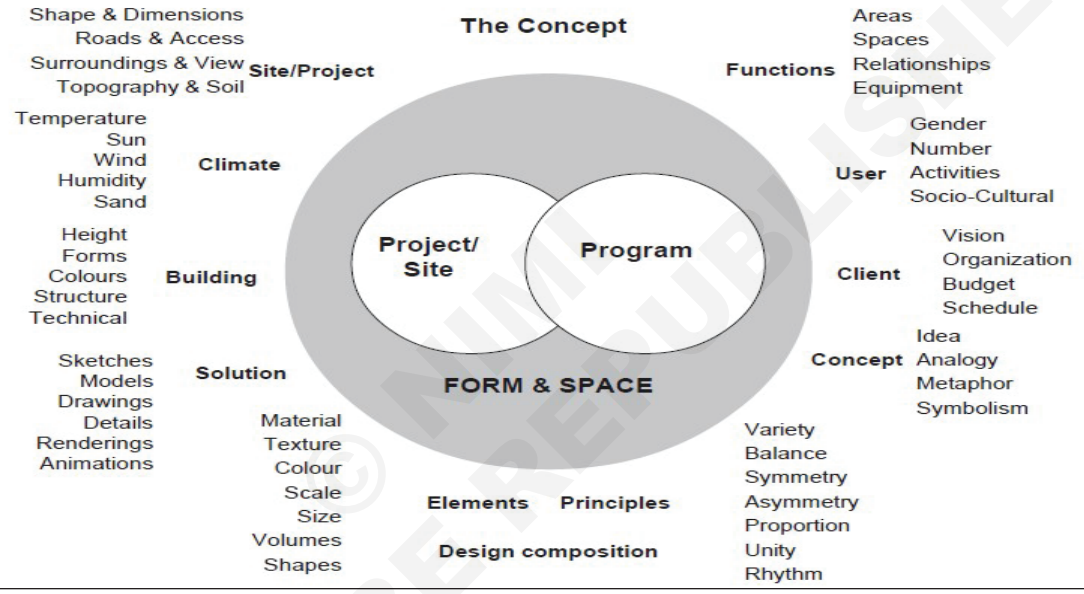
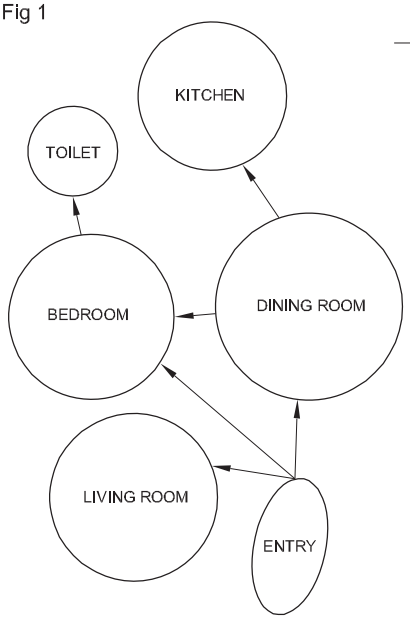
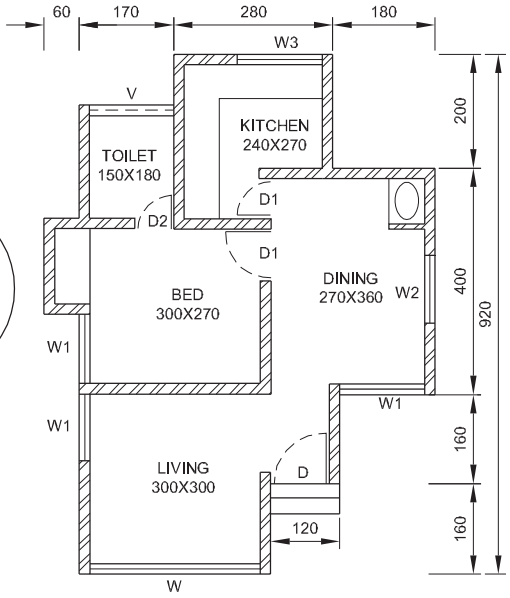


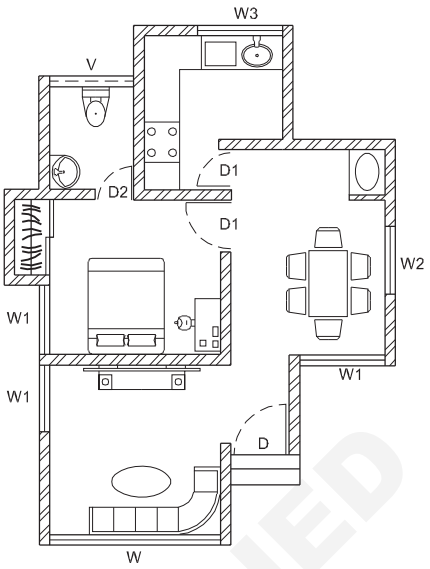
Fig 1



BUBBLR DIAGRAM



SCHEMATIC PLAN



PRESENTATION PLAN

SCHEDULE OF JOINERY				
MARK	ITEM	SIZE	TYPE	NOS.
D	DOOR	110X210	PANELLED	1
D1	DOOR	100X200	PANELLED	2
D2	DOOR	90X200	PANELLED	1
W1	WINDOW	300X150	GLAZED	1
W2	WINDOW	120X150	GLAZED	1
W3	WINDOW	150X120	GLAZED	1
V	VENTILATOR	150X60	GLAZED	1

ALL DIMENSIONS IN MM

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DESIGN PROCESS OF INTERIOR SPACES

Elements and principles of design

Objectives: At the end of this lesson you shall be able to
- **explain elements of design**
- **explain principles of design.**

Elements of interior design : Elements are basically visual components used in creating an object or a composition in Interior Design. They can be classified as:

1 Point 2 Line 3 Shape

4 Form 5 Texture 6 Colour, etc.,

1 Point

A point is basically the beginning of “something” in “ nothing”. It is a single dot or mark that has position but is otherwise limited. It is a single entity in itself and alone it can act as a focal point or a stopping point in a composition. For example a target or dart board has a single point as its focus. Together a number of points can have a leading effect where the eye naturally attempts to “connect the dots” to create a line or form. (Fig 1)

Fig 1

POINT

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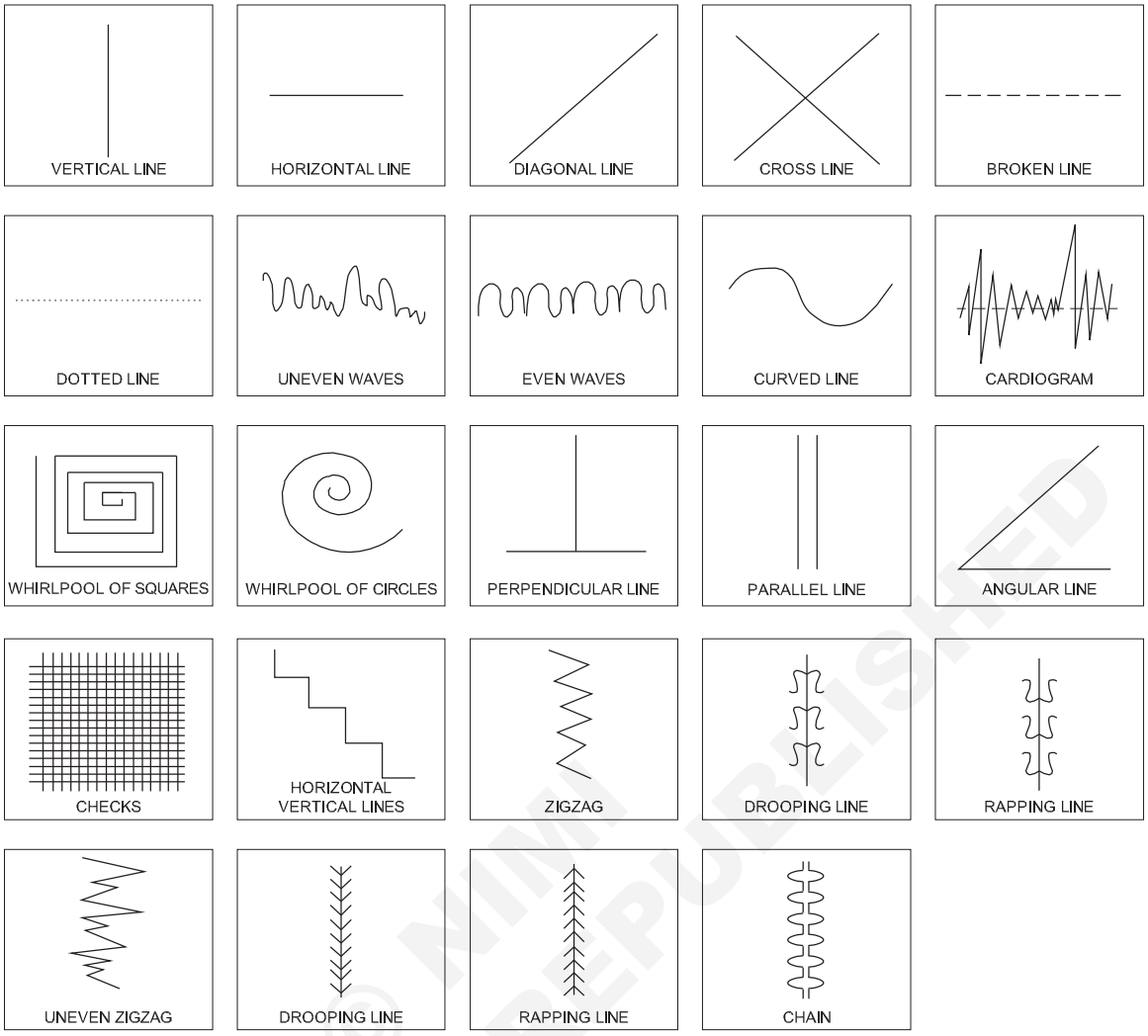
2 **Line :** Line is the basic as well as an important element line is formed by a point when it moves. A point, when extended, becomes a line. A line, is a set of points, straight or curved of as having length without breadth or thickness. Any design is formed with point and then line. Line describes the path of a point in motion. A line expresses the direction, movements, growth, length and position. Our perception of length/ width ration and the degree of continuity determine the character of a line. It is the line which gives shape and describes the edge of a plane.

Types of lines (Fig 2)

Basically there are two types of lines, viz straight and curved. Each has its own character.

A **Straight lines :** Straight lines are the ones which extend uniformly in the same direction without curve or bend. They are subdivided into three. viz., vertical, horizontal and diagonal lines. Emotional significance is attached to these lines based on the position of the human body while carrying out various activities.

Fig 2



TYPES OF LINE

i **Vertical lines :** Vertical lines symbolizes a human body in standing position. The body is in a state of equilibrium with itself and with the forces of gravity.

If vertical lines are high enough, they evoke a feeling of aspiration. They are considered to be severe, upright strong and disciplined which are the qualities generally attached with a man. Hence vertical lines give a masculine effect. Due to this, vertical lines are successfully.

An optical illusion can be created by using vertical lines to add height to an object as the eyes move up and down in vertical direction is a such an illusion can successfully be created in a room which has low ceiling, by using vertical lines in curtains and wall papers, Having curtains hanging from ventilations till the floor, with the folds of curtains creating vertical lines, will also add to the height of such a room. Tall cupboards, high and narrow doors as well as windows without cornice/valance would also add to the height of a room. Wall-decorations emphasizing vertical lines in prints.

ii **Horizontal lines :** When a human being lies down to rest or sleep, his position resembles a horizontal lines. Hence, horizontal lines suggest rest and relaxation, tranquility and steadiness and serenity. A horizontal lines can represent the ground plane hence may give a down-to-earth feeling. It expresses solidness and stability, But if horizontal lines are short and interrupted, they become a series of dashed which generate a restless feeling. Horizontal lines express informality,comfort and relaxation in a room, horizontal lines should be emphasized. Low tables, low book cases, cornices of windows, low ceilings, broad openings and stretched out furniture emphasize horizontal lines in a room.

Horizontal lines break the severe effect of vertical lines since they carry out eyes right to left, they help to add width to any object. This feeling can be used to create optical illusion in a room which has too high ceiling and one wants to reduce its height. Long cornices over windows, a horizontal wall hanging, wall papers having horizontal designs, etc., would help in visual reduction of height.

iii **Diagonal Lines :** A man bends forward to run or to pull or push something making his body in a diagonal position. Therefore diagonal line suggest force and movement in a particular direction. A diagonal line is about from either vertical or horizontal. It can be

received as vertical line falling on the ground or horizontal line rising from the ground towards the sky.

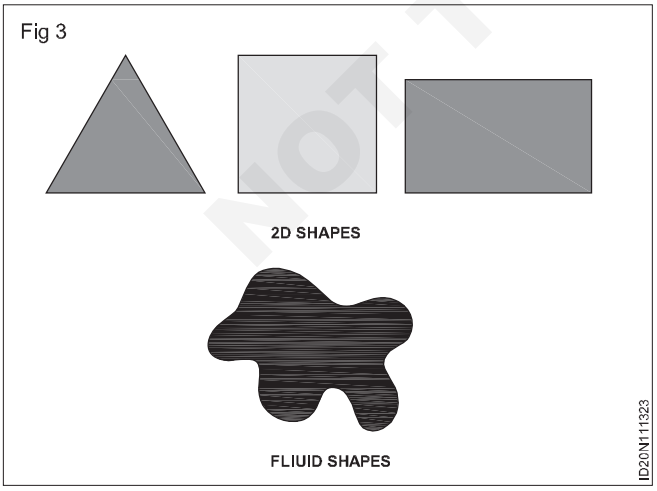
In interior design such lines go will on the wall near the staircase. The area where one is going to stay for a short time, diagonal lines can be used. Due to constant movement of eyes along with the lines, one does not feel 'at least'. Due to this, such lines can be used in the hallways, passengers, dining hall/table, staircase and such other place where a person need not stay for a long time.

B Curved lines : The human body takes curved positions when it is relaxing or playing. Hence, curved lines suggest flexibility and joy. If the curves of the lines are big and upwards, then they express a feeling of power and up life. On the other hand feelings of sadness and seriousness is generated by looking at the large downward curves. Horizontal curves express gentleness and quietness. Curved lines are graceful and they look feminine.

The rooms, in which one wants emphasize curved lines, can be used they successfully. They would create beautiful interiors in a females room. The bedrooms, lounges, restaurants, playroom and other places of enjoyment wave the interiors where theses lines dominate. However, too much of curves give a feeling of instability and weakness, hence should be used very carefully. Curved lines are helpful in creating a subtle transition in line contrast. The sharpness and contrast of vertical and horizontal lines is reduced to a great extent by the curved lines. Hence, in interiors, curved lines could be used at strategic points. For example, the curtains can be tied-back with a gentle curve, rather than stretching them to create diagonal straight lines.

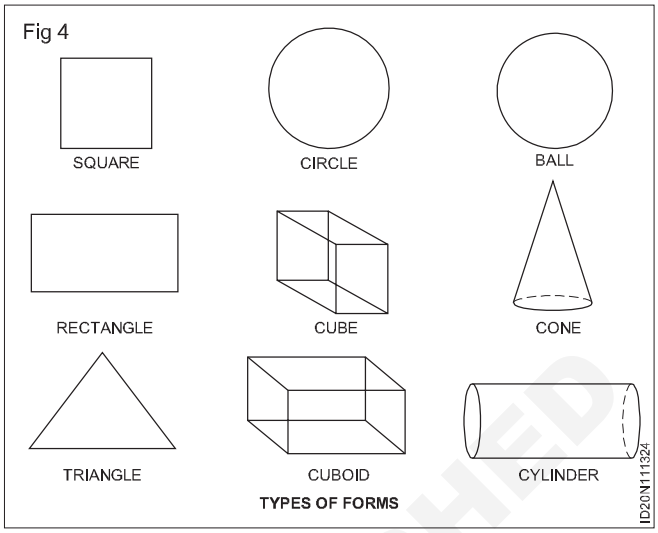
3 Shapes : Shapes are essentially closed lines. Shapes are two dimensional. The basic two dimensional shapes are squares, rectangles and triangles with the related three dimensional forms being cubes, bricks (technical name is a rectangular prism) and pyramids. An infinite amount of other shapes also exist, whether they are fluid organic shapes or rigid abstract shapes. (Fig 3)

Fig 3



4 Form : When lines are combined together or arc arranged in certain manner, they create form. Form is something solid and tangible. A beautiful form is perquisite to any object or art. Form is different than line, area, plane and spare. Area refer to the two-dimensional shape such as floor or area of a room. The term "plane" also implies a form/shape. (Fig 4)

Fig 4



Various Forms : Each type of form has its own identity and individed. They can be used in numerous ways either individed or in combination with each other to create a new form.

Each basic informs can be rectilinear, angles or en. Sometimes the designer, refer to the form as hard or soft depending on the sharp or curved edges or corners.

A liner Forms : Form has flat and solids, such as in square objects. In curvilinear form the curvilinear form the planes are curved a box. Rectangularity is most commonly associated larger space such as a whole house or rooms or the pieces of furniture like sofa and bed. Rectangles more active than square. They give a greater safety than square due to different size is lines it has its dimensions though variety can be found in size. and texture. The square has shapes in rectangular and can range from a linear thinness to cubical fullness. Tall narrow window frame exemplifies the liner and a television set exemplifies the cubical but is not. Cubes feeling of motionless stability whereas rectangles, especially the slender ones, give a feeling of movement along oneline. Rectangles have certain positive qualities, such as stability, certainty and clarity.

B Angles forms : Traingles are pyramids. It is said that form a structural point of view traingles are one of the most stable form because their shapes cannot be altered without breaking or bending one or more sides. They are secure yet dynamic, they add briskness to interiors and attract as well as hold attention of the viewer. They are relatively less common than rectangles and squares.

C Curved Forms : Curved forms are seen easily in nature around us. The animals and birds around us, our own body, the flowers, leaves and trees all have curves. Curved forms give a feeling of continuity, strongly resisting breakage or other damage. They give a constant feeling of chance.

Relationship of forms : The apparent size, shape and its character are determined to a large extent what happens within outline practically used in home furnishing.

Since each form in used in combination with other form, it may appear small or large in comparison with other form. For example, apparent size of a furniture seems small when placed in a large rooms and teh same furniture seems large when placed in a smaller room.

5 **Textures :** Each material has a surface quality, that is, the tactile quality, which is referred to as texture. Texture refers to the qualities that are perceptible through the sense of touch. Texture described how one feels when one touches any material and how the surface affects the light that strikes it. Sometimes the term texture is also applied to the effects on the surface which give illusion of texture. For example, a laminated sheet having illusion of wooden or stoney texture. On touch the surface is smooth but it gives an illusion of roughness. Thus the texture actual or visual. (Fig 5)

Fig 5

Texture (wooden)

Properties of Texture

i **Light reflection and appearance :** The roughness or smoothness of a material makes it absorb or reflect light. Very smooth materials such as satin or polished metal reflect light. Their colours look clear and strong. Thus, they attract the attention of the viewer. The rough textures absorb light unevenly, hence their colours look and dull.

ii **Maintenance of material :** Since various textures are used in household, the effort for their maintenance needs due consideration. Smooth surfaces are easier to clean than rough surfaces. But dust and dirt are easily seen on shiny, smooth surfaces, rather than on rough surface. It is better, hence, to have a material which has visually, a rough surface but actually a smooth surface, e.g. naturally finished wood, laminated board having stoney appearance, etc.

iii **Source of beauty and individuality :** Various texture combined harmoniously create beautiful surroundings. While combining various textures one expresses individuality. Textures give character and beauty to the objects, interiors, paintings, buildings and even to the landscape. Everything of the same texture creates monotony and dullness. Hence, it is essential to combine various objects or parts of one object having different textures, which will create interest, if certain guidelines are followed.

6 **Colours :** We react emotionally to different color in different ways. Our national flags and political party flags are good examples of our attachment to various colors. We all know that colors are an integral part of our religion and culture, so the choice of color is very important and relative to the functional use of space. Light is intimately linked with color because light is the sources of all colors in nature. Bright colors should be used in dark areas and dark colors can be used in lighted areas. There are wide varieties of colors for interior surfaces. A careful and thoughtful use of colors is very essential for attractive interiors.

There are 3 main components of colour they are:

i Hue ii Value iii Saturation

i **Hue :** Hue describe a pure colour that is found on the colour wheel and has had nothing added to it to change its properties. [primary and secondary colours (yellow, orange, red, violet, blue, and green) are considered as hue; however, tertiary colours would also be considered as hue]. (Fig 6a)

Fig 6a

Hue

ii **Value :** Value refers to the relative lightness or darkness of a color. Value includes the extreme range of light and dark of a hue, with black at one extreme and white at the other, and includes the pure hue within the spectrum. (Fig 6b)

iii **Saturation :** Saturation is the purity and intensity of a colour as displayed in an image. The higher the saturation of a colour, the more vivid and intense it is. The lower a colour saturation, or Chroma, the closer it is to pure gray on the grayscale. (Fig 6c)

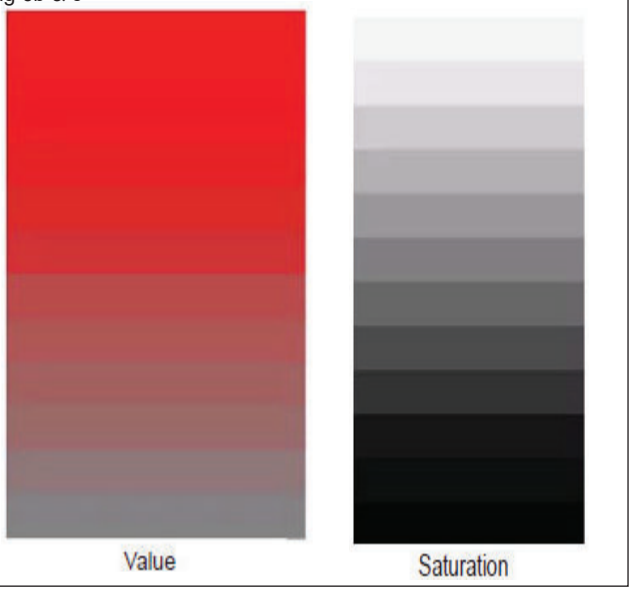
Principles of Design

The principles : The principles help us in determining an object, whether it is artificially good bad in appearance. They can be classified into

1 Balance 2 Rhythm

3 Emphasis
4 Contrast
5 Harmony
6 Proportion

Fig 6b & c



1 Balance : Balance refers to the appropriate arrangement of objects in a design to create the impression of equality in weight or importance. It provides stability and structure to a design.

There are three types of balance

i Symmetrical balance

ii Asymmetrical balance

iii Radial balance

i Symmetrical balance : Symmetrical balance can be described as having equal "weight" on equal sides of a centrally placed fulcrum. It is also known as formal balance. Balance is formal when both sides are symmetrical in terms of arrangement. (Fig 7)

Fig 7


symmetrical balance

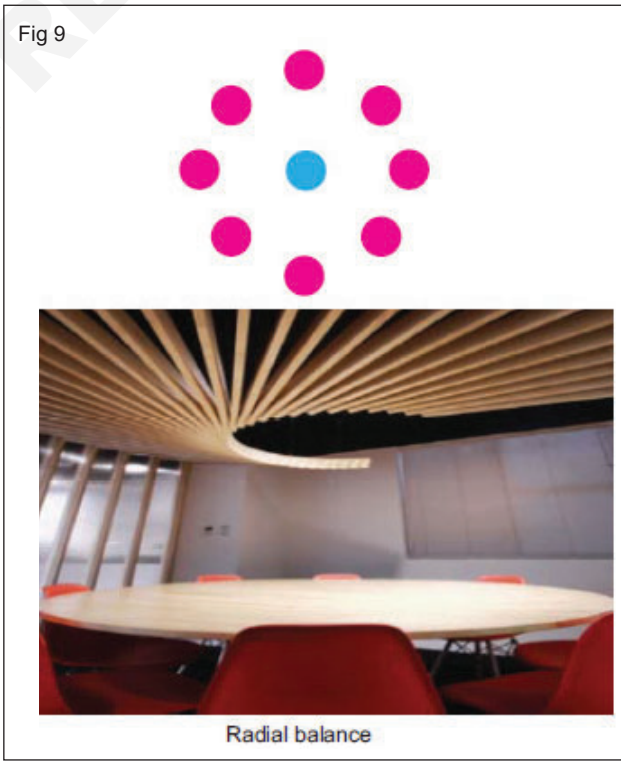
ii Asymmetrical balance : Asymmetrical balance relates very strongly to the visual weight of objects. Rather than repeating the same item within a space to achieve balance, in this case we are using different elements with a similar perceived weight to achieve balance on the opposing axis. It is also known as informal balance. Balance is informal when sides are not exactly symmetrical. (Fig 8)

Fig 8


Asymmetrical balance

iii Radial balance : Radial balance is almost circular - distributed arrangement of items around a central point either extending outward or inward. Common examples of radial balance translated to the interior environment include chairs centered around a table, the structure of a circular rotunda, or even a circular lighting fixture. If you wish to create focus on a central item, applying radial balance (so that the your attention is directed inward) is a great way to achieve this. (Fig 9)

Fig 9


Radial balance

Balance in Interiors : Balance helps to determine emotional effects to be created. Formal balance creates an air of formality, while informal balance gives a feeling of gaiety, youthfulness and casual air. Formal balance

could be used in large rooms while in small rooms informal balance is more desirable. In furniture arrangement also this principle should be kept in mind. The two halves of a wall should have equal attraction and opposite walls should balance. The windows on one wall should be balanced by cupboards or tall books shelves on the opposite wall.

The distribution of weight to produced balance should be considered not only from side to side but from top to bottom. Top should not be heavy. This impression is given when a very low room has heavy ceiling beams or light fixtures or when a low slender lamp base has a bulky shade.

In decorating a room it is usually a good plan to have atleast one wall with informal balance, two walls may have formal balance but monotony may result if formal balance is used, too often.

2 Rhythm : Rhythm is nothing but, regular repetition of lines, shapes, or colours that create a movement.

In interior design, rhythm is all about repetition of design elements that help to create movement within a space. Rhythm may be applied in bold statements that make an obvious suggestion about a path of travel, or more subtly applied to move your eye about a space without you even realizing the rhythm is there. (Fig 10)

Fig 10

Rhythm

There are six ways in which rhythm can be obtained. As representated by (Goldstein and Goldstein, 1960) they are:

i Rhythm through - Repetition of shapes

ii Progression of sizes or gradation

iii Continuous line movement

iv Radiation

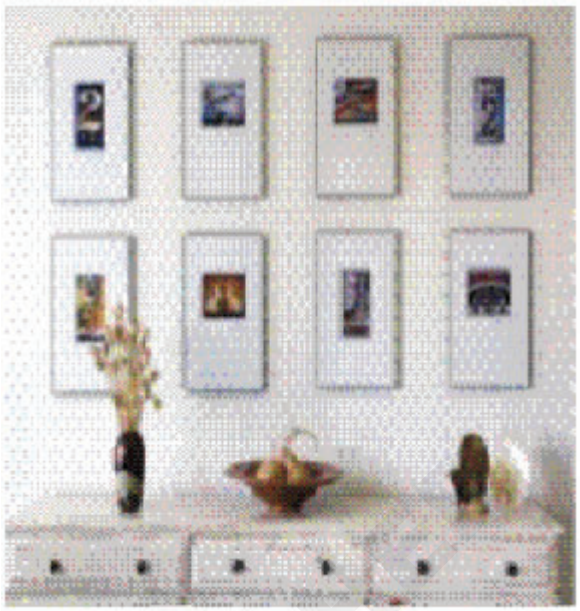
v Opposition

vi Transition

i Rhythm through Repetition - This form of rhythm can be achieved by repeating the shapes, sizes, lines and colours at regular interval creating beautiful space relationships. For example, a rectangular shape, is regularly repeated at short intervals, a movement is created which leads to rhythmic advancement along the entire length of the space.

In this above image the photo frames are given to create rhythm in repetition. (Fig 11)

Fig 11



Rhythm through Repetition

ii Rhythm through Progression of Sizes - This form of rhythm creates a rapid movement and therefore needs careful handling. They could mislead the eye from the centre of interest to other areas around the room. For example, when you arrange picture or objects against a wall in a series of steps, this would carry the eye towards ceiling.

In the above image the photo frames are arranged in such a way that it creates rhythm through progression of sizes. (Fig 12)

Fig 12

Rhythm through Progression of Sizes

iii Rhythm through a Continuous Line Movement - This form of rhythm is obtained by use of curved lines. The lines in this type of rhythm are unbroken and give a feeling of continuous movement. The movement does not stop at any place till the end. For example, when built- in furniture and cupboards are made in a continuous line. (Fig 13)

Fig 13

Rhythm through a Continuous Line Movement

iv **Rhythm through Radiation** - This is also another way of obtaining organized movement. It is closely related to radial balance. This type of rhythm can give a room circular radiation feeling. This rhythm grows out of a central point or axis. When comes out in straight lines it needs to be bound by some other line but if it curves out then it does not need the help of other lines. (Fig 14)

Fig 14

Rhythm through Radiation

v **Rhythm through Opposition** - This form of rhythm results when lines come together at right angles, for example, square and oblong furniture shapes, straight cornices over windows with draperies hanging straight.

In the above image the striped rug goes horizontally and the striped pillows go the opposite direction, this gives the rhythm in opposition. (Fig 15)

vi **Rhythm by Transition** - This type of rhythm carries the eye more gradually from one place to another, for example, arched doors, curved cornices, fitted valances that run around three sides of a window.

In the above image, the curve of the window causes the eye to move from one side of the window to the other, this creates rhythm through transition. (Fig 16)

3 **Emphasis :** Emphasis is nothing but making one element stand out from the right. The term emphasis literally means to give importance. The principle of emphasis in interior design is the process of creating focus within a designated space. Once the focal point is chosen, the rest of the design can work around it. Emphasis can become a room's focal point through isolation, contrast, and placement.

Fig 15

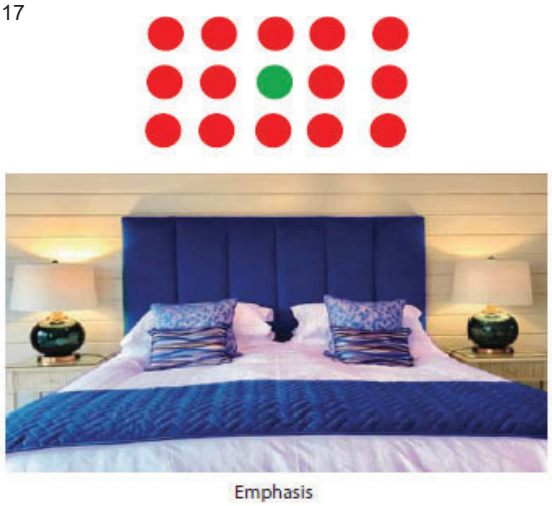
Rhythm through opposition

Fig 16

Rhythm by Transition

In the above image the bed will be the dominant feature. The headboard, surrounding wall colour and texture, bedside tables and lamps are given to create interest. (Fig17)

Fig 17



Emphasis

There are certain ways to emphasize in Colour Appendix some important ones are

i **Emphasis through Grouping of Objects** - When objects are grouped around one function or purpose they create emphasis. The various objects should be relevant and placed in their proper place. The arrangement would also have unity. For example, a small isolated picture may be lost in entire room but if it is grouped with other picture sin a well spaced manner it may attract more attention.

In the above image group of photo frames create emphasis. (Fig 18)

Fig 18

Emphasis through Grouping of Objects

ii **Emphasis through Colour Contrast** - The contrasting colours when used together attract a lot of attention. This contrast can be in the hues, values or intensities of the colours. For example, the best effect can be obtained by using light colours as accents in dark colour scheme and dark colour as accents in light colour schemes.

In the above image the colour red and green are contrast colours which creates emphasis. (Fig 19)

Fig 19

Emphasis through Colour Contrast

iii **Emphasis through Decoration** - Decoration placed anywhere and everywhere does not emphasize. It should be placed at strategic points if it has to attract the attention of people. The decoration at structural points of an object enhances the beauty of the form or structure of the object some objects are not functional but are used purely for decoration, such as painting, sculpture, etc. These beautiful object can be used in interior design as points of emphasis.

In the above image wallpaper creates emphasis through decoration. (Fig 20)

Fig 20

Emphasis through Decoration

iv **Emphasis through Plain Surface** - Enough plain background surface is also used as a means of placing emphasis on an object. The two important guidelines are:

a An object gains importance when it is separated from other things and is given enough space for background

b When objects are placed close together they are seen as a group and not as separate units.

The use of plain surface is therefore very important as it helps to bring out the quality of every object seen against it.

In the above image the orange background creates emphasis through plain surface. (Fig 21)

Fig 21

Emphasis through Plain Surface

v Emphasis through Contrasting Lines, Shapes and Sizes - Straight lines when used with curved lines hold

attention. Vertical and horizontal lines when placed together strongly contract . Apart from this any unusual lines, shapes or sizes of an object are emphatic. For example, block letter used in a headline.

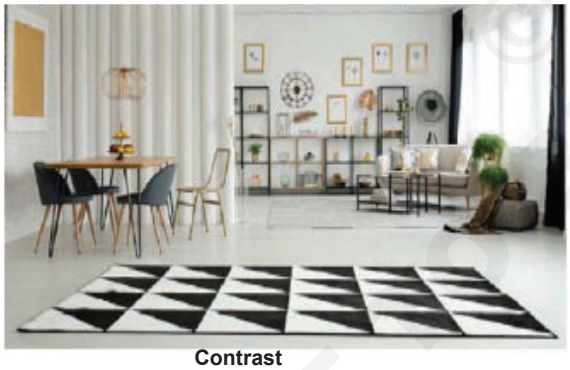
In the above image emphasis is created by unusual lines, shapes, colours and size. (Fig 22)

Fig 22

Emphasis through Contrasting Lines, Shapes and Sizes

4 **Contrast (Fig 23) :** Contrast refers to the comparison of different elements of design (for example: rough & smooth textures, dark & light values) in order to highlight their differences or create visual interest, or focal point. It allows us to emphasize or highlight key elements in our design.

Fig 23



Contrast

Contrast in Interior Design is the key design principle that will help your room's focus 'pop out' in a visually appealing manner. Contrast also helps in preventing your design look monotonous.

The most common example of this is monochrome décor, where black and white are colours that are complete opposites of one another, and yet, when used together, create a jarringly beautiful result.

Contrast can be created in any interior using the following methods

i Contrasting with Colours

ii Contrasting with Forms

iii Contrasting with Textures

iv Contrasting with Materials.

5 **Harmony :** Harmony is the sense that all of the elements of your design fit together.

It is the fundamental requirement in any piece of work in which appearance and utility both are to be considered. Harmony is defined as the selection and arrangement of consistent ideas and objects. For example, all objects used in a room should have a strong family resemblance and they should be so arranged that they follow the line of the room. The amount of likeness which should be sought and the amount of variation which should be created needs to be carefully considered. For example, big pieces of furniture should be alike and small pieces can contrast. The principles of harmony has five aspects.

These are as follows

i Harmony in line and shape

ii Harmony in size

iii Harmony in Texture

iv Harmony in Idea/ Theme

v Harmony in Colour

i Harmony in line and shape

Line - The lines in any composition can be either horizontal, vertical or curved. In any composition they are grouped into three main groups:

1 Lines which repeat one another, i.e. Harmony through repetition.

2 Lines which contrast with one another, i.e. Harmony though contrast.

3 Line which soften to modify the other, i.e. Harmony through transition.

Shape - A combination of lines results in shape. Therefore, when harmonious lines are used in a shape, it also becomes harmonious in a shape. When an object with straight diagonal line cuts the corner it is harmonious.

In window Treatment vertical folds harmonize with shape of window. Tie-back at the centre of curtain create centering contrast but a frilly edge of curtain softens the contrast by transition.

Similarly, sharp horizontal and vertical lines of the houses are softened by transitional lines in landscaping.

Wherever a number of shapes are used, an orderly arrangement is important. The shapes used in the arrangement should be harmonious. Some simple rules mentioned here would be very useful.

1 Large objects should follow the lines of room and variation should be brought only through small objects. You can place them at varied angles. Too many angles on the other hand contradict each other and create confusion.

2 Lines could be used to alter the shapes against which they are used.

a Through repetition you can get the attention to the shape.

b Contrasting lines emphasize the shape very strongly.

c Transitional lines makes contrast less harsh. (Fig 24)

Fig 24

Harmony of lines and shapes

ii **Harmony in sizes :** When size which are too different are used together- they are inconsistent. The size should have a definite proportion or scale when they are used together. For example, large vases should not be placed on small tables. A tall cupboard should not be placed next to a small table. A large room should not have tiny furniture. (Fig 25)

Fig 25

Harmony in sizes

iii **Harmony in Textures :** Coarse textures do not harmonize with very fine ones but the middle ones could be combined with either coarse or fine. For example. wood which has coarse structure should be used with coarse materials, rough textured fabrics, unpainted materials. While fine wood should be combined with skills and other fine textured and glazed finish material. Raw silk and other such materials are fine yet have a rough texture so they can be used to balance too fine or too coarse textures in any room. (Fig 26)

iv **Harmony in Ideas :** The harmony should not only be in sizes, shapes, colours and textures but it should also be in the idea which is presented. One main idea should dominated the whole room and its furnishings. (Fig 27)

Fig 26

Harmony in texture

Fig 27

1 It should indicate the purpose it is going to serve e.g. a living room should look like a living room and not like a hospital room.

2 It should be present in all aspects of furniture whether it is furnishing materials, table ware and dress.

For example, you can take any state of India has its own tradition, design and crafts. By using colours, prints and objects which are typical of that state you can build up a theme. Similarly a Moghal room should reflect the culture and art of Moghal period. A material could also be used as a theme, For example, bamboo. The wall treatment, the furniture, the lamp shades, etc. could be made from this material as a dominant idea.

v **Harmony in Colours :** Use harmonious colour schemes like monochromatic or analogous. The colours should be chosen in such a manner that they match with the entire scheme. The large areas should have uniformity and only in small object colour contrast can be highlighted. If contrasts are desired some cool colour should be used in warm colour scheme and some warm colour in cool colour scheme. (Fig 28)

6 **Proportion :** Proportion in interior design refers to the balance between design elements such as shape, color and texture. Proportion is the relative judgment of the "rightness" of an arrangement. You achieve correct proportions by repeating shapes, color and textures, controlling light, and providing style and variety. (Fig 29)

Fig 28

Fig 29

Proportion

In the above image the coffee table and sofa have a good proportions to each other.

The three problems we face in relation to proportion are:

i How to achieve arrangements which will hold interest?

ii How to make the best of given sizes and shapes?

iii How to judge sizes which can be successfully grouped together?

The means by which you can solve these problems are:

1 For creating arrangement

2 To make best use of available sizes and shapes, we must learn to change the appearance of object.

3 In order to judge sizes which can be ground together we must understand the significance of scale.

Theory of colours and psychological effects of colours and graphic symbols

Objectives: At the end of this lesson you shall be able to
- **explain the elements of colours**
- **explain the colour wheel**
- **explain the psychological impact of colours.**

Colours : Colour is what the eyes see when light is reflected off an object. You cannot see colour without light. When white light passes through a prism, it reflects into seven colours forming a band known as spectrum. It is like the rainbow in the sky. This band is also known as vibgyor (v-violet, i-indigo, b-blue, g-green, y-yellow, o-orange,r-red). A colour is only a sensation, it is not in an object.

Elements of colour : The intensity of colour depends on the amount of energy contained within the wavelength, colour has three virtues.

1 Hue 2 Chroma 3 Value

Hue: The actual colour - (The color it self) : Hue is simply the colour position around the colour wheel and the brightest, purest version of each colour. Hue is determined by the wavelength because each wavelength produces a definite colour on retina of the eye. The largest wavelength creating the red colour and the shortest wavelength creating violet colour. In the same way the intermediate wavelengths in between these two colours represent other colours. (Fig 1)

Fig 1

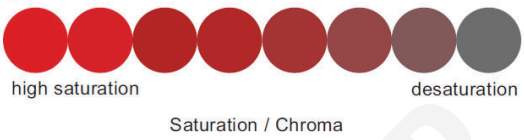
Hue

Saturation / Chroma - The brightness or dullness of a colour

Saturation or Chroma is also known as intensity. This tells how vibrant (lively) a colour is. A desaturated colour is greyed out and dull, while a saturated colour is vibrant and strong. If colour has more intensity it means the colour has more saturation. (Fig 2)

Value The lightness or darkness of a colour : Value tells us how dark or light a colour is. When dealing with pure colour (hue) value can be affected by adding white or black to a colour. (Fig 3)

Fig 2



Saturation / Chroma

Fig 3

Value

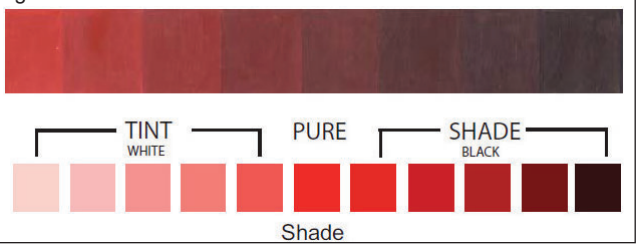
i **Tint :** A tint is created when you add white to a color and lighten it. It is also sometimes called a pastel color. (Fig 4)

Fig 4

Tint

ii **Shade :** A shade is created when you add black to a color and darken it. Just as with tints, you can add black to any of the twelve hues of the color wheel or to any combination of hues of the color wheel to create shades of that hue by adding various amounts of black. (Fig 5)

Fig 5

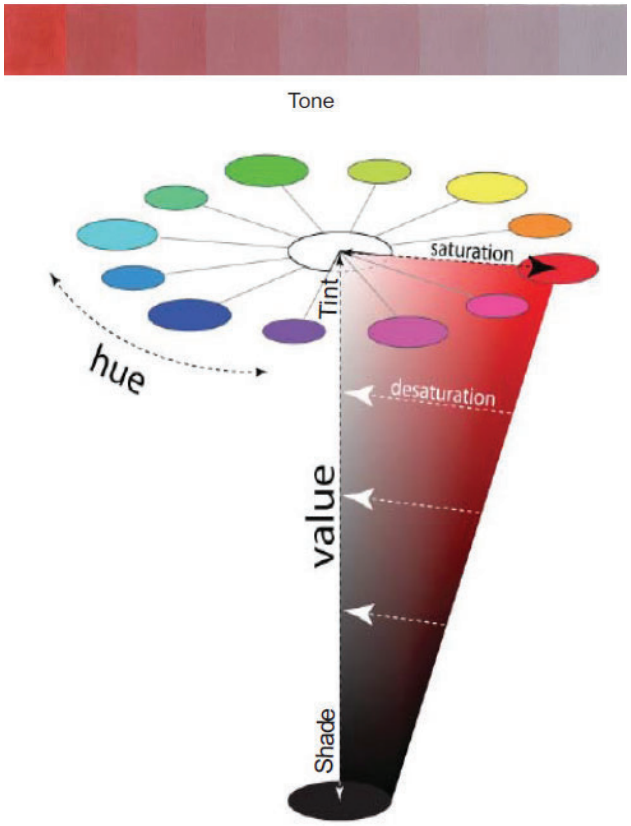


Shade

iii **Tone :** A tone is created when you add both white and black (which is grey), to a color and tone it down. (Fig 6a & 6b)

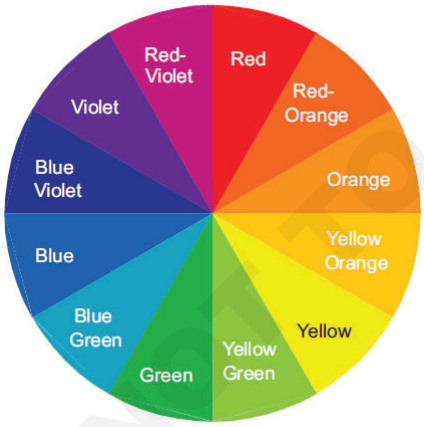
Colour Wheel : The color wheel or color circle is the basic tool for combining colors. It gives good understanding of colours. It consists of the colours of the rainbow arranged in circular fashion. This colour wheel can be used to explain the main relationships of colours. An understanding of these relationship is useful for choosing furnishings, coverings, paints and other colour materials.

Fig 6a & b



The first colour wheel was presented by Sir Isaac Newton in the 17th century when he first discovered the visible spectrum of light. Around this time, colour was thought to be a product of the mixing of light and dark, with red being the “most light”, and blue the “most dark”. (Fig 7)

Fig 7



Colour wheel

Primary Colours : Red, blue and yellow are known as primary colours because they cannot be obtained by mixing any other colours. (Fig 8)

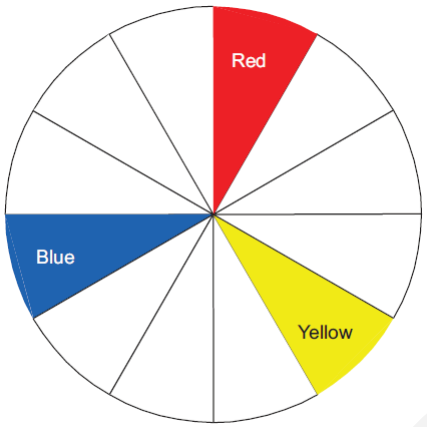
Secondary Colours : Secondary colours are obtained by mixing two primary colour. They are orange (red + yellow), green (yellow + blue), and violet (blue + red). (Fig 9a)

One Primary Colour + Another Primary Colour =

1 Secondary Colour

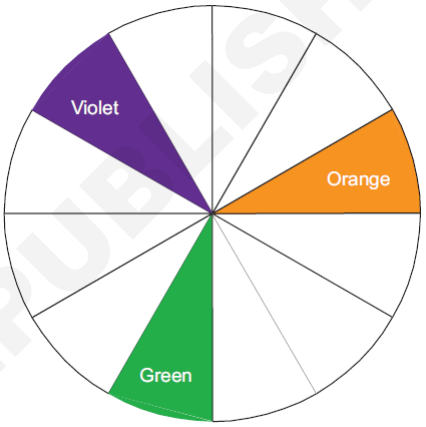
Example: Red + Yellow = Orange (Fig 9b)

Fig 8



Primary colours

Fig 9a & 9b



Secondary colours

Tertiary colours : Tertiary colours are created by mixing equal parts of a primary colour and a secondary colour together. There are six tertiary colours - red - violet, red - orange, blue - green, yellow - greeen, blue - violet and yellow - orange. The proper way to refer tertiary colours is by listing the primary colour first and secondary colour, second. (Fig 10)

Red violet (magenta)

Red orange (vermilion)

Blue green (aqua)

Yellow green (lime green)

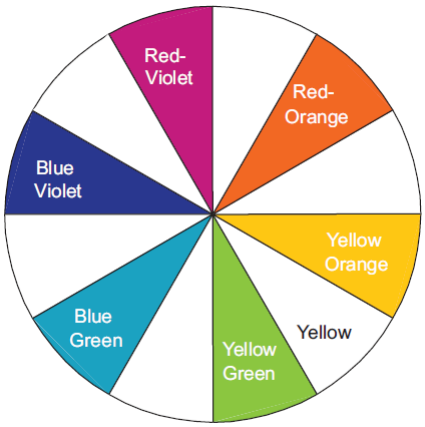
Blue violet (purple)

Yellow orange (marigold)

One Primary + One Secondary = One Tertiary colour

Example: Red + Orange = redorange (Fig 10b)

Fig 10



Tertiary colours

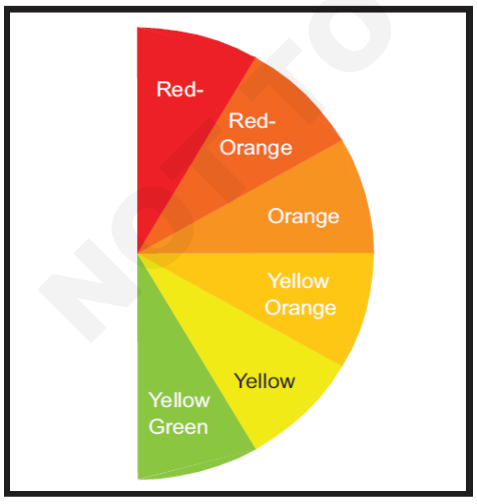
Classification based on characteristics of colours

Colours can also be classified into various groups based on their characteristics.

1 **Colour temperature :** Colour temperature refers to the warmth or coolness of a color. A color's temperature affects the color of everything we see. The colour wheel can be split into two main groups warm colours and cool colours.But, individual colours can also change in temperature as we move around our colour wheel. For example, A warm red includes more yellow and a cool red includes more blue.

i **Warm colours :** Warm colours are those colours which are bright, aggressive, attract attention and excite emotions. It also makes a colour schemes cheerful and rich. The hue from red to yellow colour including orange, pink and brown are on the maximum side warm colours. (Fig 11)

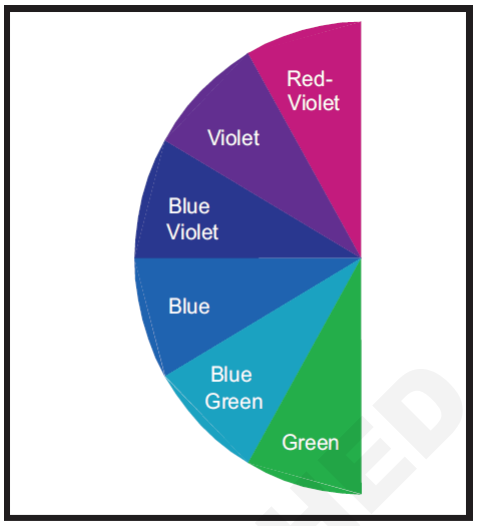
Fig 11



Warm colours

ii **Cool colours :** Cool colours have opposite effects of warm colours. It cools down the metabolism of the body. Sometimes it appears gloomy and oppressive but cool shades of blue and green look clean and inviting for a nice change. The hues from green to violet including blue and all shades of grey are known as cool colours. (Fig 12)

Fig 12



Cool colours

2 **Light colours :** Light colours is the mixture of basic hues and white colour which reduces the intensity of colour. Light colour looks sof and sublimed and is preferred in interior decoration. Light colour scheme may look effective in its quiet way depending on environmental surroundings.

3 **Dark colours :** Dark colours are the mixture of basic hues with black or warm colours with their actual hues which may or may not be mixed with black colour. These colours look heavy, dense, strong and solid and generally combined with lighter colours. Dark red, purple, green and blue are associated with royality and dignity.

4 Dull colours : Dull colours are the mixture of basic colours and grey or in other words we can say diffusion of basic colour in grey. It creates a blurry impression but at the same it helps to reduce tension.

Colour scehme : Color schemes are logical combinations of colors on the color wheel. The purpose of a color scheme is to create an aesthetic feeling of style and appeal.

Uses of colour scheme

Colour is responsible for so many factors

i It makes the interior pleasing.

ii The dimensions of an interior can be made to look smaller or bigger with the help of colours.

iii It camouflages undersized elements in an interior

iv It creates a certain mood in an interior - mood of relaxation or mood of activity etc.

Types of colour scheme

1 **Monochromatic color schemes :** "Mono" means "one", "chroma" means "colour". A monochromatic colour scheme consists of using one colour in varying intensities. (Monochromatic color schemes are derived

from a single base hue and extended using its shades, tones and tints. Tints are achieved by adding white and shades and tones are achieved by adding a darker color, grey or black).

This colour scheme helps to give a spacious feeling to an interior and provides unity for a composition and a quiet background for objects and people within it. (Fig 13)

Fig 13

Monochromatic color schemes

2 Analogous color scheme : Analogous color schemes use colors that are next to each other on the color wheel. They usually match well and create serene and comfortable designs. Analogous color schemes are often found in nature and are harmonious and pleasing to the eye.

This colours scheme is one of the simplest and most appealing colour harmonius and works best if you choose one dominant colour and use the other colours as accents. (Fig 14)

Fig 14

Analogous colour scheme

3 Complementary colour schemes : Complementary colours are directly opposite to each other on the colour wheel. These colours need not be used in thier pure form. They can be used in many values or intensities. The high contrast of complementaru colours creats a vibrant look especially when used at full saturation.

This type of colour scheme is great for creating strong contrast in your image. (Fig 15)

Fig 15

Complementary color scheme

4 Split-Complementary color scheme : The split-complementary color scheme is a variation of the complementary color scheme. In addition to the base color, it uses the two colors adjacent to its complement.

This color scheme has the same strong visual contrast as the complementary color scheme, but has less tension. (Fig 16)

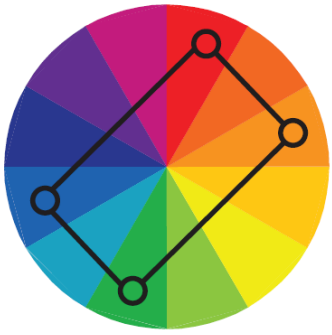
Fig 16

Split Complementary color scheme

5 Rectangle (tetradic) color scheme : The rectangle or tetradic color scheme uses four colors arranged into two complementary pairs. This rich color scheme offers plenty of possibilities for variation.

This colour scheme works best when you focus on one main colour and use the other colours as contrasting accents (subtle way). (Fig 17)

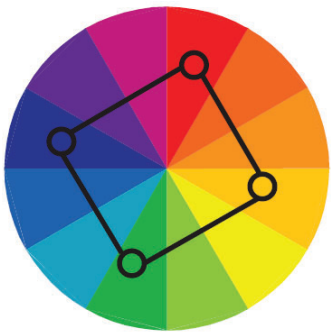
Fig 17



Rectangle colour scheme

6 Square colour scheme : The square color scheme is similar to the rectangle, but with all four colors spaced evenly around the color circle. Square color schemes works best if you let one color be dominant. (Fig 18)

Fig 18



Square colour scheme

7 **Triadic colour scheme :** A triadic color scheme uses colors that are evenly spaced around the color wheel. Triadic color schemes tend to be quite vibrant, even if you use pale or unsaturated versions of your hues.

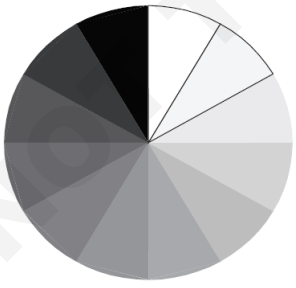
This colour scheme works best when you use one colour as dominant colour, and the other two in lesser quantity. These colour combinations are often bolder and more vibrant. (Fig 19)

Fig 19

Triadic colour scheme

8 **Achromatic colour :** An achromatic color scheme is simply colorless scheme possessing no hue, using only black, white and grey. It has (White, grey and black) lightness but no hue or saturation. They can be created by mixing complementary colours together." (Fig 20)

Fig 20



Achromatic colour

Natural colours (Fig 21) : [Colours which are not included in colour wheel are known as neutral colours eg: white, black, grey, brown and tans]

Guidelines for good colour schemes

a In all colour schemes one colour should dominate. This basic colour occupies 60 to 70 percent of the whole colour.

Fig 21

b Definite colour schemes like harmonious, complementary or traid are recommended.

c A safe colour scheme consists of tints and shades of one colour

d A colour scheme should be definitely dark or light.

e Either warm or cool colours should dominate.

f Every colour scheme must have a dominating colour and secondary colour.

g A neutralised colour (grey) is best for large areas.

h Rely on colours to brighten dark areas.

Psychological impact of colours

Introduction : Color psychology is the study of colors in relation to human behavior. Colors and emotions are always closely linked together. A Warm colour can evoke different emotion than a cool colour and a bright colour can create different feeling than a muted colour. It all depends on how the psychological effects of color are being used.

Colour psychology in interior design : Colour psychology is a powerful interior design tool that impacts the mood of a room more than any other factor. Different shades evoke certain emotions so, when choosing colours, it's important to consider the kind of atmosphere you wish to create and which colours will help you achieve this. It is important to note that each colour impacts on different people differently. Many factors can influence these including one's age, race, culture as well as life experiences. However, people will always respond to colour no matter what. In general, following colors create following psychological effects in interiors.

1 **Red colour :** Red colours is the bright colour in the whole spectrum. It has a dynamic character and denotes courage and aggressiveness. It affects the atmosphere and makes it hot and non tolerable. But it is a definite positive colour. It should be used in a room where the sun rays do not reach. The most intense colour, red raises a room's energy level and pumps the adrenaline. In the living or dining room, red draws people together and stimulates conversation. In an entrance hall, it creates a strong first impression. (Fig 22)

Fig 22

Red colour

2 **Blue colour :** Blue is one of the strongest hues of the colour psychology spectrum, It is believed to bring

down blood pressure and slow respiration and heart rate. It is a cool static colour which has the property on increasing the distance from which it is being reflected to the observer. It makes atmosphere calm and soothing. It promotes relaxation after a day of hard work, but at the same time too much of blue can be depressing. This colour is often recommended for bedrooms and bathrooms where you want to create a relaxing environment. (Fig 23)

Fig 23

Blue colour

3 **Yellow colour :** Yellow is the colour of intellectual nature. It captures the warmth of sunlight and evokes positivity. It's a great choice for kitchens, dining rooms and bathrooms, where it is energising and welcoming. (Fig 24)

Fig 24

Yellow colour

4 **Green colour :** Green is psychologically the most soothing colour and it is largely found in nature. It is a combination of blue and yellow. It cools the environment and is a natural healing agent. It is a soothing and safe colour, even its excess use does not harm. Being a cool friendly color it mixes well with many other colors. It looks great with white and is suitable for almost any room in the house. It stimulates thoughts of balance, growth and restoration in colour psychology. (Fig 25)

Fig 25

Green colour

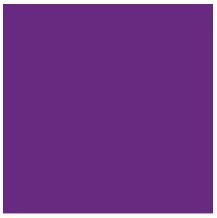
5 **Orange colour :** Orange hues are bright, fun and energetize. It is a combination of yellow and red. It brings brightness, cheer and happiness in the atmosphere. It gives the feeling of well being. It is suitable for lobby and children room. (Fig 26)

6 **Purple colour :** Purple has long been the colour of royalty, and can inspire creativity and spirituality. It's a popular choice for kid's rooms. It is great in areas for study room, but should not be used in a busy or active room. Lavender can become grey looking in rooms that do not have much natural light. Using this colour in a dressing room creates the maximum effect, and you can also use it in your hallway to give a good impressive look. (Fig 27)

Fig 26

Orange colour

Fig 27



Purple colour

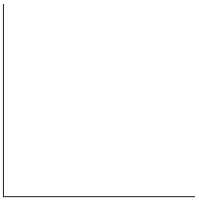
7 **Black colour :** Black is always associated with sophistication, elegance and luxury. It's most often used as an accent in the home, as all - black interiors can become dreary and overwhelming very quickly. (It is always used in small amounts with contrasting, complementary colors. When used right, it can add depth and timeless elegance to a room. Avoid using black in large quantities as it can seem oppressive). (Fig 28)

Fig 28

Black colour

8 **White colour :** White is the colour of purity and cleanliness, and often is regarded as blank palette. White can help smaller spaces appear large. It can also make rooms look livelier, fresher and crisper, but can also be very cold and barren without the proper accent pieces. Excess use of this colour can lead to feeling of emptiness. (Fig 29)

Fig 29



White colour

9 **Grey colour :** Grey is a combination of white and black and therefore a mixture of qualities of both. The grey interior gives a formality that is subtle elegance without being too conservative. Its effect

depends very much on the color shade that you will use. For example, if grey has a yellow tint it may be depressed, especially if you have things in the room in various shades of brown. But a beautiful shade of grey, in combination with not very bright white color, can create a clean and refreshing appearance. If you have too many grey areas will become predominant and create a boring environment. (Fig 30)

Fig 30

Grey colour

10 Brown colour : Brown is a mixture of red, yellow and black. It represents tradition and conservation taste. It stimulates growth and achievement. It is said to be a rich colour as we get qualities of red, yellow and black. Brown is the best for furniture upholstery and wardrobes. Brown shades are turly versatily, and go with any design style and mood. (Fig 31)

11 Beige colour : Beige is a mixture of light yellow and grey. It can be matched with all colours. It merge with surroundings. If you are not sure which colour is suitable for a room, try beige. (Fig 32)

Fig 31

Brown colour

Fig 32

Beige colour

Graphic symbols in interior space

Objectives: At the end of this lesson you shall be able to

- **enumerate on graphic symbols in various forms of plans.**

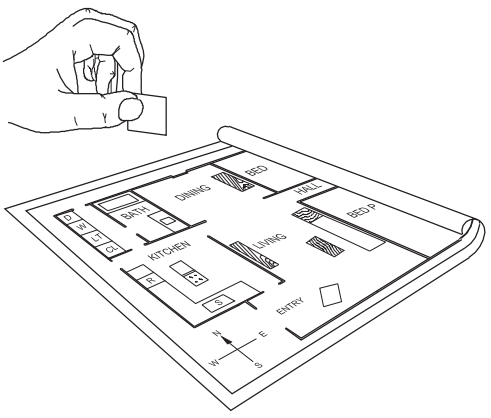
Introduction : Room sizes often appear adequate on the floor plan, but when furniture is placed in the rooms, the occupants may find them too small or proportioned incorrectly. After the house is built, it is too late to change the sizes of most rooms. Therefore, extreme care should be taken in the planning stage to ensure that the plan as designed will accommodate the furniture, fixtures, and traffic anticipated for each area.

Template Preparation : One method of determining the adequacy of room sizes and proportions is to prepare graphic symbol of each piece of furniture and equipment that will be placed in the room. These graphic symbol should be on the same scale as the floor plan. Placing the graphic symbol on the floor plan will (Fig 1) show graphically how much floor space is occupied by each piece of furniture. The home planner can determine whether there is sufficient traffic space around the furniture, whether the room must be enlarged, whether the proportions should be changed or whether, as a last resort, smaller items of furniture should be obtained. (Fig 1)

The placement of the graphic symbol on the plan in (Fig 2) indicates that some rearrangement of adjustment should be made in the furniture placement in bedroom No.3 and that the dining room might be inadequate if the table is expanded.

Checking by graphic symbol can be significant only if they are carefully prepared to the tame scale as the floor plan and if the actual furniture dimensions are used in the preparation (Fig 3) shows typical furniture sizes that may be used in the preparation of templates for checking purposes. The floor-plan design can be checked. much more quickly by this method than it can be a model. Furthermore, if they are used while the plan is still in the sketching stage, adjustments can be made easily and rooms rearranged to produce a more desirable plan.

Fig 1



PLACING TEMPLATES ON A FLOOR PLAN

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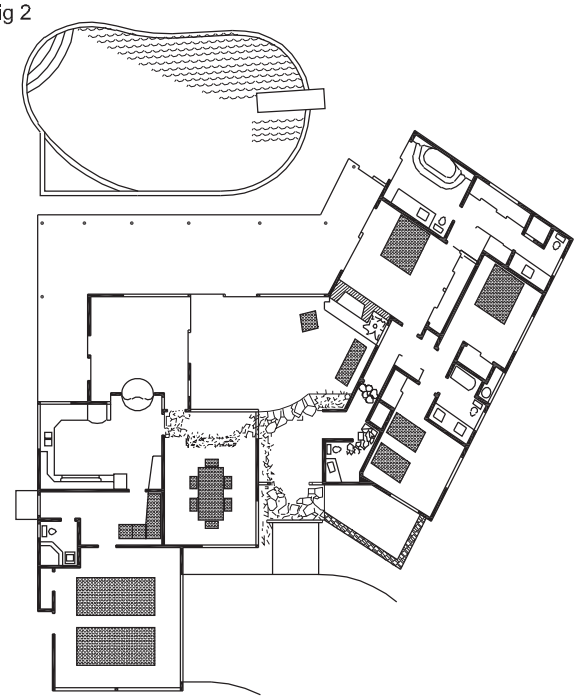
Space requirement can be determined by placing furniture templates on the floor plans.

Some of the commonly used graphic symbols are as follows

Fig 2



SPACE REQUIREMENTS CAN BE DETERMINED BY PLACING FURNITURE TEMPLATES ON THE FLOOR PLANS.

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1 Graphic symbols used for various furniture used in living and dinning room. (Fig 4)

2 Graphical symbols used for various types of doors. (Fig 5)

Fig 5

SL.NO	OBJECT	SYMBOLS
01	VERTICAL CENTRE HUGE	
02	VERTICAL SLIDING	
03	HORIZONTAL CENTRE HUGE	
04	TOP HUGE	
05	BOTTOM HUGE	
06	SIDE HUGE RIGHT HAND	
07	SIDE HUGE LEFT HAND	
08	SIDE HUGE RIGHT HAND	
09	SIDE HUGE RIGHT HAND	
10	SIDE HUGE RIGHT HAND	

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3 Graphical symbols used for various types of windows. (Fig 6)

Fig 6

SL.NO	OBJECT	SYMBOLS
01	VERTICAL CENTRE HUGE	
02	VERTICAL SLIDING	
03	HORIZONTAL CENTRE HUGE	
04	TOP HUGE	
05	BOTTOM HUGE	
06	SIDE HUGE RIGHT HAND	
07	SIDE HUGE LEFT HAND	

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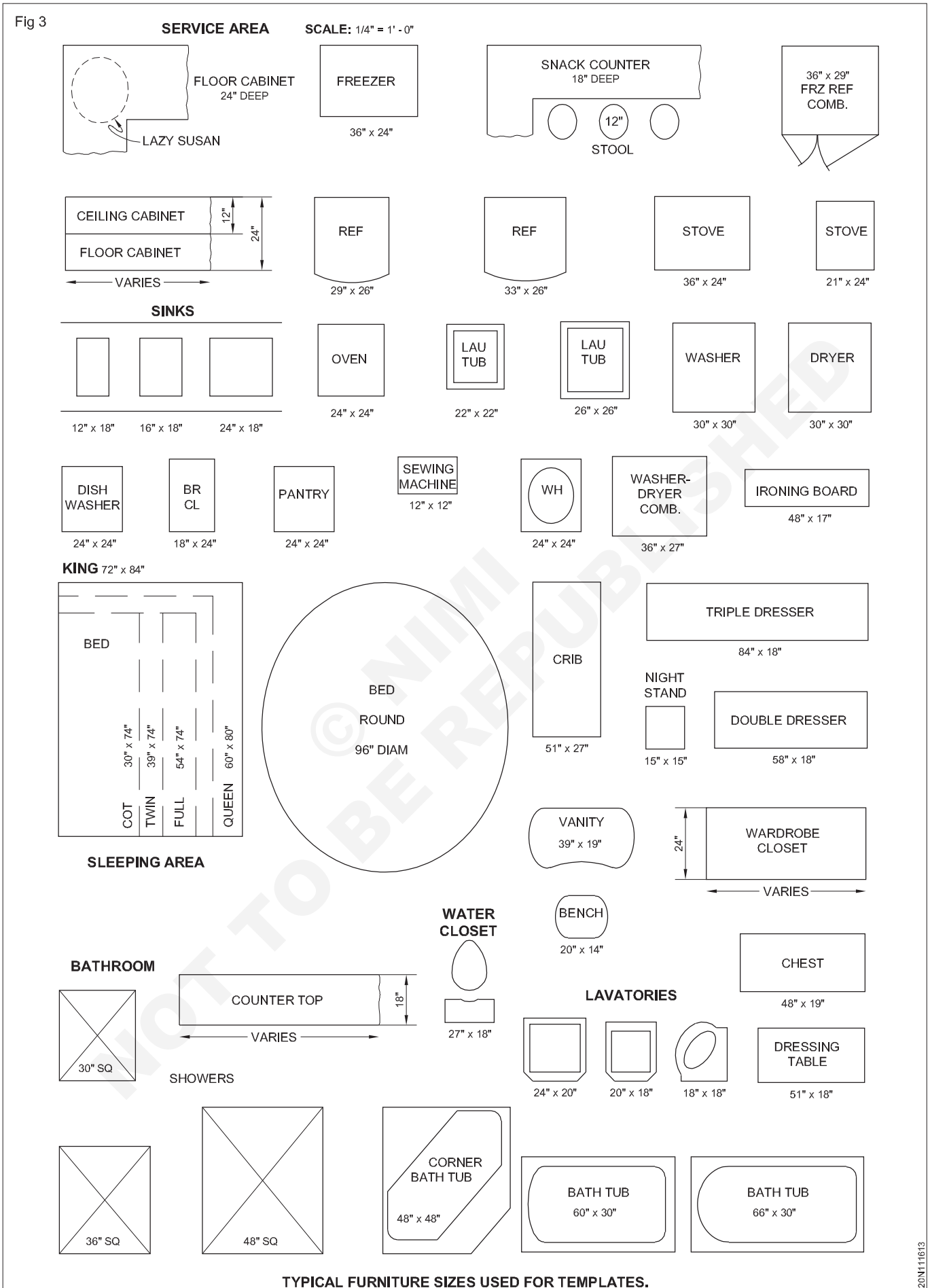
4 Graphical symbols used for various types of lighting devices and electricals. (Fig 7)

5 Graphical symbols used for sanitation. (Fig 8)

Fig 3



TYPICAL FURNITURE SIZES USED FOR TEMPLATES.

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Fig 4

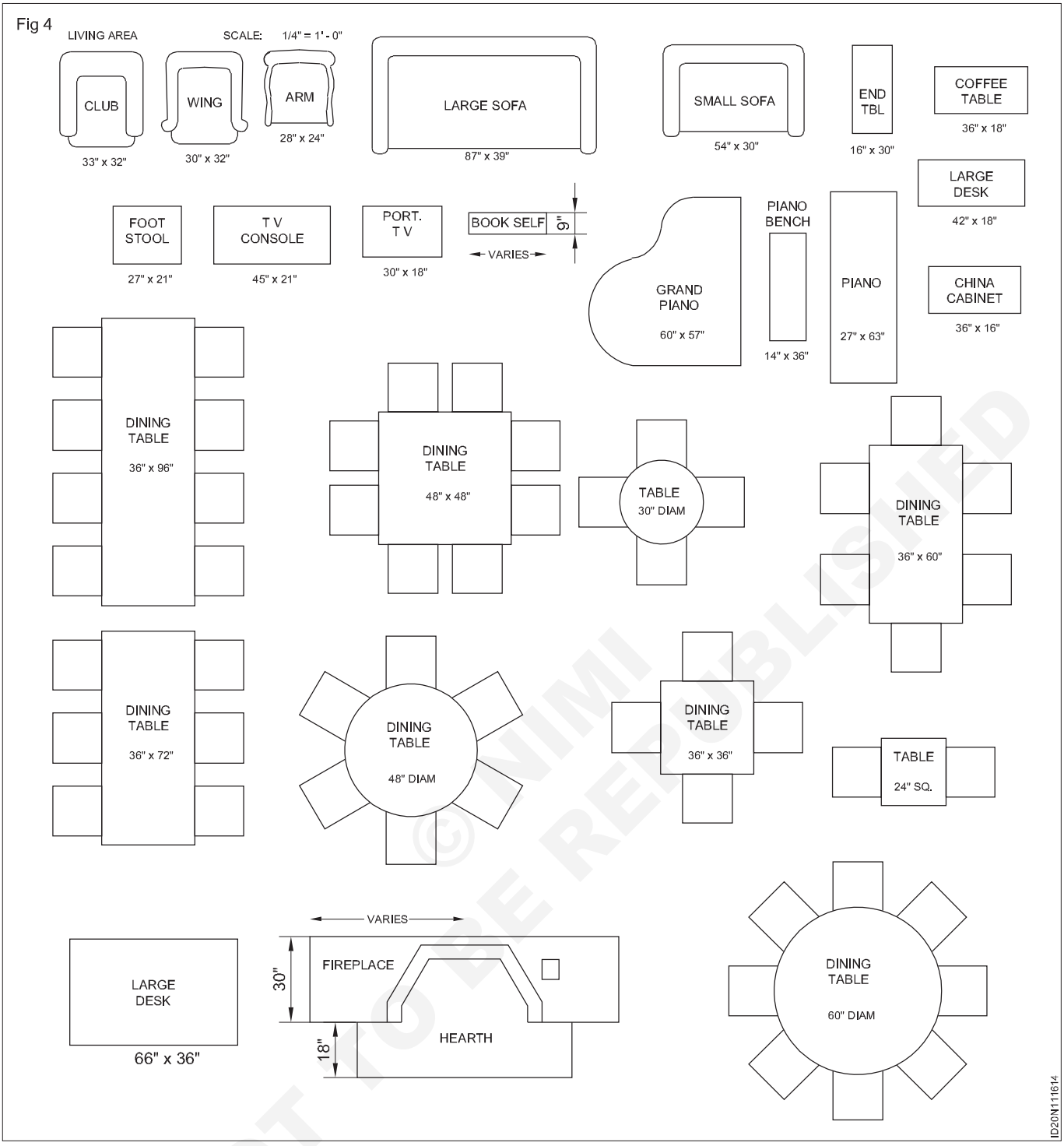
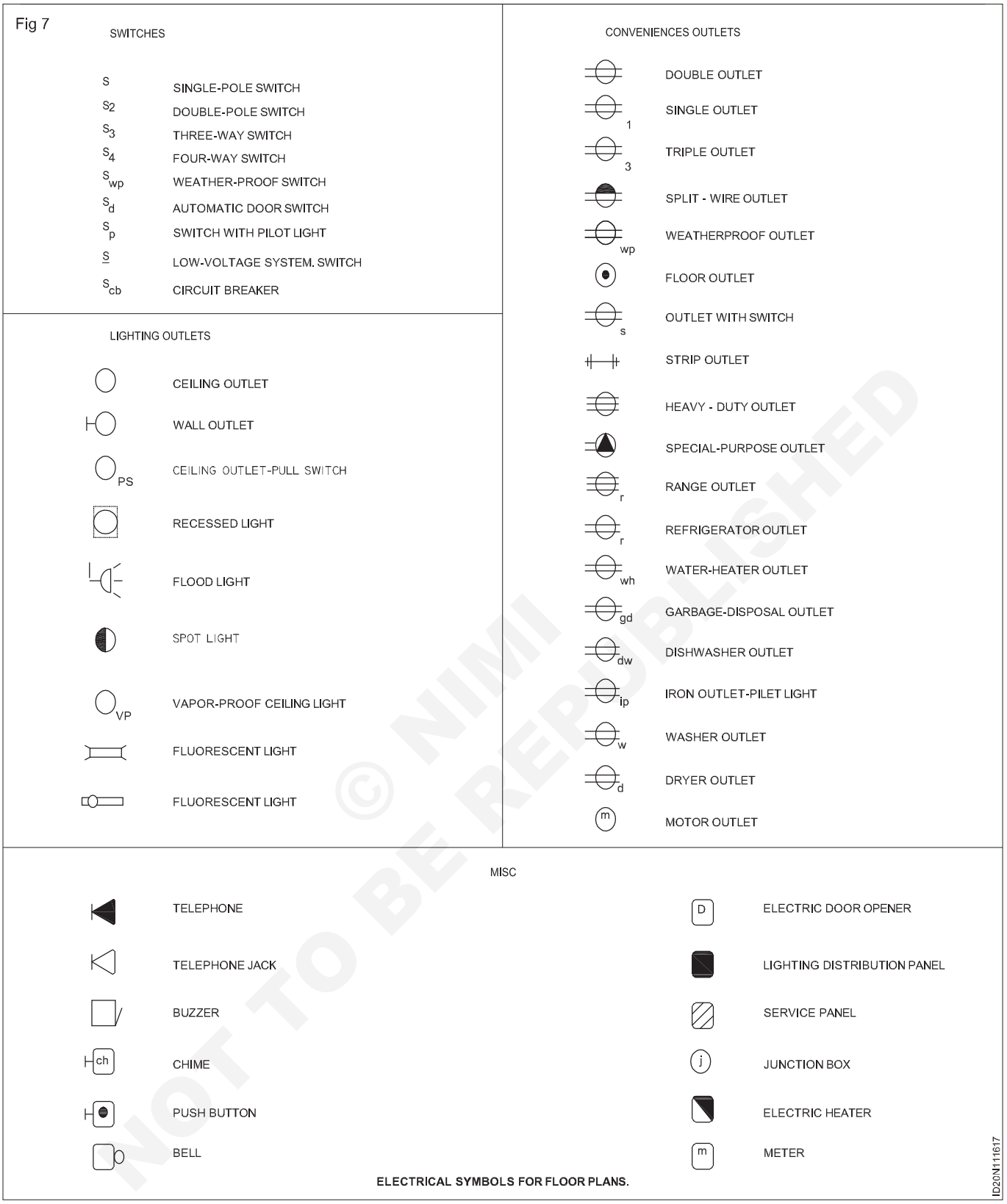


Fig 7



ELECTRICAL SYMBOLS FOR FLOOR PLANS.

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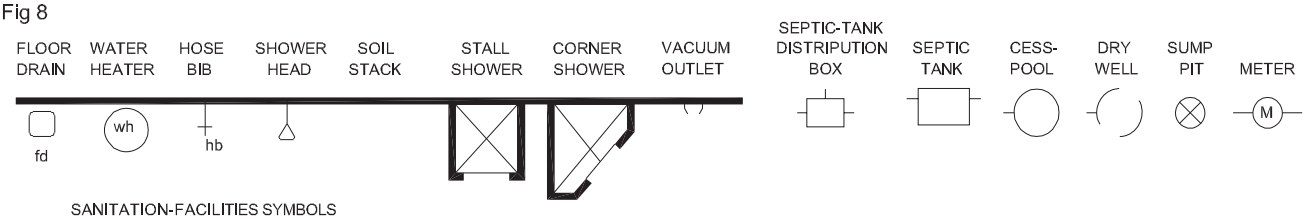
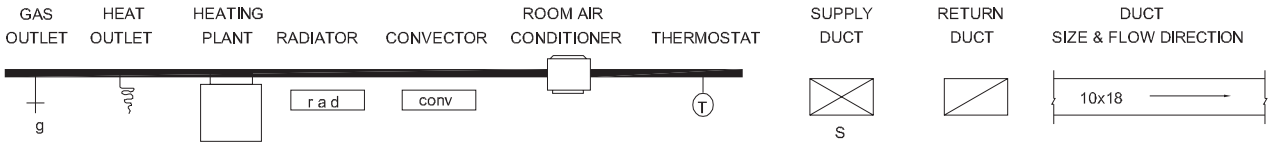
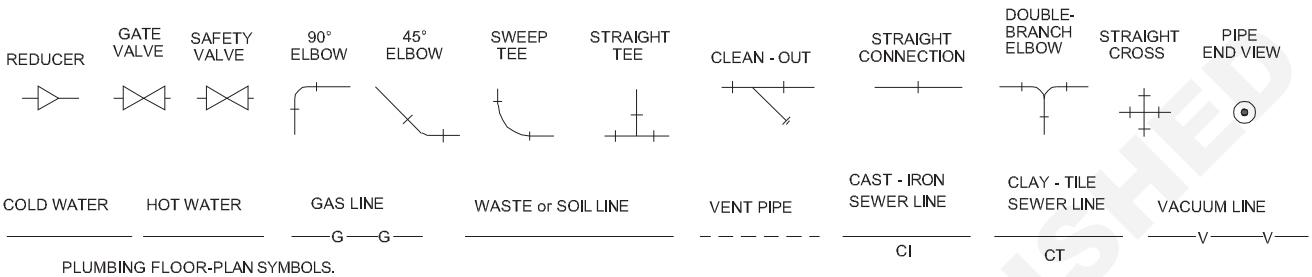
Fig 8



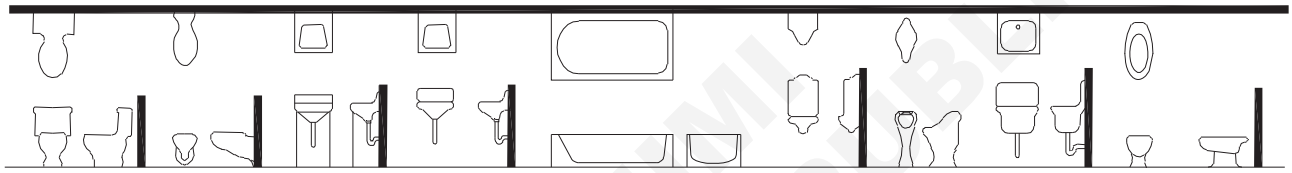
SANITATION-FACILITIES SYMBOLS



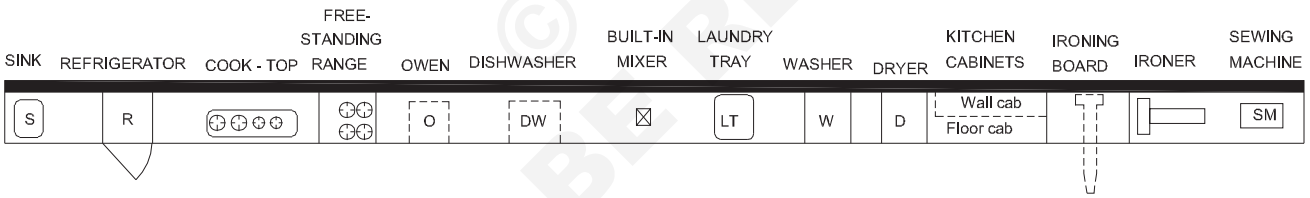
HEATING AND AIR-CONDITIONING FLOOR-PLAN SYMBOLS.



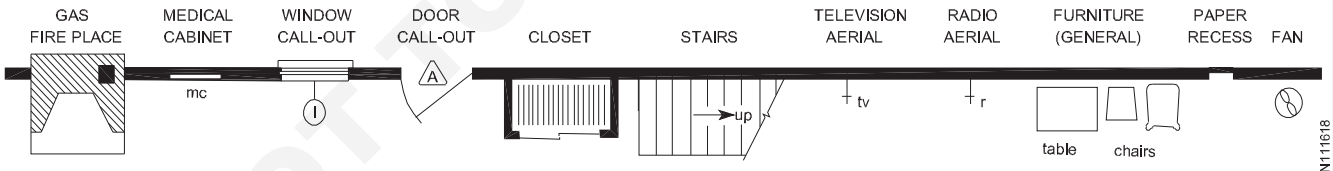
PLUMBING FLOOR-PLAN SYMBOLS.



LAVATORY-FIXTURE SYMBOLS.



KITCHEN AND LAUNDRY SYMBOLS.



BUILT-IN-COMPONENTS SYMBOLS.

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Furniture styles and types

Objectives: At the end of this lesson you shall be able to
- **describe different furniture styles**
- **describe usage and importance of furniture from classical era to contemporary era**
- **describe types of furniture based on functionality , body measurement for furniture.**

Introduction

Furniture are movable objects or the mass which may:

- support the human body
- provide storage
- hold objects on horizontal surfaces above the ground
- make room more comfortable for inhabitants (interior/ exterior) living room
- helps decorate rooms.

Importance of furniture in interiors : Furniture is important because interior design is concerned with the design of spaces, and what makes those spaces is furniture.

Interior design and furniture : Furniture is the primary tool for designers to make a space functional. With so many styles of furniture available in the market today, it is the task of the designers to rightfully select the ones that fit the need and want of their clients in order to create a space that they will enjoy.

Furniture styles are broadly classified into three types based on era, usage and style

A Traditional style (early era style
  - Classical style
  - Ethnic style

B Modern style (modern era)

C Contemporary style

A Traditional style : Traditional style of furniture reproduces the classic decor with European flair. Traditional design emphasizes elegance and simplicity. The main characteristics are deep colors and wood tones, decorative details and a variety of ornamental elements.

Features

Forms: classic silhouettes, curved lines, wing and Queen Anne backs, claw and bun feet.

Colors: deep wood finishes, rich shades of brown, cherry, espresso, merlot, black and white.

Fabrics and textiles: upholstery in rich and solid colors. Noble materials like leather, velvet, silk are used. This style can also include more affordable fabrics, such as chenille, linen or cotton. Floral, foliar or damasks patterns are widely used.

Accents: decorative details like moldings, paneling, intricate embellishments, throw pillows are abundantly used.

Here are some of the elements of a traditional room

i Upholstered furniture in a traditional room exhibits classic lines and understated details. It is functional, unfussy and restful looking. Edges are soft, smooth and blend into the whole.

ii In general traditional room will use a mix lines with more restful horizontal lines. Gentle curves are seen in furniture pillows and accessories.

iii Fabrics in a traditional room are generally neither too shiny nor too textured. Florals plain colours muted plaids, understated stripes, geometrics, tone on tone and small all over patterns are common.

iv Color in a traditional room is often in a mid-range of tones though very dark and very light colours can also be used pretty multi color florals are often the basis of a traditional color scheme that uses the lightest color on the walls and deeper hues for upholstery and flooring. Avoid neon bright and jarring.

v The overall ambience of traditional decor is homely, understated and non jarring.

vi As in forms settings furniture in a traditional room is after arranged on straight axis within the room. The sofa will directly face or sit perpendicular to the fire place and a bed will back up to the center of the longest bedroom wall.

vii Wood furniture will usually have a straight and curves lines. There may be light carving details as well. White wood pieces will often be finished with darken stains a traditional room might also use lighter woods as long as the times of each piece are classic.

viii Interiors in a traditional home will often feature trim and molding that is painted glossy White Crown moulding is common and adds to the formal took. Walls might have a chair rail and simple molding details, with wall surfaces done in a flat painted finish or wall paper ceilings are often white and may have simple beams.

ix Details are not particularly important in a traditional room. Trims tassels and fringes are used sparingly if at all, in favour of a simpler, calmer look.

x Window coverings in traditional rooms show classic style. Look narrow shutter, traverse draperies and under treatments of pinch pleates sheers. Cornices and valances may also be featured.

xi Accessories include pairs of lamps, urns, plants, mirrors, framed prints, china, vases and collections of books. Pairs of objects are usually arranged in balanced symmetry.

xii Light fixtures exhibit classic styling. Lamps with silk shades, wall sconces, and floor lamps might all be used. Shades should be fairly plain and in ivory or white.

Traditional style can be classified into many types but, mainly two types are given importance.

a Classical style : Includes era from early Mesopotamian to ancient Chinese style, Greek style, Egyptian style.

b Ethnic style : It refers to style of particular region as in general to a country. Style various from place to place.

a Classical style

i Prehistoric furniture (Fig 1)

Fig 1

Prehistoric furniture

a When people learned to farm and lived in permanent settlements they began to make furniture.

b In Europe some of the earliest known furniture comes from a stone age a village at Sara in the Orkney islands in Scotland about 2,000 BC.

c The Stone Age farmers lived in some huts with roofs of whalebone and turf. Inside they may stone furniture such as cupboards and beds.

ii Ancient Egyptian furniture (Fig 2)

Fig 2

Ancient Egyptian furniture

a The ancient Egyptians had simple but well made furniture

b The craftsmen and wood workers created the simple furniture

c There are not many; types of furniture.

d Object were stored in boxes, but also very often in baskets.

e Chairs are an item of luxury, reserved for people in a higher position, sitting on the ground, often on malls, was more common. Beds are also luxury objects, only reserved for the richest in society.

f Most people slept on simple mats laid on the ground.

g Headrests are an important category of furniture.

iii Ancient Greek furniture (Fig 3)

Fig 3

Ancient Greek furniture

a In ancient Greece even in rich home furniture was basic.

b The Greeks stored things in wooden chests or hung them from wooden pegs o the walls.

c A rich home would also have dresser to display expensive cups.

d People reclined on couches (Which could also set on beds)

e The couches were simply wooden frames with rope webbing, mats or rugs laid on top.

iv Roman furniture (Fig 4)

Fig 4

Roman furniture

a In Rome rich people enjoyed luxuries such as mosaics and (in colder parts of the expire) panes of glass in windows and even a form of central heating called a hypocause.

b The wealthy owned very comfortable furniture. It was upholstered and finely carved.

c People ate while reclining on couches.

d Oil lamps were used for light.

e Of course for the poor Roman furniture was very basic and sparse.

f Roman furniture is made mainly from cedar wood.

v Saxon furniture (Fig 5)

Fig 5

Saxon furniture

a Life even for rich Saxons was hard and rough and furniture was very simple.

b Usually in a Saxon has there was only one room shared by everybody.

c Thanes (upper class Saxons) and their followers slept on beds with straw mattresses and pillows but the poorest people slept on the floor.

d Very little is known about Saxon furniture but it must have been basic and heavy such as wooden benches and tables although upper class Saxons liked having tapestries on their walls.

e There were no panes of glass in windows, even in a Thanes's hall.

vi Chinese style (Fig 6)

Fig 6

Chinese furniture

Characteristics

- Bold fusion of black, red & gold
- Paper lanterns
- Comfortable furnishings
- Bamboo, black or red lacquer finishes
- Oriental vases

b Ethnic style

Ethnic style are inspired by different culture. This style is intended for stunning and luminous shades of design at home. We will be mainly taking Indian ethnic style and describing furniture styles. The furniture traditions of India have been influences by the raw material an regional variations.

For example

i Ebony wood furniture : Ebony was vogue in South India in early 19th century, However as the ebony wood become rare rosewood furniture began to be build.

Traditional Indian wood careers still we simple tools to create pieces of comfort and aesthetics.

ii Rajasthani and Gujarati : Rajasthani and Gujarati wood craft that draw admires from the colourful designs are used on the furniture namely in mall chairs and tables. Boxers, cabinets, mirror/picture frames, doors and window. In Rajasthan Shekhawatiregion of Rajasthanis notable use a sheesham, mango (Mangifera indica), and babool or kikar (Acacia nilotica for vintage look treatment is given to the furniture.

iii Barmeri furniture : Barmeri furniture is known for its typical and very distinctive style. There is a huge range of chairs, sofa sets with centre tables, couches, cabinets, dressing tables etc.,

The woods used for ornamental work in India are walnut, which provides the base for the fine workmanship of Kashmir.

iv Mughal Furniture : Workmanship and design of contemporary wood craving.

v Tuscan furniture : Tuscan furniture is typically made from ornamental wood and hand-worked wrought iron in designs that range from simple to complex. Its rich materials and polished finishes will add a touch of class to any establishment is used for embellishment purpose.

vi Coco furniture : Coco furniture made up of all synthetic material steel, glass, fibres, plastic is used in many parts of India.

vii Furniture in the mInterior Design & Decorationle age: (900 - 1500)

a Furniture in the middle ages had to be practical above all else.

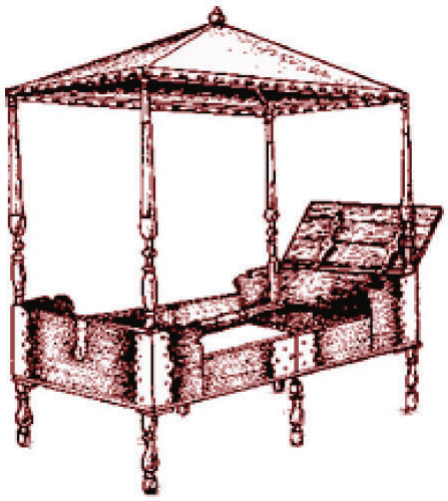
b Large chests of simple construction were made of heavy oak to discourage thieves.

c The chest or trunk was the most important piece of furniture used to contain valuables and designed to be moved from place to place.

d They were used as a seat by day, a bed by night (with cushions) and also as tables.

viii 16th century furniture (Fig 7)

Fig 7



16th century furniture

a Folding field bed, it was adorned with curtains and cushions, Italy, 16th century.

b Furniture was more plentiful than in the Middle Ages but it was still basic.

c In a wealthy home it was usually made of oak and was heavy and massive.

d Middle class people used feather mattresses rather than straw ones.

e In the 16th century, chairs were more common than in the Middle Ages but they were still expensive.

f Even in an upper class home children and servants sat on tools.

ix 17th Century furniture (Fig 8)

Fig 8

17th Century furniture

a In the late 17th century for the wealth became more comfortable and much more finely decorated.

b In the early 17th century furniture was plain and heavy. It was usually made of oak.

c In the late 17th century furniture for the rich was often made of walnut or (from the 1660s) mahogany.

d It was decorated in new ways. One way veneering. (Thin pieces of expensive wood were laid over cheaper wood).

e Some furniture was also in laid. Wood was curved out and the hollow was filled in with mother of pearl. At this time lacquering arrived in England.

f Pieces of furniture were coated with lacquer in bright colors.

g William and marry long chair, new England, 17th century.

h A design by Thomas Chippendale for King George III circa 1792.

x 18th century furniture (Fig 9)

Fig 9

18th century furniture

a The bed of Marie-Madeleine Guimard, the renowned 18th century ballet dancer.

b In the 18th century the wealthy owned comfortable upholstered furniture.

c They owned beautiful furniture, some of it veneered or inlaid.

d In the 18th century much fine furniture was made by Thomas Chippendale (1718-1779)

e Another furniture maker was George Hepplewhite (? -1786). In 1788 his widow published a book of his designs. The cabinet maker and upholster's guide, which had a big influence on Regency furniture.

f Thomas Sheraton (1751 -1806) was a cabinet maker. In 1791 - 93 he published his designs, in he cabinet maker and upholsterer's drawing book. The famous clockmaker James Cox (1723 - 1800) made exquisite clocks for the rich.

xi 19th century furniture (Fig 10)

Fig 10

19th century furniture

a Well off Victorians lived in very comfortable houses.

b For the first time furniture was mass-produced. That meant it was cheaper but unfortunately this cheap furniture lead to a fall in design standards.

c To us middle class Victorian homes would seem overcrowded with furniture, ornaments and knick-knacks. However only a small minority could afford this comfortable lifestyle.

d In the early 19th century the poorest people slept on pillows of straw because they could not afford beds. Modern furniture

B Modern furniture (Fig 11) : Modern style is the opposite of traditional styled furniture. This era is mainly associated with the age of machination and can be connected to the time frame of 1920-1950.

Fig 11

Modern furniture (bed room)

With a sense of simplicity, modern furniture style is defined by clean and crisp lines, a simple design, neutral color palette, and "cold" materials. The style grew out of the decorative arts and was started in the 20th century.

Features

Forms: clean silhouettes, crisp lines, geometric shapes.

Colors: neutral colors and glossy finishes, black and white palette, gray.

Materials: wood, plastic, metal, steel and glass. Natural wood with wood grain pattern can be found.

Fabrics and textiles: leather, vinyl and faux leather, PU, microfiber.

Accents: Few ornamental details.

C Contemporary furniture (Fig 12) : Contemporary furniture design describes the style that's based on present times — "the here and now". In that case it's similar to the modern. Contemporary furniture style is fluid — it may contain smooth shapes and curved lines.

Features

Forms: simple silhouettes, crisp or curved lines, geometric shapes.

Fig 12

Contemporary furniture (living room)

Colors: glossy finishes, neutral colors such as black, white, gray, silver, chrome.

Materials: metal, steel, wood, plastic and glass.

Fabrics and textiles: microfiber and suede, leather, vinyl and PU.

Accents: few ornamental details.

Furniture Types: Based on functionality

1 Storage furniture

2 Seating furniture

3 Surfaces furniture

4 Space furniture

1 Storage furniture (Fig 13) : Storage furniture are mainly used for storing or holding objects. Examples - Armoire, Bookshelf, Shoe rack, Wardrobe etc.

Fig 13

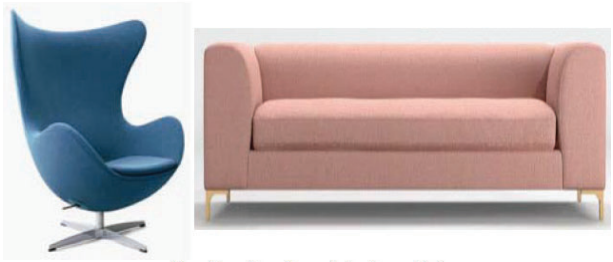
Storage furniture (wardrobe and bookshelf)

2 Seating furniture (Fig 14) : Seating furniture helps humans to seat or relax on them. Example - Chair, Sofa, Bench etc.

3 Surface furniture (Fig 15) : Surfaces furniture are used for holding objects.

Example - Coffee Table, Tea Table, Table etc.,

Fig 14



Seating furniture (chair, sofa)

Fig 15

Surface furniture (bed)

4 Spaces furniture (Fig 16) : Spaces furniture are generally big and needs some spaces.

Example - Bed, Reading Table, Dining Table etc.,

Fig 16

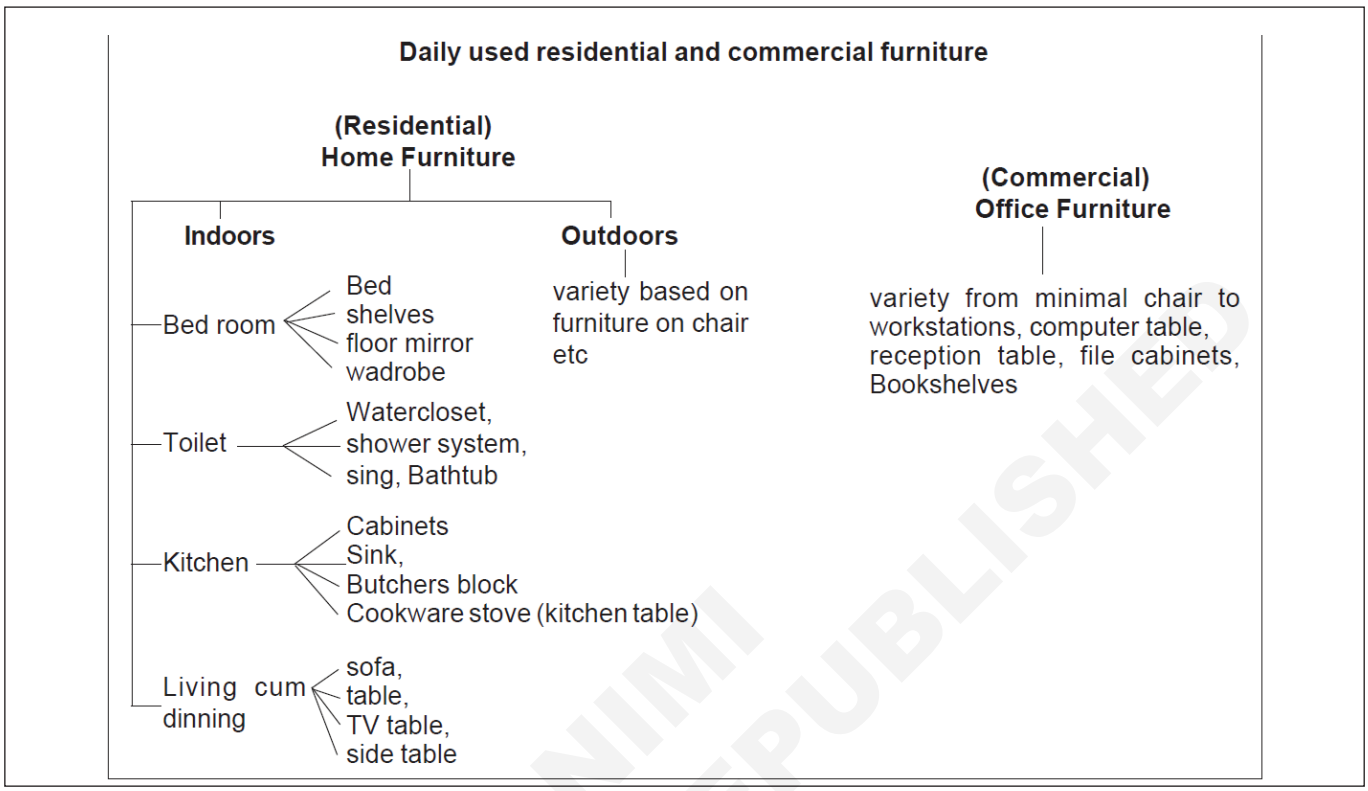
Space furniture (coffee table)

Classification of furniture

Storage	Seating	Spaces	Surfaces
Armoire Bookcase Cabinet Chest China cabinat Credenza cupboard Curio Dresser Filing cabinet Coat stands Hatsand Knoll sofa Side board Wardrobe Storage wall	Bean bag Bench Chair Couch Fauteuil Footstool Ottoman Recliner Settee Sofa Stool Tuffet	Bed room set Living room furniture Dinning set Bath room furniture Study furniture	Coffee table Desk End table Folding table Gateleg table table

Types of furniture based on their functionality and usage

1 **Daily used furniture :** Furniture both immovable and movable are under this category, it based on functionality and comfort level. Even it places an important role in spare planning where maximum usage in considered in the placement and arrangement of furniture. It plays major element. Since it engages the users in emotional, social or cultural means. Lets take two different places for our understanding as Residential and commercial and understand daily used furniture.



2 **Loose carpentary furnitures (Fig 17) :** They are - Furniture, fixtures and equipment, abbreviated FF & E or FFE, are movable furniture, fixtures or other equipment that have no permanent connection to the structure of a building or utilities. These items depreciate substantially over their long-term use, but they are definitely important costs to consider when designing internal space.

Fig 17

Loose carpentary furnitures

Examples of FF & E include desks, chairs, computers, electronic equipment, tables bookcases and partitions, sofas, dining tables etc., based on carpentary made. [Some times, the term furniture, fixtures and accessories (FF&A) is used in place of FF&E].

3 **Fixed carpentary furniture (Fig 18) :** They are furniture, furniture fixture which are immovable in natures. They have a permanent connection to the structure of building/(interiors).These item come for a long time if well maintained.

Example is, cabinets used as loft in many areas for storage.

Fig 18

Fixed carpentary furniture

4 **Mutli utility storage furniture (Fig 19) :** Multi utility storage furnitures are furnitures which can be used for various purpose. These storage furniture are adaptable furniture and have dramatically new concept in there designs. They are much in vogue, due to these modular ratio, infinity adaptable storage units which have brought change in traditional furniture of decades in new era both in form and materials. For example cabinets used in table racks, shelves, drawers used as multipurpose furniture. These well designed pieces of multi utility storage furniture will

transform and adapt to fit your changing needs, so you can save both space and money.

Fig 19

Multi utility storage furniture

The above figure is a good example for multi utility storage furniture.

5 **Open and closed storage furniture (Very commonly used in kitchen as cabinet) :** Kitchen cabinets provide our kitchen with a huge degree of visual impact. They create storage solutions and integrate our appliances with the rest of the room. Cabinetry can use half of our kitchen budget. We use kitchen cabinets every day, selecting durage and attractive kitchen cabinets should be a top priority. Different form of sizes and shapes of kitchen cabinets, such as wall cabinets, which are those attached to the upper portion of the wall, base cabinets, which rest on the floor and rise to about waist level, and tall cabinets, which run from the floor up 5feet (1.52m) and above are used as in (Fig 20).

Fig 20

Open and closed storage

Purpose and function of kitchen cabinet : Kitchen cabinets are the built-in furniture installed in many kitchens.

Uses for storage of food, cooking equipment and often silverware and dishes for table service.

Refrigerators, dishwashers and ovens are often integrated into kitchen cabinetry.

Kitchen cabinets provide our kitchen with a huge degree of visual impact.

Kitchen cabinets create storage solutions.

Types

1 **Face Frame cabinets (Fig 21) :** Face frame or traditional cabinets are characterised by the frame or face that masks the raw edges of each cabinet box.

Fig 21

Face frame cabinets

2 **Raised panel doors (Fig 22) :** Raised panel doors and drawers have decorative panel either routed into a door pander or inserted into the frame of a door.

Fig 22

Raised panel doors

Body Measurements for furniture (Fig 23)

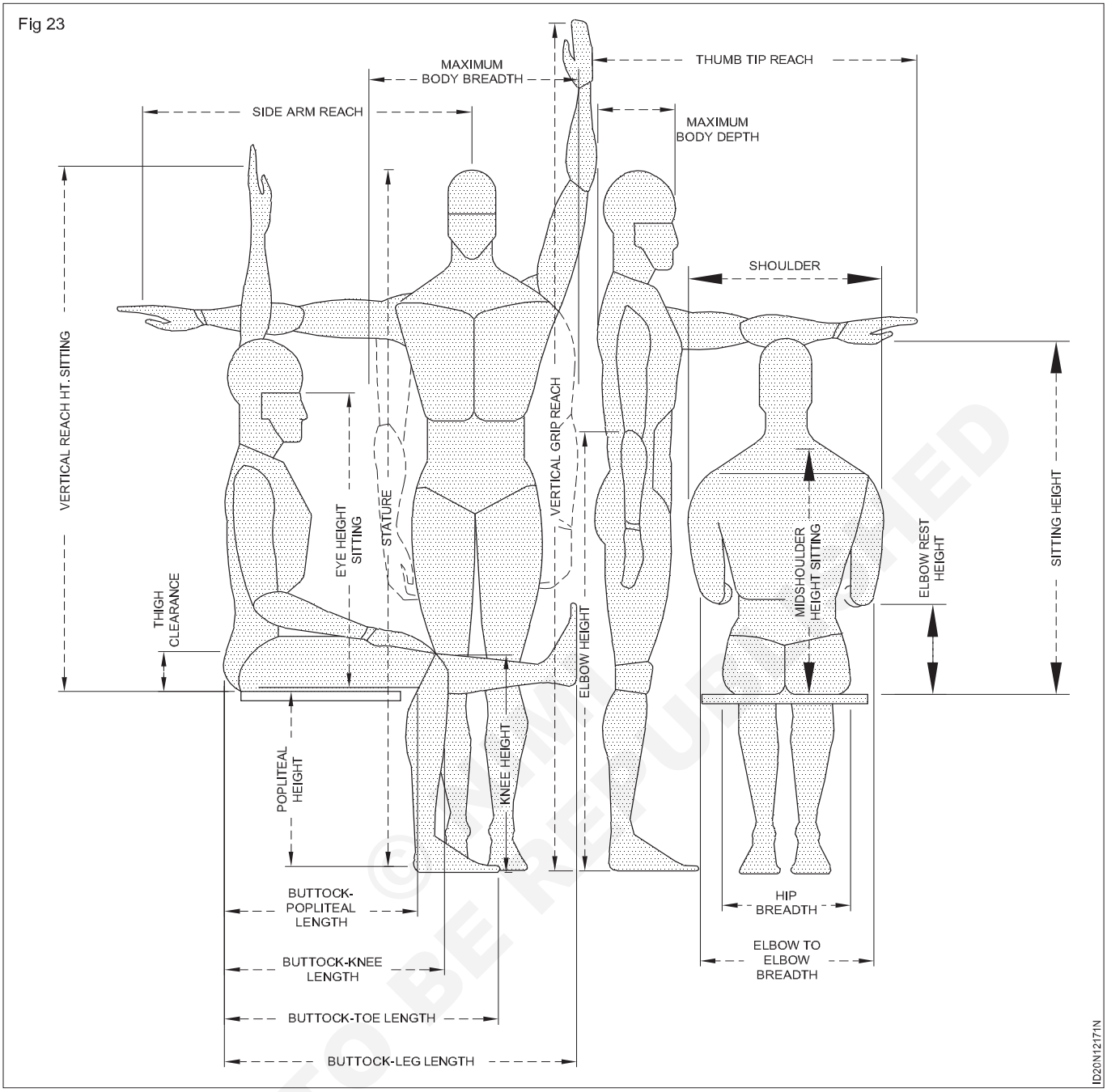
Anthropometrics : Anthropometrics is the science of measurement of the human body and its movement in the human space. The human body made up of some two lines and numerous muscle is a respect piece of understanding the basic principle of ergonomics and the application of body measurements Anthropometrics to interior and furniture.

As a designer we should make for people to apparate with minimum frustration and fatigue. Every design situation is open to innovation and improvement simple through acquiring and understanding of the puson and artinty in which they are involved whether it is sitting, writing, dressing, bathing, reading, cleaning ,etc.,

It is essential due to the very variable involved that the data selected be appropriate to the use of the space of furniture to be designed of the west is a small group, it

may in certain situation be feasible to develop your own anthropometrics data by actually having individual body measurement taken (Fig 23 shows anthropometrics of human being).

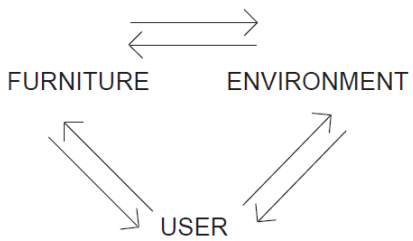
Fig 23



Ergonomics of furniture (or) human face (Fig 24) : It is the study of man in relation to his working environment. From the Greek word 'ergo' means work, nomics means natural law. It is the adoptation of product design to the individual so that he may work at maximum efficiency. The ergonomics process is typically managed through the health and safety department.

Use of furniture probably started from the first of human civilization. Even the primates makes there bed and sitting arrangements on trees for maximum comfort and proper functioning. It is not known when the first furniture was made, who made it and of what kind of material it was made but it has been established that furniture was being used as for back as 300 BC. Paintings excavation from pyramids gives us some idea of the kind of furniture used in ancient time. Ergonomics is also related to subjects like anthropology, physiology and psychology.

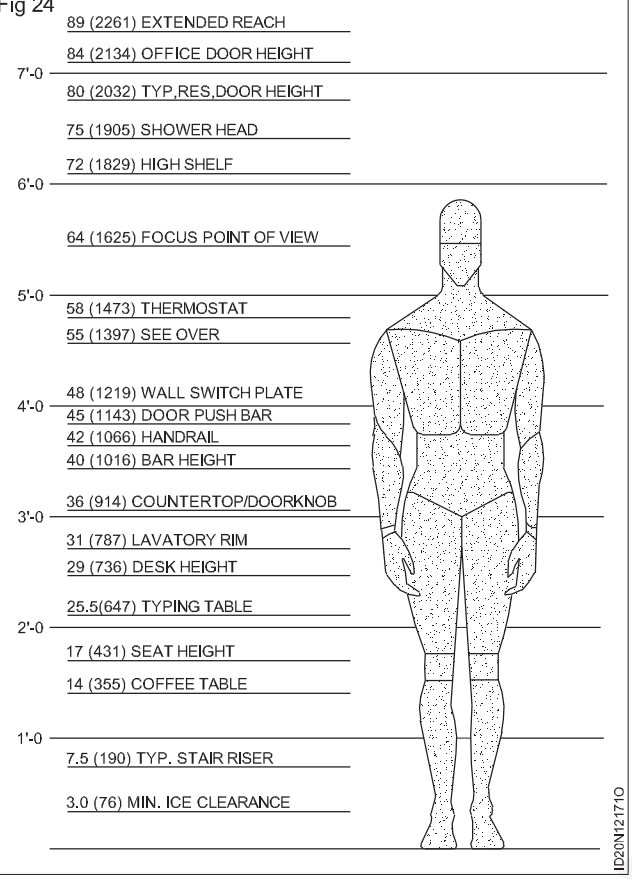
Benefits of ergonomics : There are many benefits to integrating an ergonomics process deeply into all of your operations. Among the many benefits are:



- It reduces costs
- It improves productivity
- It improves product quality
- It increases employee engagement

- It creates a better company safety culture.

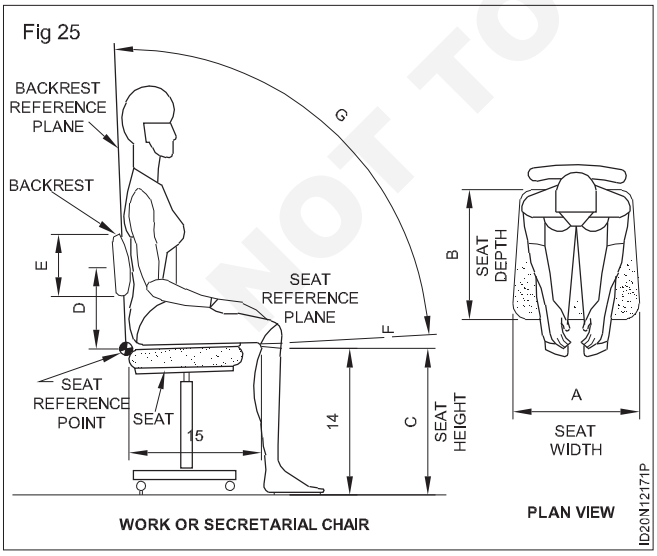
Fig 24



Anthropometrics for various furniture are as follows

1 **General purpose chair :** The top diagram shows dimensions for a general purpose chair intended for brief periods of use. A 17-in, or 43.2-cm, seat height will accommodate most adults, except very small females, who may require a 16-in, or 40.6-cm, and in extreme cases, even a 14-in or 35.6-cm, seat height. A smaller user, however, can function with a greater seat height by using a footrest. (Fig 25)

Fig 25



2 **Easy Chair (Fig 26) :** The easy chair, shown in the drawing at the top, is a difficult chair type to design, or establish guidelines for, since it is primarily intented for relaxation and comfort qualities which are highly personal. The following suggestions should also prove helpful:

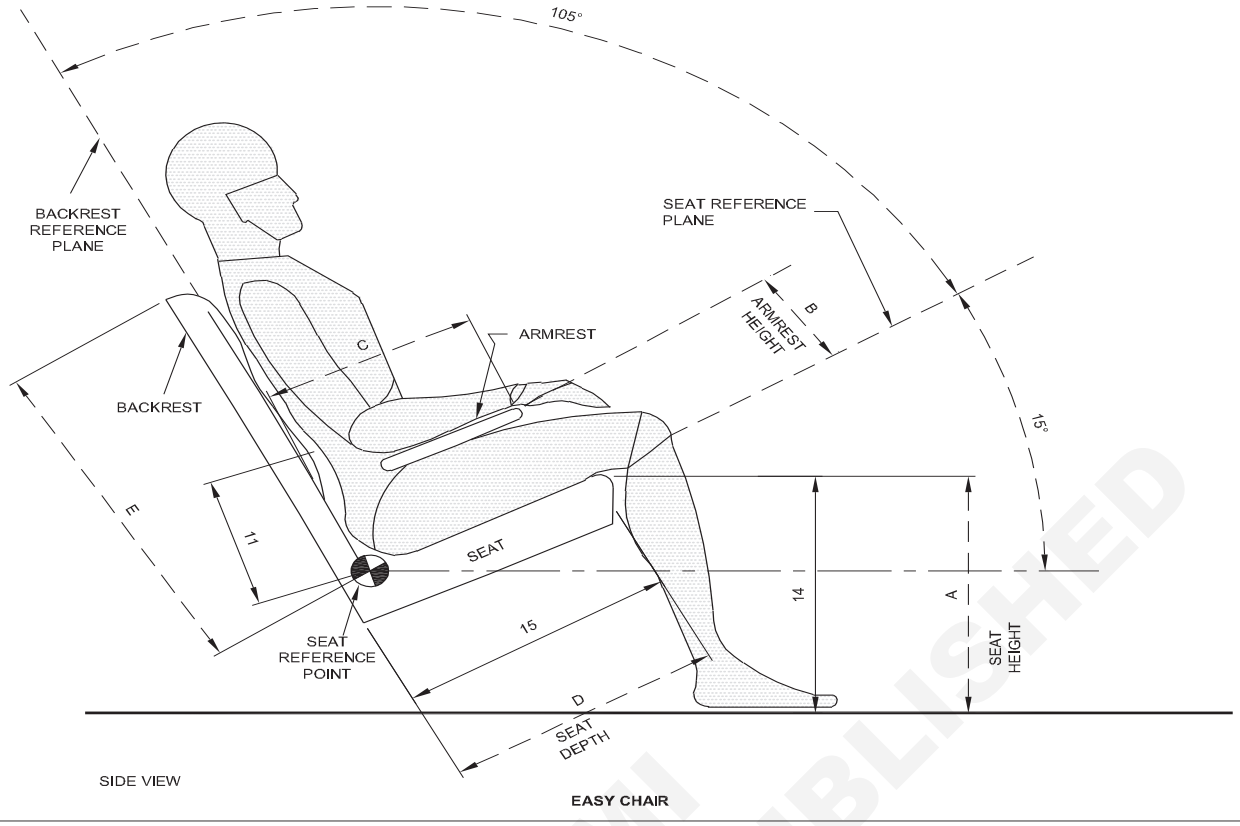
	inch	cm
A	31 - 33	78.7 - 83.8
B	15.5 - 16	39.4 - 40.6
C	16 - 17	40.6 - 43.2
D	17 - 24	43.2 - 61.0
E	0 - 6	0.0 - 15.2
F	15.5 - 18	39.4 - 45.7
G	8 - 10	20.3 - 25.4
H	12	30.5
I	18 - 20	20.3 - 25.4
J	24 - 28	61.0 - 71.1
K	23 - 29	58.4 - 73.7

- The angle formed by thighs and trunk should not be less than 105º. Angles significantly less than this will cause discomfort
- Design should allow the user to change body posture.
- The front edge of the seat should be rounded to prevent irritation.
- The backrest should provide lumbar support by following the spinal contour in the lumbar region. (Fig 26)
- The seat surface should tilt backwards. Too severe an angle, however, may cause a person difficulty in getting up from the chair, particularly for elderly people. A seat angle of about 15º should be adequate.
- If the angle formed by the backrest with the vertical exceeds 30º provisions for a headrest will be required in the form of a separate design element or extension of the backrest itself.
- Arm rests should be padded and designed horizontally or at the same angle as the seat surface.

3 **Drafting Chair/Stool :** The drawing at the bottom provides basic dimensional information for the design of a drafting stool,which is similar in many aspects to the secretarial chair. (Fig 27)

4 **Sofa seating (Fig 28) :** The drawings here examines the relationship of female and male body dimensions to sofa seating, in order to determine how much space the body requires to sitting. The anthropometric measurements of major interest here are maximum body breadth and buttock-popliteal length.

Fig 26



EASY CHAIR

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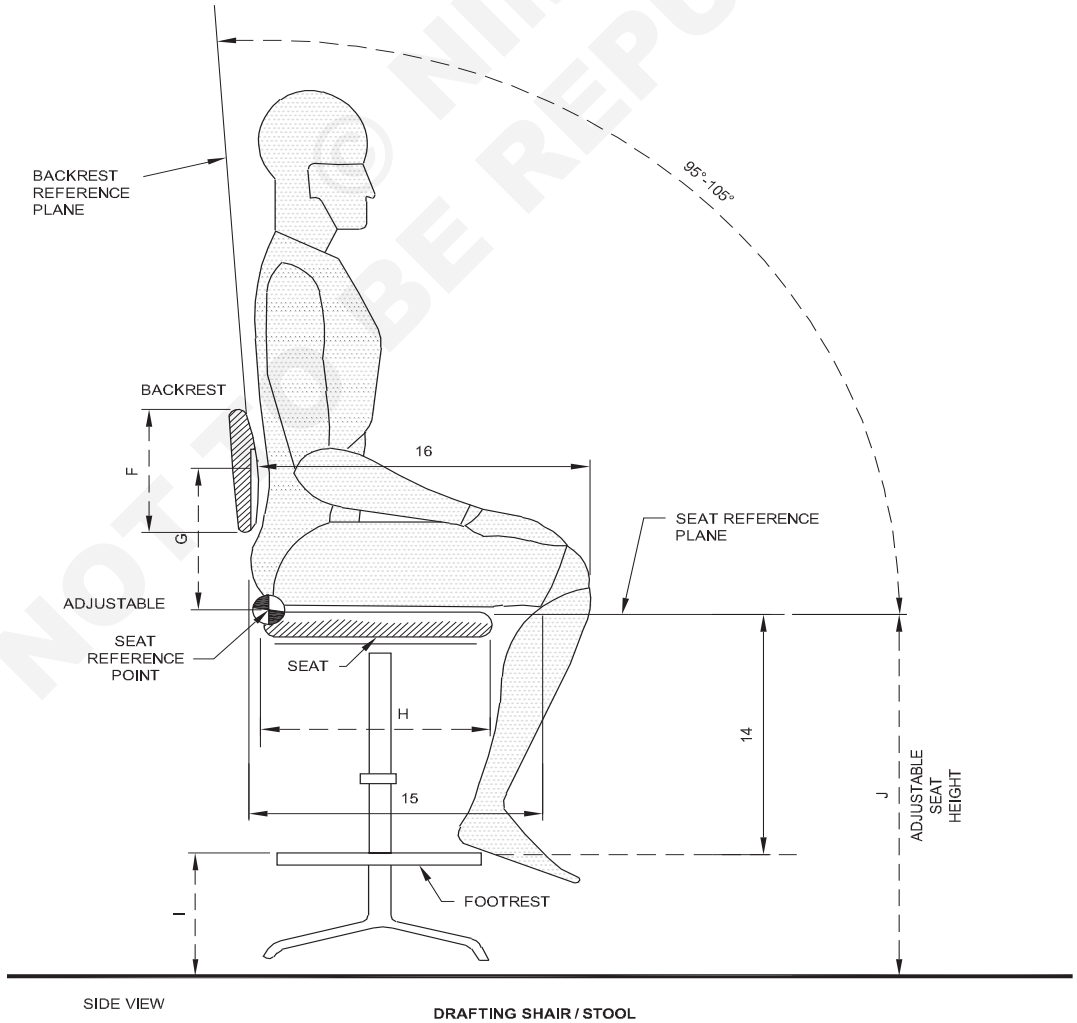
Fig 27



DRAFTING SHAIR / STOOL

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Fig 28

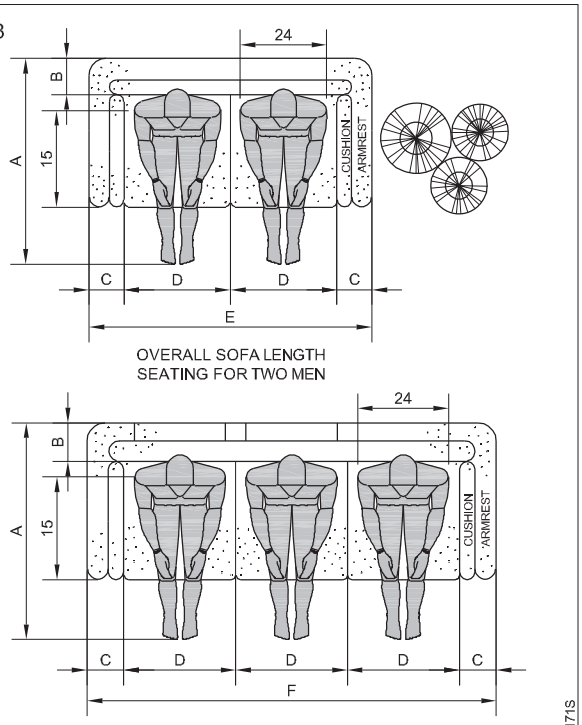
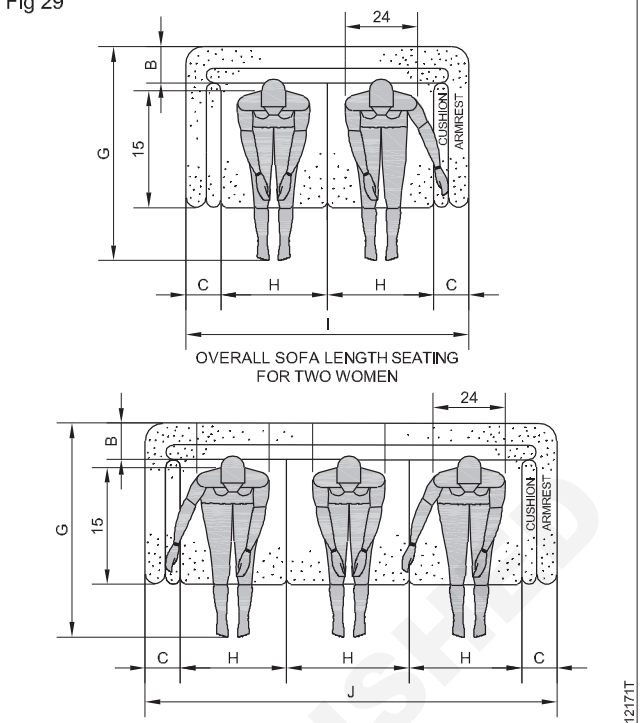


Fig 29



The top drawing deals with male dimensions; the maximum body breadth dimension is 22.8 in, or 57.9 cm, with a nude subject. Allowing for clothing and some body movement as well as change in posture and position, a minimum dimension of 28 in, or 71.1 cm, is suggested as a width allowance for a seated person. The overall dimension, therefore, includes the individual width allowances and the width of a sofa arm construction, which obviously can vary depending on personal design preference. A range of 3 to 6 in, or 7.6 to 5.12 cm, is suggested. Using the buttock-popliteal length of the similar allowance of 6 in to 9 in, or 15.2 to 22.9 cm, for backrest construction as well as a minimum zone in front of the sofa for foot movement, an overall depth dimension of 42 to 48 in, or 106.7 to 121.9 cm, is suggested. The rationale with female data is the same. In spaces where seating is to be used by both sexes, the larger dimensions should apply. (Fig 29)

General principles

Furniture Arrangement for residential planning : Furniture arrangements should be carefully planned. Preliminary plans should be made on paper of an orderly arrangements to create beautiful and comfortable rooms. The formality of traditional arrangements has replaced the informality of modern living. Some of the guideline one can use in planning furniture arrangement are :

1 The furniture should be grouped according to purpose or activity. Function oriented arrangements are generally comfortable. A living room, for example, should have a group of furniture which encourages conversation and is suitable for entertaining guests.

2 In a group of furniture the various items should be arranged in such a way that space between two items is less than the size of any one of the objects. But if you want to isolate a particular pieces of furniture or group of furniture the space between two sets should be more than the size of the furniture.

3 Furniture should be so grouped that people face each other. So, semi-circular, circular and rectangular arrangements are more effective.

4 The traffic area should be kept clear of furniture piece. A definite pattern should be planned and the traffic lanes should not pass through conversation group. They should go around it.

5 The main passages should be a5-6 ft wide and minor one should be 3-4 ft wide.

6 Furniture should be so placed that it does not come too close to door or window frames. Approaches & doorways should be kept clear of furniture.

7 Decide the centre of interest first and then arrange the furniture around it. This centre of interest and could be fire place in cold climate, a large picture window, a television unit, a painting or any other important objects.

8 Emphasis in furniture groupings can be established by using an item of contrasting size, shape, colour, variation in amount of decoration, such as plain chair among upholstered group or upholstered chair among wooden chairs.

9 Balance in furniture arrangements should be sought. All four walls should have furniture that has equal attraction, especially those walls which face each other.

10 Windows and doors on one side of the room should be balanced by tall pieces of furniture such as cabinets, bookcases, etc on the opposite walls.

11 If a room is large and furniture in small, grouping of furniture would make them look better in proportion. Small - scale objects could be grouped together leaving less space between them. So that they give an impression of large unit of furniture.

12 A long narrow room could be divided into two activity areas by placing large piece of furniture at right angle to the long wall.

13 The furniture grouped together should have harmony in line, shape, size, colour of texture.

14 Large pieces of furniture should be placed parallel to wall so that harmony of line can be maintained.

15 Place large pieces of furniture first then fill the space with small pieces and decorations.

	inch	cm
A	42 - 48	106.7 - 121.9
B	6 - 9	15.2 - 22.9
C	3 - 6	7.6 - 15.2
D	28	71.1
E	62 - 68	157.5 - 172.7
F	90 - 96	228.6 - 243.8
G	40 - 46	101.6 - 116.8
H	26	66.0
I	58 - 64	147.3 - 162.6
J	84 - 90	213.4 - 228.6

	Living room Furniture	**Bed room Furniture**	**Bath room Furniture**	**Kitchen Furniture**
Specific	General parameters needs to be considered as this place is accessed by people of dimensions and background	Highly customized - for example in case of children's room all utilities need to be within reach of child	Customized	General - but background of he user needs to be known in order to make space compatible ot style
Water proof material	Low importance	Low importance	Highly important	important
Fire proof material	Low importance	Low importance	Very low importance	Highly important

Planning of interior spaces furniture functional space and circulation of furniture and templates

Objectives: At the end of this lesson you shall be able to
- **describe factors determining spatial planning.**

Factors determining spatial planning

A Assessing the client's needs

1 A successful interior design adequately accommodates within a structure the lifestyle and specific needs of the user.

2 Determine specific requirements of the client

Prepare a list that includes design considerations and necessities

a Family size and structure

b Family or individual's interests and activities

c Budget of project

d Location of site

e Number of levels

f Architecture style

g Zoning ordinances and covenants

B Levels

1 One story homes are typically compatible with a limited number of architectural styles and have the potential to be more costly if located on a larger site.

2 One and one-half story homes utilize the attic as a living space through structural elements including a steep roof and dormers projecting from the roof to let in air and light.

3 Two story homes are economical to build because of smaller roof and foundation area.

4 Split-level homes are developed with a separate sleeping, living and recreation on different levels.

C Traffic patterns

1 Are a primary consideration in designing a functional plan

2 Main traffic areas include the halls, stairs, foyers, entrances to rooms, and exterior entrances.

3 Travel should be short and if possible not pass through other rooms.

4 Trace various routes through the house to analyze traffic flow

- Halls

a Minimum width of 3'-0", 3'-4" is preferable

b Plan for the movement of furniture

c Long hallways waste useful space

6 Doors should be planned and located to guide traffic through rooms.

7 Doors and openings located near a corner of a rooms usually result in less wasted space. Leave a minimum of 3"5" for casing inside corners inside corner to frame.

- Entrance

a Usually include an outside waiting area.

b Flooring materials should not be affected by water or dirt.

c Minimum of 2' width of entrances are advisable.

d Main house entrance

e Should be easily identified

f Should include a foyer if space permits

g size depends on size of house

h often omitted in small houses

9 Should be able to view visitors without opening a door

10 Minimum entrance is 3'-0"

D Room planning

- Living area

a Generally, comprises 1/3 of the house and includes the living room, dining room, foyer, recreation or family room, informal/format room, home office, or other gathering spaces.

b Types of floor plans

1 Closed/Formal plans, which have placement of rooms in cubicles accessible through doors and openings.

- Found frequently in traditional style homes.

2 Open/Informal plans include partial separations or may combine several spaces (rooms) into one open area.

a Area rugs or furniture provide a visual separation

b Floor elevations and ceiling heights may differentiate

c Living room

3 Size and layout is determined by its purpose

a TV Area

b Center of activities

c Entertaining guests

d Furniture

e Living habits of occupants

4 Limit traffic patterns though living areas

5 Centrally located near an entrance

6 Consider views to outside

7 Dining and entertaining are closely related and should be located in close proximity to each other.

• Dining room

8 Size and layout is determined by its purpose

i Closed/Formal or Open/formal plan

ii Presence of smaller eating area.

iii Number of guests to be served

iv Furniture

9 May be accessible to porch for outside dining

10 Ideally located between the family room and kitchen

11 Allow ample space for serving and movement

• Sleeping area

a Includes bedrooms, baths, dressing rooms, and closets.

b Homes are categorized by the number of bedrooms and baths.

c Three bedroom homes are most common.

d Rooms are often grouped together in a quiet, separate wing/level.

e Master bedrooms may be separated from other bedrooms.

f Bedroom size and layout is related to furniture and function.

- Minimum size is 70 square feet or 7' in any direction.
- Consider furniture items and size to be used.
- Plan for movement of furniture.
- Consider planned activities.
- Writing
- Reading
- Watching TV
- Hobbies

g Typically, bedrooms should be accessible to a hall.

- Doors should swing into the bedrooms.
- Minimum width of door to bedroom is 2'-B".
- Door size should allow for furniture movement.

h Windows

- Used for ventilation and light
- Must be included as a second means of egress.
- Windows use wall space that could be used for furniture arrangement.

i Dressing areas

- May be an alcove or a separate room
- May include sinks, make-up counters, mirrors, chairs, closets and other dressing items
- Often adjacent to the master bath

j Bathrooms

• Includes plumbing fixtures such as the toilet, shower, tub, sink, and bidet.

i Lavatories may be wall-hung, pedestal, or countertop.

ii Various sizes and styles of fixtures are available.

iii Allow 15° minimum from center line of water closet to wall or adjacent fixture.

12 Plumbing wall for toilet should be constructed.

13 May be compartmentalized.

14 Bedrooms should placed close to a bathe or have an adjacent bath.

15 The master bedroom usually has an adjacent bath.

16 Bath sizes vary according to space available.

a Minimum size for full bath is 5'0" x 8'0"

b A half-bath contains a lavatory and a toilet

c Minimum size for half-bath is 3'0" x 7'0"

17 Bath furnishings may include built in cloths hampers, shelves for linens, counter space, medicine cabinets, and mirrors.

18 Must have natural ventilation and or fan to remove moisture

19 Grouping baths increases efficiency by allowing for centralized plumbing.

20 Modifications are required for special medical/disabled clients. One accessible bathroom on the first floor is required. This bathroom must have a 32" swing door or 30° pocket door to be designated accessible

21 Linen closets should be minimum of 18" deep.

• Service area

• Kitchen

a Purpose is food preparation but may include dining, laundry, and storage.

b Kitchen is made up of three work centers:

c Food storage and preparation (refrigerator, cabinets, pantry, countertops).

d Cooking (range, oven, microwave, countertops).

e Clean-up (sink, dishwasher, countertops)

22 Work triangle measures efficiency

a A line from the center front of each work center makes up the work triangle.

b The sum of all sides of the work triangle should not exceed 22'.

c When possible, traffic lanes should not impede the work triangle.

- Garage or carport

Size depends on the number of cars to be housed and other purposes it will be used for

a Single car space is recommended to be from 11' x 19' to 16' x 25' depending on the car and access space

b Double car space is recommended to be from 20'x20' to 25'x25'

c Space may be increased if garage is to be used for storage

- May be attached to the house or a separate structure
- Style should match the house
- Maybe connected by a breezeway

A carport is like a garage except one or more walls are removed and no doors are provided.

a Less expensive to build than a garage

b Does not provide as much protection as a garage

c Better suited to mild climates

Garage doors vary in style, construction, and size.

Garage floors are most often constructed with concrete.

a Slope toward doors or built in drain

b 4" thick with vapor barrier and reinforcement

c Apron connects floor to paved driveways

Driveways

a May include a turnaround to avoid having to back into the street

b Desirable widths are 10' for a single car of 18' for a double car garage.

c Turning radii of 15' should be provided where the driveway connects to the street.

d Driveway layout may vary due to size and position of house as related to the lot.

Outside living areas (porches, patios, decks).

a Patios are located at ground level and are generally constructed of concrete.

b Porches and decks are structurally connected to the house and are raised above grade.

c Porches are built of various materials

d Decks are constructed of pressure treated lumber as well as composite and recycled materials.

Spatial planning based on functionlity

Objectives: At the end of this lesson you shall be able to

- **explain spatial planning in**
  - **bedroom**
  - **bathroom**
  - **living room**
  - **dining room**
  - **kitchen**
  - **storage room.**

Types of room in spatial (space) planning (Fig 1)

There are variation of room types in residential space, each requiring specific design strategies. As an interior designer you should be familiar with design cream and solution. Good spatial planning depends on circulation pattern and configuration of rooms.

Various space in residence are

A Bedrooms : The most important goal in designing a bedroom is to establish a comfortable relationship between the user and their bed and between the bed and the room at large. Because people spend an average of six to eight hours a day in the bedroom, the space must give feelings both of relaxation and security. The design of bedrooms should also accommodate activities such reading and functions such as storage for personal belongings. Privacy is design for bedroom. Ideally recommended sizes minimum for bedroom is10'0" x 12'0" exclusive of closets, while recommended minimum size for a larger bedroom should be 12'0" x 16'0" exclusive of closets.

Furniture's

Beds (Fig 2) : The bed is the only indispensable piece of furniture in the bedroom, many other functional requirements can be accommodated by built-in furniture. Examples include built-in window seats and closets. The standard dimensions for beds below will be helpful when selecting the right size bed for a specific room.

Additional furniture (Fig 3) : Depending on the size of the room, side tables, lounge chairs, side tables, and even writing desks can be added to a bedroom to promote quiet

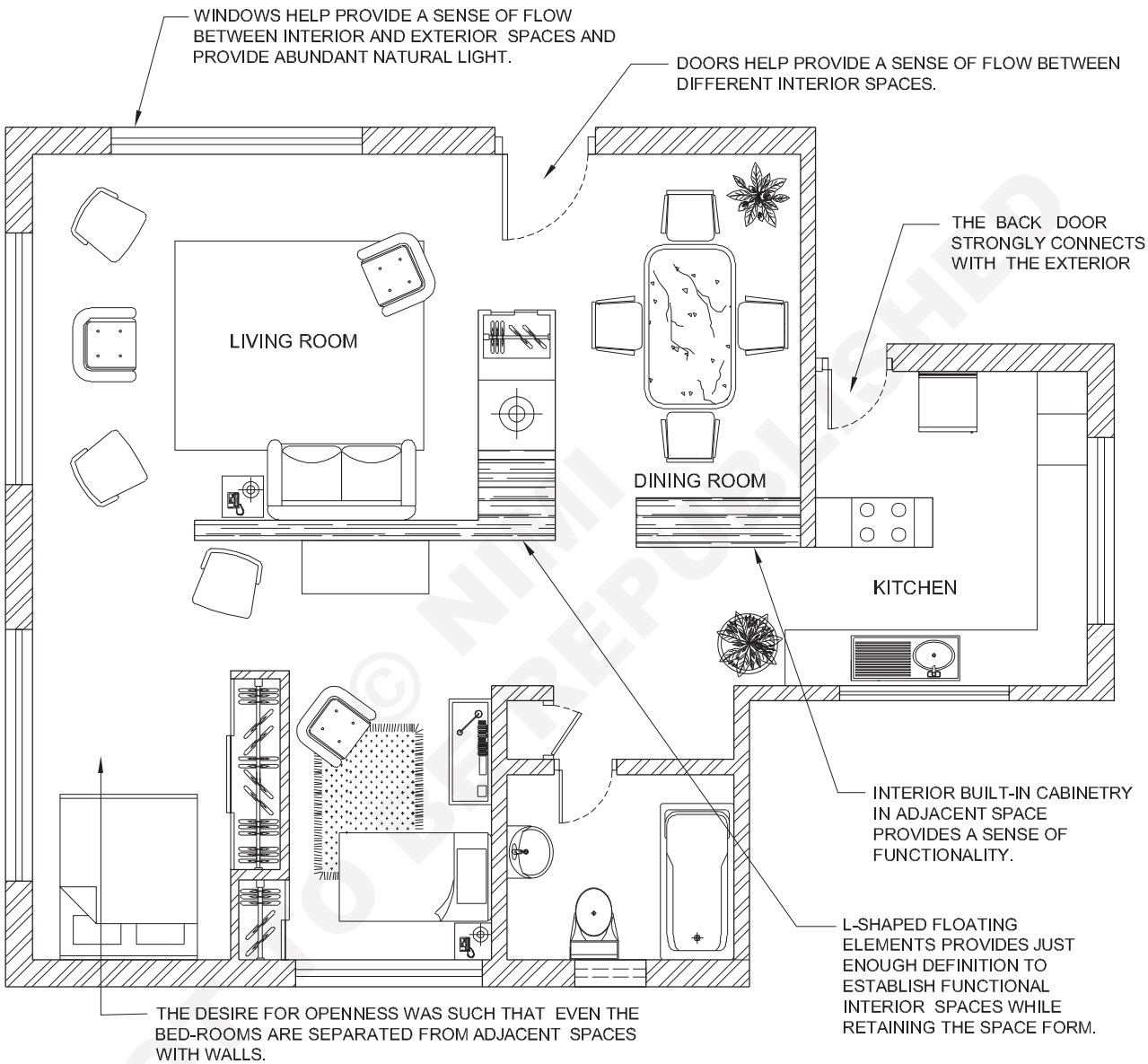
activities during waking hours built in closets. Dressers, armoires, and vanities provide other forms of storage in larger rooms.

Bedroom layouts

Bed centered in rooms (Fig 4) : The most typical and practical configuration is to place the bed in the center of the room against one wall. The dimensions recommended below provide ample space for two people to get into and out of bed.

Twin beds in a room (Fig 5) : A minimum of 30 inches (762 mm) between beds is recommended: this allows for a shared night table and ample room to get into and out of bed.

Fig 1



A SCHEMATIC PLAN SHOWING SPATIAL PLANNING OF RESIDENTIAL SPACES.

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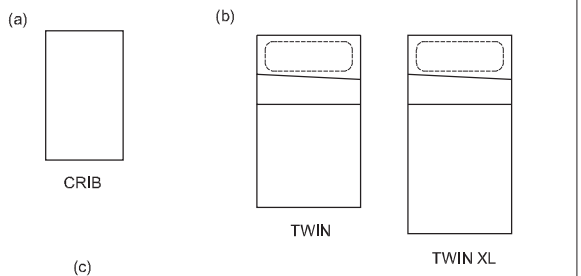
B Bathrooms (Fig 6) : bathroom configuration range from two-fixture to five-fixture master bathrooms suites. The diagrams below include the average sizes for bathrooms based on the number and position of fixtures. For all bathroom layouts, comfort and privacy are top priorities.

Types

Types of bathrooms : Bathrooms can be categorized into several different types based on their size and function. The smallest footprint for a bathroom is usually the powder room and the half bath. There are plenty of variations, depending on the type of fixtures present like the three-fixture bathroom, compartment bathroom, powder room, utility bathroom (with laundry facilities), large bathroom and bathroom that is accessible to the physically challenged and many more.

Three-Fixture bathrooms : The conventional three-fixture bathroom without compartments is designed for use by one person at a time. The three fixtures can be a wash basin, a toilet and a shower cubicle or a Wash basin, a toilet and a shower cubicle or a wash basin, a toilet and a bathtub with-or-without-shower.

Fig 2



TYPE	INCHES	MILLITERES
CRIB	24 X 54	610 X 1372
TWIN	39 X 75	990 X 1905
TWIN XL	39 X 84	990 X 2134
FULL	54 X 75	1372 X 1905
FULL XL	54 X 84	1372 X 2134
QUEEN	60 X 84	1524 X 2134
KING	76 X 84	1930 X 2134

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Fig 3

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Fig 4

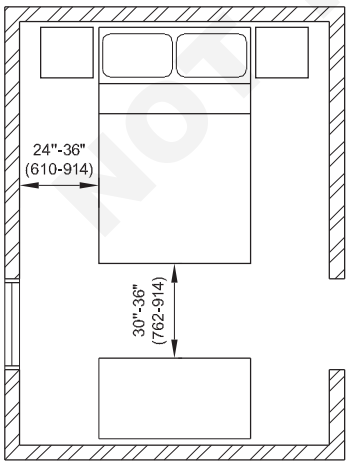

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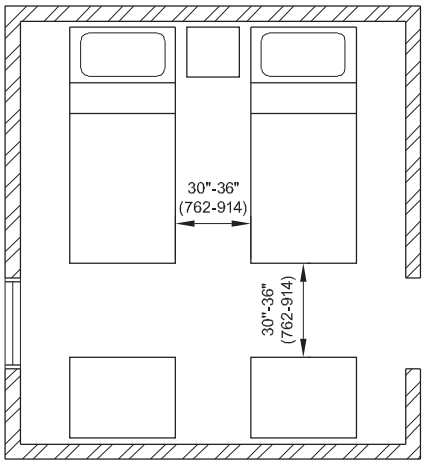
Fig 5



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There are different ways of arranging the fixtures in a bathroom. The best arrangement in terms of using the space efficiently is having the three fixtures in a row against the wall opposite the door.

For a bathroom with wash basin in the centre and toilet and bathtub/shower on either side, the minimum size required is 7’4” x 5’6”. In this type the door is in the centre of the wall opposite the wash basin.

For a bathroom with wash basin first , than toilet and lastly bathtub/shower, the minimum size required is 7’8” x 5’0” (for a shower type) and 8’0” x 5’0” (for a bathtub type). In this type, the door to the toilet is opposite or adjacent to the wash basin.

For a square type bathroom, with shower cubicle in one corner and wash basin on one wall and the toilet on the other wall, the minimum size required is 6’0” x 6’6”.

For a square bathroom, with bathtub in one corner, wash basin on one wall and toilet on the other wall, the minimum size required is 6’0” x 8’0”.

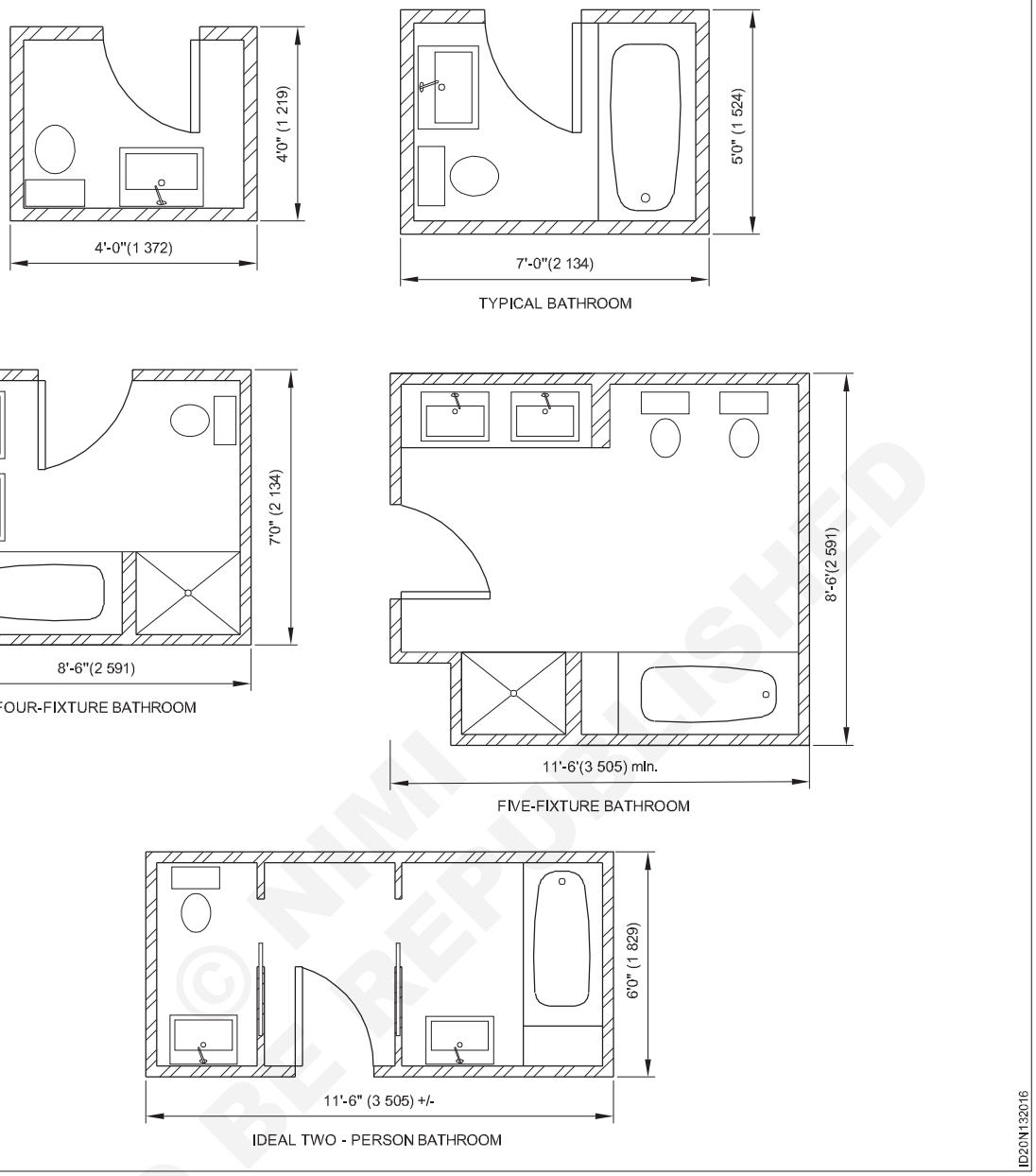
Compartment bathroom : To avoid excessive humidity in the usual three-fixture bathroom, the bath tub or shower cubicle is located in one compartment with a separate door, while the toilet and wash basin are located in another compartment. This type of bathroom is 10’6” x 6’0”.

Another variation is to have 2 separate bathrooms with separate doors-one with the toilet, (the minimum size of the Toilet is 3’5” x 5’0”) and the other with the Shower/ bathtub and wash basin. (the minimum size is 5’6” x 6’0”). In this type, the bath can become a combination bath dressing room.

Utility bathrooms : This bathroom is a three-fixture one but has additional space to allow other functions like laundering, dressing etc. The minimum size of a bathroom with a shower cubicle, a wash basin, a toilet and a dressing area/deyiing cabinet/linen cabinet/extra wash basin is 6’6” x 7’6” and with a bathtub it will be at least 9’6” x 6’6” or 11’x5’6”.

Guest bathroom / Powder room : Also called “1/2 bath” or guest bath”. It usually refers to a two-fixture bathroom, with only a toilet and a wash basin meant for guest. The minimum size of a powder room is 5’0” x 5’0”. It is usually located close to the living/dining room to allow easy access to guests.

Fig 6



Design considerations

Two-Person use : Placing lavatory, bath, and toilet in a single space is not ideal when the bathroom is shared. When two people commonly use a bathroom suite at the same time, an enclosed toilet or a separate toilet room should be considered if space allows.

Wall and floor finishes : Numerous options are available for floor and wall finishes for a bathroom, from ceramic tile to glass tile stone. Wall finishes need to be water-resistant with a waterproof substrate to 72 inches (1.829mm) above finish floor and floors need to be slip-resistant.

Lighting : Bathrooms should include both general room lighting and task lighting at the mirror and over the shower. The best mirror lighting at the sides via wall sconces, which prevents shadows in the face. Wall sconces should be placed approximately 66 inches (1.676mm) above the floor and minimally 30 inches (762mm) apart. Avoid using ceiling-mounted fixtures as the sole source of light. If the bathroom is too small and there is not enough room for side lighting, consider introducing a light cove above the mirror.

Shower controls : The many recent advances in shower design can make the selection of shower controls confusing. Here basic elements are defined.

Spray showerhead : Traditional showerhead that can be used in a shower enclosure or as part of a tub-shower combination. Mounted to the wall, it comes in a variety of spray patterns.

Supplemental handheld showers allow for more flexibility.

Shower diverter : Valve that redirects water from a spout to a showerhead or handheld shower. A two way diverter is for a bathtub and shower combination. These diverters can be as simple as a pull-tab on the tub spout that redirects the water flow from one function to the other. A three-way diverter, which redirects the water flow among tub, showerhead, and handheld shower, is a separate control value mounted on the wall.

Thermostatic-controlled valve : Valve that allows the water temperature to be set, while controlling the amount of water coming through the system at a precise temperature.

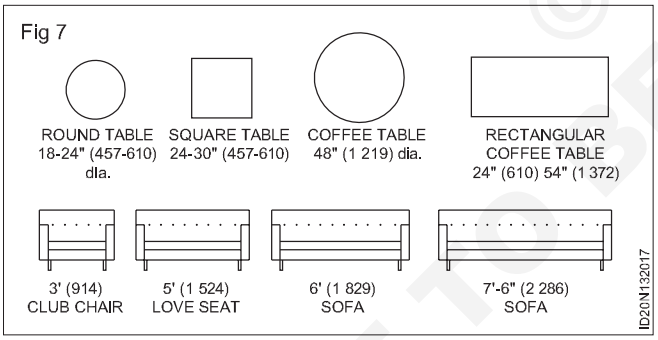
High-flow valve : Valve that controls custom designed showers with multiple spray heads. At this end of the spectrum, the various manufacturers offer many features that are unique to their system.

C Living rooms : Of all the rooms in a house, the living room is the centre of the living area it requires neither appliances, nor plumbing fixtures, nor storage. As a result has a great deal of freedom in terms of dexon of character and configuration of the space. The living room should be designed to reflect the particular lifestyle of a family. Hence the function, location decor, size and shape are important.

Function : The living room is designed to perform many functions. The exact function depends on the living habits of the occupants. In the home it is often the entertainment center, the recreation center, the library, the music room, the TV centre, the reception room, the social room, the study, and occasionally the living room is to perform all or some of these functions, the it should be designed accordingly, the shape, size, location decor, and facilities of the room should be planned to provide for each activity. For example of the living room is to used for television viewing, it will be planned differently from a living room without television. Figure-6-1 show some of the considerations in planning a room for TV viewing.

Minimum requirements (Fig 7) : A living room for a 3-4' bedroom dwelling unit requirement more space for its occupations than one-two bed room dwelling unit.

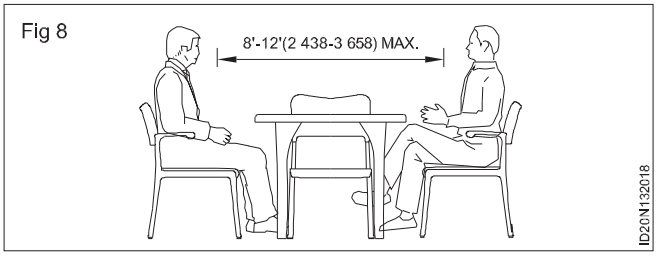
Fig 7



Specific functional requirements and the size and shape of the room will help set the agenda for selecting and arranging most appropriate furniture. Below are the dimensions of typical living room furniture. Be mindful that the dimensions of specific pieces may vary from the typical sizes. Furniture that diverges widely in dimension from these examples may be uncomfortable and impractical,

However the distance between chairs and sofas, can influence the behavior of the occupants of a space. Two people sitting across from each other must be within a specific dimensional range for conversation to be comfortable. The behavior of larger groups of people around and across a coffee table is also affected by the relative intimacy of the furniture arrangement. (Fig 8)

Fig 8



The configuration of the dining room is predicated on the size and shape of the dining table. Otherwise, the dining room allows for a great deal of design flexibility, Once a formal room occupied primarily on special occasions, the dining room today lends itself to a wide range of interpretations and can accommodate a variety of lifestyle. The dining room can be an extension of the kitchen, a zone within a large living room, or a separate room, organized around the specific rituals of enjoying a meal. Regardless of the configuration, the dining room should be immediately adjacent to the kitchen work areas for easy delivery and cleanup of meals.

Location (Fig 9) : The living room should be centrally located. It should be adjacent to the outside entrance, but the entrance should not lead directly into the living room. In smaller residences the entrance may open into the living room, but whenever possible this arrangement is to be avoided. The living room should not be a traffic access to the sleeping and service area of the house. Since the living room and dining room function together, the living room should also be adjacent to the dining room.

D Dining room : Configuration of the dining room is predicated on the size and shape of the dining table,. Otherwise, the dining room allows for a great deal of design flexibility. The dining room can be an extension of the kitchen, a zone within a variety room, or a separate room organized around the specific rituals of enjoying a meal. Regardless of the configuration, the dining room should be immediately adjacent to the kitchen work areas for easy delivery and cleanup of meals.

Place settings (Fig 10) : The dimensions of a dining table relate directly to the area required for a place setting. The approximate area of a place setting is 24 inches (610mm) wide by 15 inches (381mm) deep. Although the standard dimension for a placemat is 18 inches (457mm) across, additional area is allocated for serving dishes, wine bottles, and elbow room.

Dining tables (Fig 11) : The average table manufacture allows 24 inches (610mm) per person: however, other elements must be considered when selecting the right table for a specific number of guests. For instance, a dining, chair with arms increases the amount of space required for an individual by 4 inches (102mm) on average. The location of table legs may also determine the number of people that can sit comfortably at a table. A variety of table configurations are shown here.

Dining room layouts : The size and shape of a room can be help to determine the best table configuration for a specific situation. The diagrams that follow look at

dining rooms combined with a living room or kitchen as well as dining rooms of minimal dimensions. In addition to tables and loose furniture consideration of the ambience of a room by including adjustable lighting above the table and near the serving area is required.

Fig 9

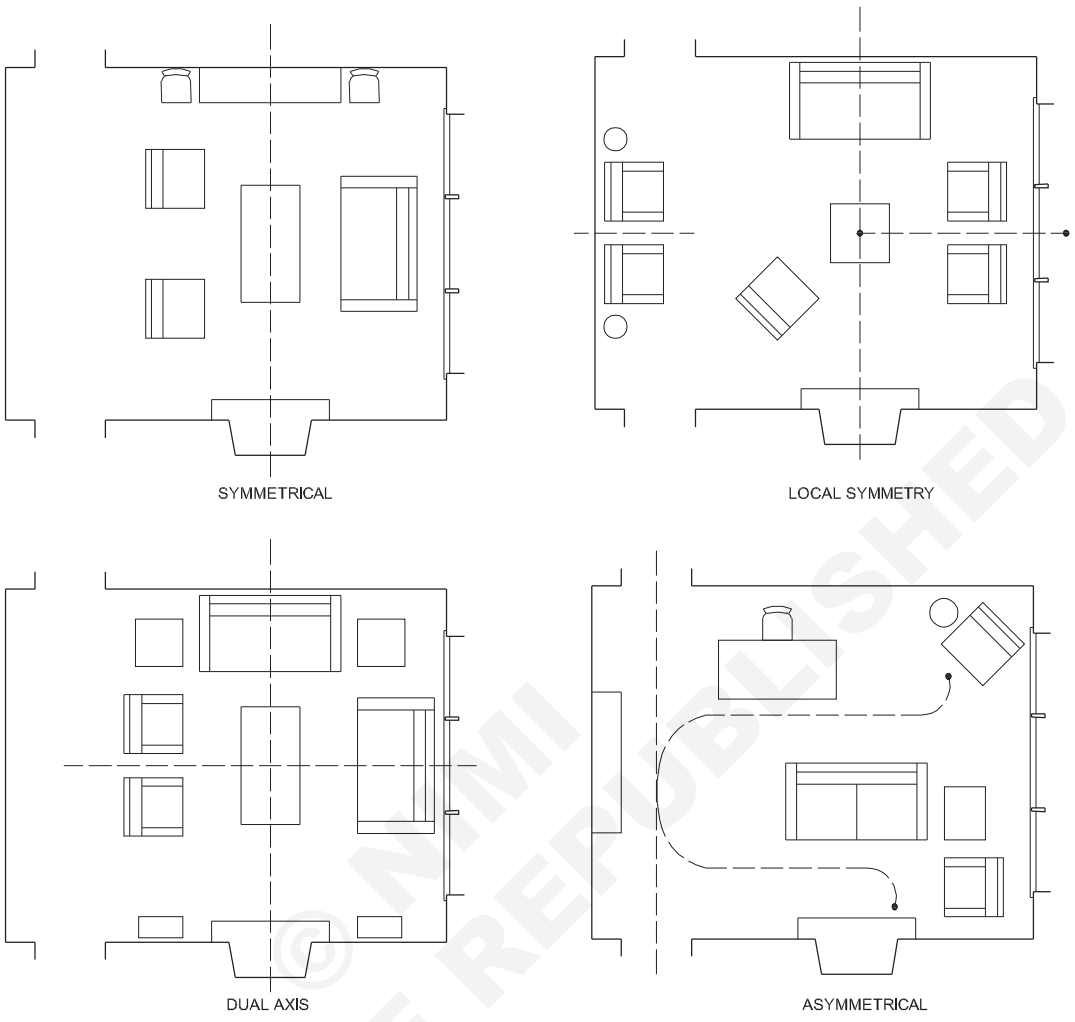
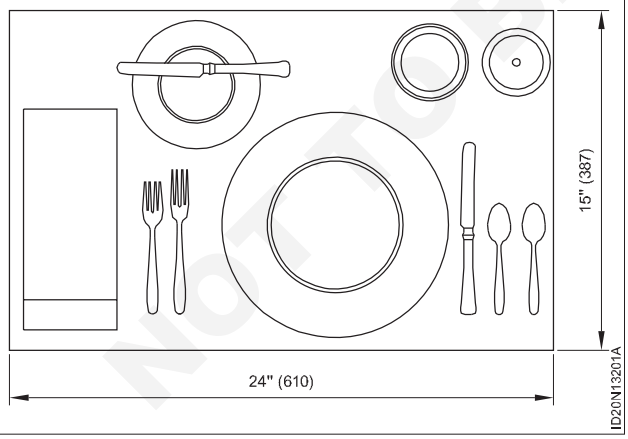


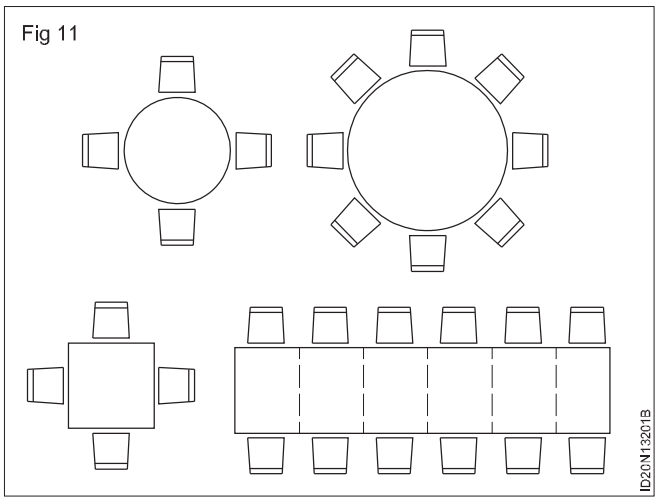
Fig 10



1 **Combined dining and kitchen (Fig 12) :** Kitchens with an eat-in dining table require additional space adjacent to the work zones.

Combined dining and living room (Fig 13) : When space is at a premium, combining the dining and living rooms may be better than isolating them into separate smaller rooms.

Fig 11



Minimal dining room: Rectangular table (Fig 14) : The minimum size of a dining room is based on the size of a rectangular table with 36 inches (914mm) of clearance on all four sides.

Minimal dining room: Round table (Fig 15) : A round table in a square room allows space for cupboards or built-in cabins in the corners.

Fig 12

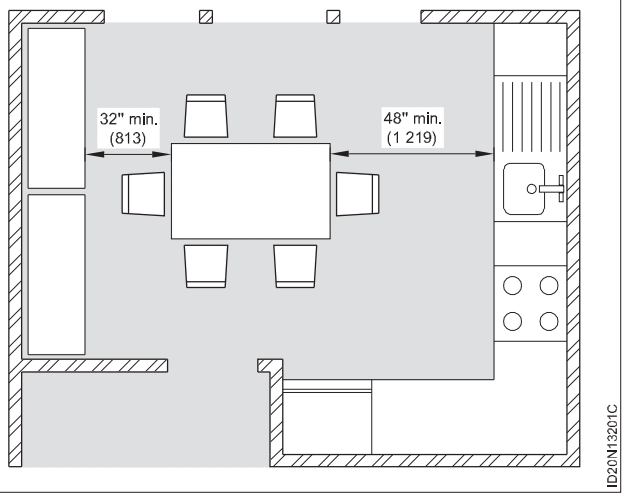


Fig 13

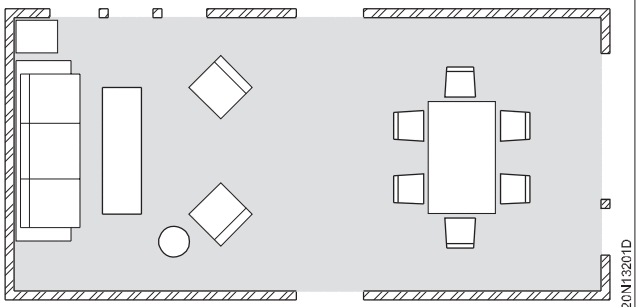
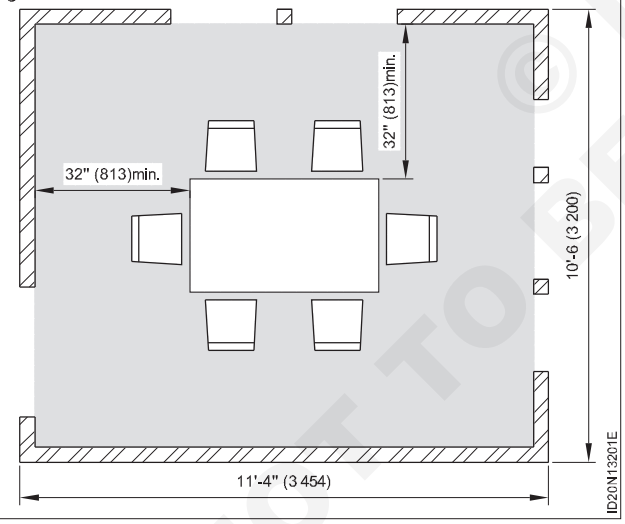


Fig 14



Dining Room with Additional Furniture (Fig 16) : An ideal dining room allows space for two additional chairs and a buffet table in the room.

E Kitchens : The kitchen is the most complex space in the house to design because of appliances, equipment. working surfaces, and storage spaces must be carefully organized into a visually coherent and functional whole. To ensure a smoothly functioning kitchen for more than one occupant. It is necessary to synthesize a wide range of working and circulation scenario. Fundamental to kitchen planning is the placement of three elements: the refrigerator, the sink, and the stove. These elements define the preparation zone, the washing zone, and the cooking zone. Together, the zones define the three points of the "working triangle". In addition to work straight the countless number of kitchen gadgets, dishes, and other accessories that are found in the contemporary kitchen are to be considered.

Fig 15

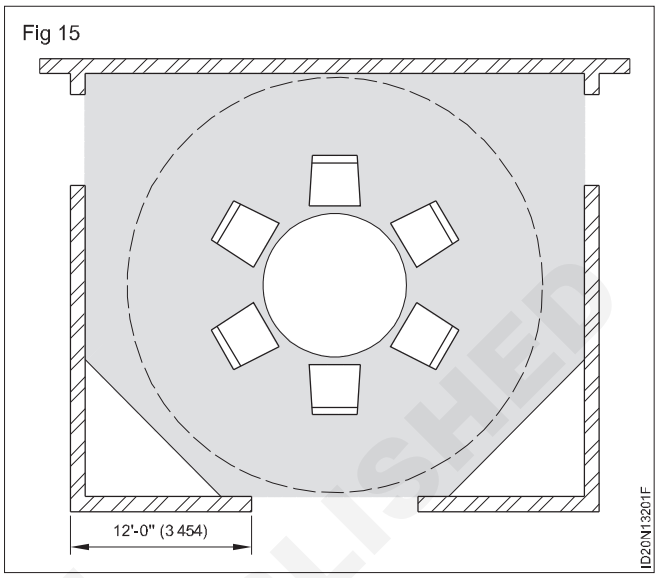
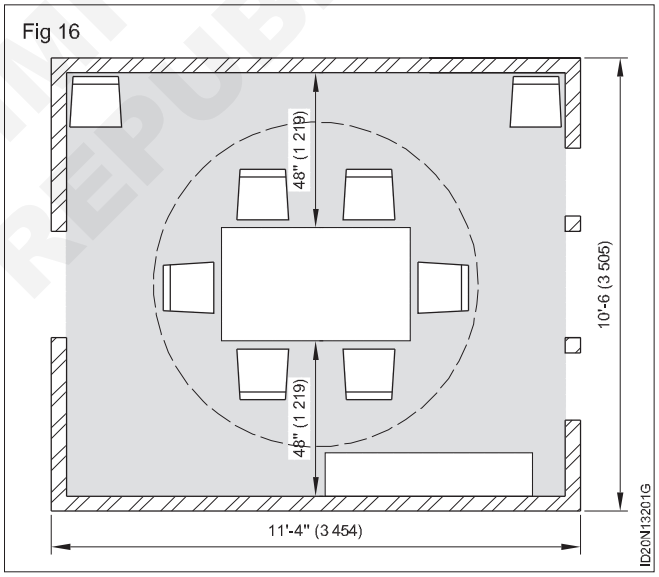


Fig 16



Working triangle (Fig 17) : The ideal total length of the segments that comprise the working triangle is 12 to 22 feet (3 658 to 6 705mm). The layouts that follow describe how the working triangle might be best arranged for the size and shape of a particular room.

Kitchen layouts

a Single-Wall kitchen (Fig 18) : The simplest kitchen organization is a single row of appliances and counter space arranged against a wall. This layout is ideal for long narrow rooms or one wall of a studio apartment where the kitchen can either be screened off or made the central focus of the space. The most practical plan should include counter space on both sides of each major appliance. The refrigerator should be placed at one end of the kitchen wall since it only needs counter

space to one side remember to specify a refrigerator with doors that open in the direcion of the adjacent counter space.

Fig 17

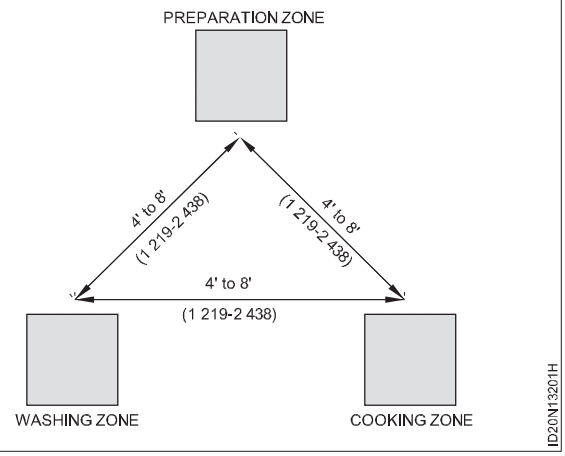
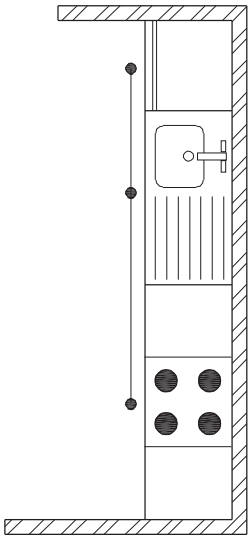


Fig 18



b Galley Kitchen (Fig 19) : A galley kitchen has two parallel runs of counters. The sink, dishwasher, and stove should be located on the same side of the kitchen (cooking and washing zones) and the refrigerator (the preparation zone) should be located on the opposite wall. The counters should be at least 4 feet (1 219mm) apart to provide adequate room for more than one cook; if the kitchen is designed for only one cook, the space between counters can be reduced to 3 feet (914mm). This layout is not recommended if other rooms are accessed through the kitchen.

c L-shaped or U-shaped kitchens (Fig 20) : In these layouts, the counters and appliances are organized around two or three walls. This arrangement can work in either small or large spaces; however, in larger rooms, the working triangle should be kept within the optimal range of 12 to 22 feet (3 658 to 6 705mm). Often in these arrangements, one leg of the L or the U forms a counter, which is ideal for casual meals. In this scenario, It is best to design a higher counter to separate the cooking zone from the eating zone.

Fig 19

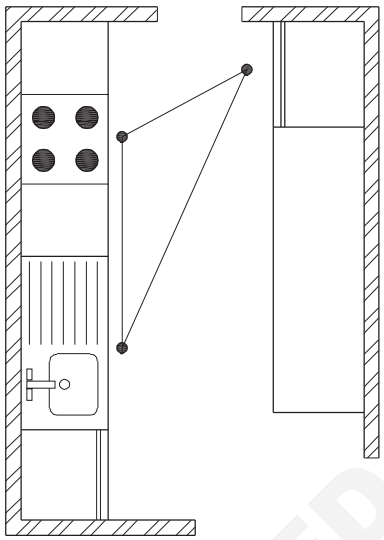
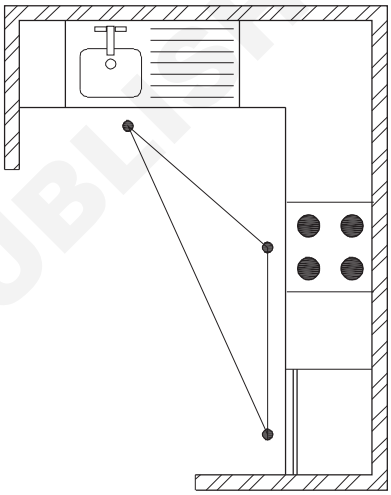


Fig 20



d Island kitchen (Fig 21) : A central workstation provides extra space for performing various culinary tasks. Depending on the preferences of the cook, the island can be designed for either preparing or cooking a meal. Of all the layouts, this arrangement encourages the most socializing in the kitchen. It is best used in large rooms that allow enough space between counters and island.

Developing the kitchen plan (Fig 22) : Determining kitchen location and the space needed

Locate the kitchen to avoid general traffic through its work area and to be convenient to the dining and living areas of the house. Here are some other things that you need to consider when choosing the kitchen location.

- Convenience to yard or outside work area.
- Need for window to look out at yard or work area, for instance, watch small children.
- Convenience for unloading groceries and disposal of garbage, trash and recyclable.
- Accessibility to an exterior door.

Fig 21

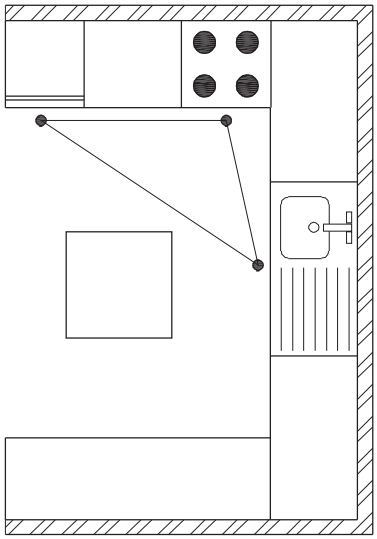


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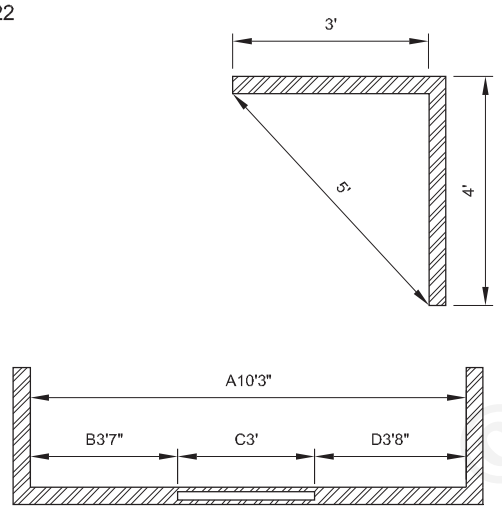
Fig 22



A.FROM WALL TO WALL
B.FROM COMER TO OUTSIDE TRIM OF WINDOW
C.OUTSIDE WINDOW TRIM TO OUTSIDE WINDOW TRIM
D.OUTSIDE TRIM OF WINDOW OT COMER

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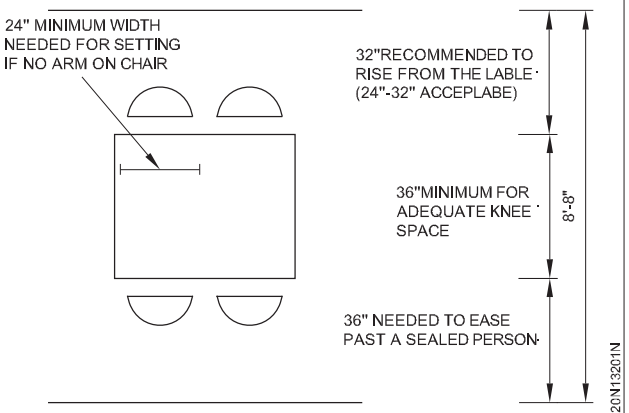
Measuring and scale drawing : Measure the kitchen space and make a scale drawing of the room. Draw in all windows and doors and note the direction of the door swing and the room or area into which the door opens. Draw in any chimneys, radiators, air ducts in walls, location of water supply, drainage pipes and vents, gas pipes, and electrical outlets, Indicate wall thickness and whether interior walls are load-bearing.

Testing possible kitchen arrangements : The actual arrangement depends greatly on the room dimensions and the door and window placement. Changing the location of doors or windows may be necessary for a more efficient arrangement.

Work centers (Fig 23) : Group other key kitchen functions into work centers. Locate the baking supplies no the oven, the clean-up materials near the sink and snack items near the microwave. The preparation center should be next to a water source. If desired, plan for counter or table space for eating.

Fig 23



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The work areas should not be split by traffic. Normally most walking during meal preparation is between the sink and the range top, There is also a lot of walking between the preparation center and the sink and between the preparation center and the refrigerator. Entry or appliance doors should not interfere with work centers.

Measure the distance between the sink, range or cooktop, and refrigerator. This distance is called the work triangle and should be not more than 26 feet. No leg of the work triangle should be less than 4 feet or more than 9 feet. A work triangle of less than 12 feet will not provide enough counter and storage space.

Planning the work space, storage and clearance space

Work Space

Counter surface recommendations : The total counter surface frontage should be at least 1.32" (11') for kitchens larger than 150 square feet, it should be 198" (16'6"). The standard depth of counter is 25" (2'1) but overhangs the base cabinet by one inch. Minimum counter depth should be at least 16" (1.4). The height of the counter should be 3" below the elbow height of the user; lower for tasks that require preparation such as kneading, standard counter height is 36(3'). but a 30 inch (2'6") high work surface is recommended for seated workers.

Sinks : A primary sink should have 24" (2') on one side and 18" (1.6) on the other side. A second sink should have 18"(1.6) on one side and 3" on the other side. A sink should never be placed closer than 3" to the inside corner of a countertop.

Ranges and built-in cook tops : A range or built-in cook top should have 15" (1.3") of counter on one side, 9" on the other side, or 3" if enclosed by and end wall protected by a flame retardant surface. If an operable window must be behind a range, place it no closer than 3" behind and 24" (2') above the cooking surface.

Built-in ovens : A built-in oven should have 15" (1.3") of counter no further than 48" (4') away (if on an island counter). The counter must be adjacent to the appliance to meet universal design guidelines.

Microwaves : A microwave should have 15" (1'3") of counter above, below or adjacent to it.

Refrigerators : A top or bottom freezer refrigerator should have 15" (1'.3") of counter on the latch side and be no further than 48" (4') from counter. A die-by-side refrigerator should have 15" (1'3") of counter on either side, and be no more than 48" away from counter. Counter must be adjacent to the appliance to meet universal design guidelines.

Preparation work space : It should be 36" (3') per person in most situation. For instance, for two people working simultaneously, two 36" work areas are needed, either side-by-side or in two separate areas of the kitchen.

Storage space

Cabinets : Standard wall cabinets are 12" (1') deep, and can range from 12" (1') to 33" (2'9") in height (30" 2'6") is common. Base cabinets are typically 24" (2') deep and 30-36" (2'6"-3') in height the counter on top brings the overall height to 36" (3') . The wall cabinet should be 24 to 30 inches above a sink.

The minimum total wall cabinet frontage recommended for a kitchen is 144" (12"). For kitchens larger the 150 square feet, it is 186" (15'6"). Wall cabinets installed 15" (1'3") to 18" (1'6") above countertop must be atleast 12" (1') deep and 30" (2.6") high and have adjustable shelving to be included in the frontage calculation.

The minimum total base cabinet frontage recommended is 156" (13").For kitchens larger than 150 square feet it should be 192" (16'). Functional base corner storage, such as lazy Susan or pie-cut cabinets, should be included if the kitchen has useable corner areas. Storage space should be arranged so that frequently used items are stored where they are first used and are easily accessible. Separate waste receptacles for garbage and recyclables are needed.

Clearance space : Adequate clearance space is needed so that cabinets and appliances can be opened and are accessible for work. Crowded plans create unsafe conditions. Because of the countertop overhang these clearance measurements are taken at the counter front, not the cabinet face. Kitchen professionals should make sure that your plan meets the industry space recommendations discussed below.

- Doors should not be placed closer than 30 inches. from the corner if cabinets are to be extended to the corner.
- Windows should not be placed closer than 1.2-3/4 inches from the corner if wall cabinets are to be extended to the corner.
- Clearance space between counter fronts above base cabinets should be at least 42 inches for two persons the clearance should be 48 to 60 inches for wheelchair users at least 60 inches is recommended for turning. Clearance space for walkway between the front of one counter and the side of another is 36 inches.
- Corner to corner clearance space between appliances or counters at right angles to each other is a minimum of 32 inches.
- Clearance must be provided for access to appliance and work spaces located at inside corners of cabinet units the corner is 2.1 inches and the minimum is 1.2 inches.
- Thirty - six inches on each side of the wall is needed for a lazy Susan cabinet.
- The microwave appliance should be on a level that is atleast 3 inches below the user's shoulders. Elbow height plus or minus 6 inches is the most convenient height for the user.

Kitchen zone

Washing zone : The washing zone is primarily up of the sink and dishwasher. Ideally, the sink has two compartments for washing and rinsing. The dishwasher should be placed immediately adjacent to the sink but carefully located so that there is enough room to wash dishes in the sink while the dishwasher is open. If the kitchen does not have a dishwasher, a drying rack should be located above the counter so that it does not take up official counter space.

It is also important to have a waste bin close to the sink for disposing of trash prior to washing dishes. Trash receptacles are often located behind a cabinet door and underneath the sink to avoid visual clutter. Lay out the cabinet for the trash can so that the cabinet door, when open, does not block the open dishwasher. To avoid this conflict, incorporate the trash cabinet in the opposite side of the sink from the dishwasher.

Preparation zone : The preparation zone consists of the refrigerator and an adjacent counter-height workspace for preparing food. The refrigerator should be placed in close proximity to the pantry so that perishable and nonperishable foods are both easily accessible from the food preparation workspace. There are many refrigerator/ freezer combinations, each suitable for particular spaces and types of users. The size of the refrigerator should be directly proportional to the size of the kitchen as shown in table:

Different types of tasks are best performed on different types of surfaces. For instance, marble slabs are best for rolling out pastries, while wood counters are best for chopping. These surfaces can be incorporated into the countertops or not, depending on the size of kitchen, the preferences of the cook, and the budget. Other common surfaces include granite, engineered quartz, concrete, stainless steel, wood, tile, acrylic surfacing and plastic laminate.

Cooking zone : The cooking zone consists of the stove or a combination of a cooktop and wall oven, In smaller kitchens, a stove is the most efficient choice. In larger kitchens, a separate cooktop and wall oven is more desirable, In either arrangement, there must be sufficient heat-resistant counter space on both sides of the cooktop. Pots and pans should also be stored immediately adjacent for easy access while cooking. A minimum aisle clearance of 36 inches (914mm) is required in front of the cook top.

It is important to select the appropriate type of cooktop ventilation system: either a system that recycles air through a charcoal filter or a system that removes smoke through a duct vented to an exterior wall. Ventilating exhaust directly to the exterior is preferred but may not be practical in multifamily residential buildings.

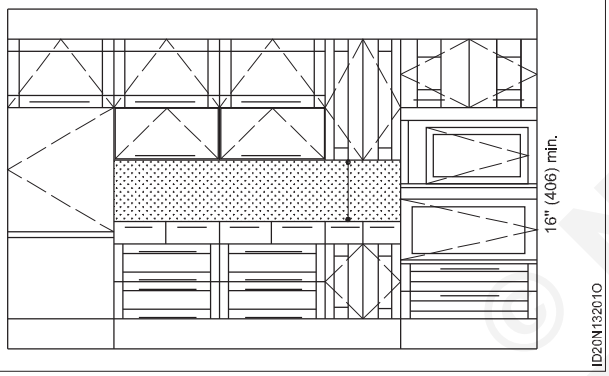
Standard Dimensions

Double Sink	28”-54” (711-1 372)mm	14”-21” (356-533)mm	7”-8” (178-203)mm
Sink	14”-32” (356-813)mm	14”-21” (356-533)mm	7”-8” (178-203)mm
Dishwasher	24” (610)mm	24”-25” (610-635)mm	33”-35” (838-889)mm
Freezer	29”-36” (787-914)mm	25”-33” (635-838)mm	66”-84” (1 676-2 134)mm

Cooktop	24”-37” (610-940)mm	21”-27” (533-686)mm	3”-8” (76-203)mm
Range	21”-40”(533-1 016)mm	24”-28” (610-711)mm	36”-46” (914-1168)mm
Dishwasher	22” -30” (559-762)mm	22”-24” (559-610)mm	28”-48”(711-1 219)mm

Vertical considerations (Fig 24)

Fig 24



Standard kitchen appliances are 35 inches (889 mm) high and typically have adjusted feet to help align them with adjacent countertops. Most appliance have a built-in toe space that ranges from 2 to 4 inches (51 to 102 mm) from the floor to accommodate the front of the feet these basic dimensions in mind.

A minimum clear vertical height of 16 inches (1406 mm) is recommended between the work surface and bottom of wall cabinets. On upper cabinets, doors should have 180-degree hinges so that no one bangs their head on the doors when open. Lift-up doors can also solve this problem.

F Storage area

Storage Facilities (Fig 25) : Storage facilities, equipment, and furniture used for storage within the various rooms of the house are divided into the following categories.

Wardrobe Closets (Fig 26) : A wardrobe closet is a shallow clothes closet built into the wall. The minimum depth for the wardrobe is 24” (610 mm). If this closet is more than 30” (760 mm) deep, you will be unable to reach the back of the closet. Swinging or sliding doors should expose all parts of the closet to your reach. A disadvantage of the wardrobe closet is the amount of wall space needed for the doors.

Walk-In - Closets : Walk - in closets are closets large enough to walk into. The area needed for this type of closet is an area equal to the amount of space needed to hand clothes plus enough space to walk and turn. Although some area is wasted in the passage, the use of the walk - in closet does provide more wall area for furniture placement, since only one door is needed.

Wall Closets : A wall closet is a shallow closet in the wall holding cupboards, shelves, and drawers. Wall closets are normally 18” (460 mm) deep, since this size proves access to all stores items without using an excessive amount of floor area is an example of wall storage with wardrobe closets on each side.

Circulation of interior spaces (bubble diagram)

Objectives: At the end of this lesson you shall be able to
- **explain circulation of interior spaces in terms of zones and furniture’s.**

Circulation factors for planning interiors (Fig 1)

a Entry point b Main space

c Clearances d Exit points

Residential zones (Fig 2) : Social: public area and most used area of the home. Comprising of the entry, family room, living room, media room, game room etc.

Private: Areas such as the bedroom, bathrooms etc.

Work: Kitchen, laundry, HVAC, storage, office, etc.

Most of these areas should not be in direct view of guests (except the kitchen).

Fig 25

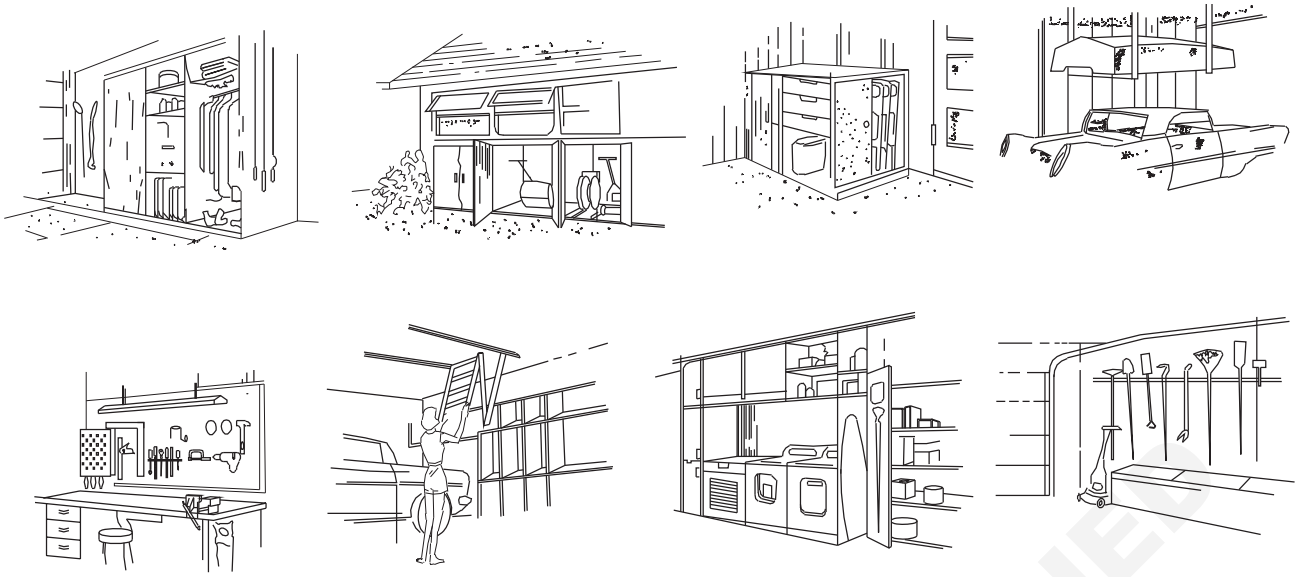


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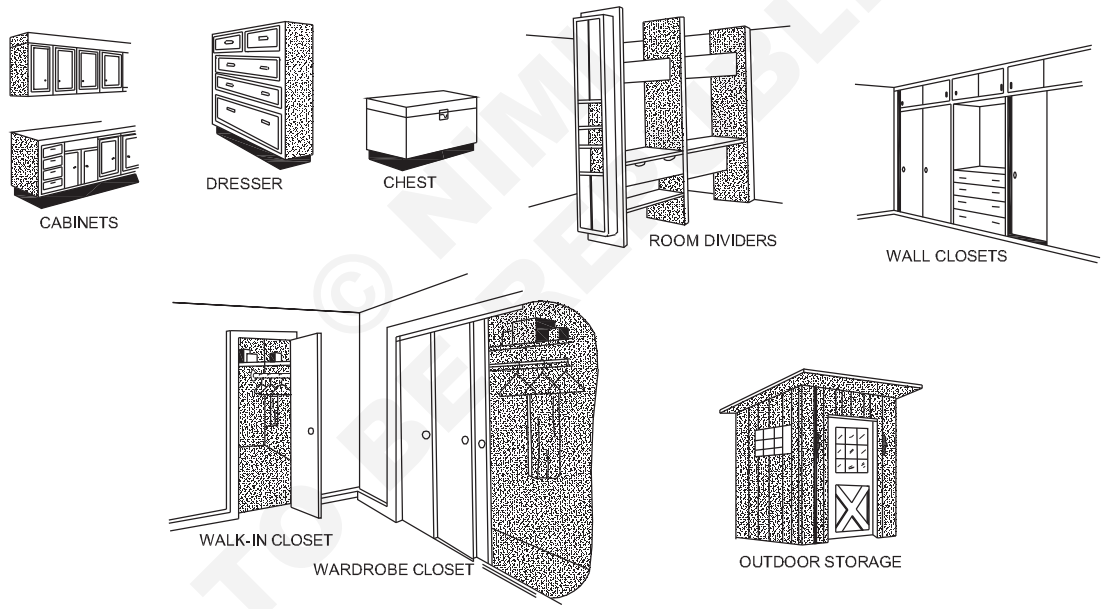
Fig 26



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Circulation principles for planning interiors (Fig 3)

Shape & Proportion (Fig 4)

- Not many shapes and proportions will produce a good room.
- Rectangular rooms are the most common.
- Avoid overly long and narrow rooms.
- If the length of a room exceed its width, the proportion becomes uncomfortably narrow in relation to its length.

Circulation and Inter - circulation : Circulation means path, approach for movement from one space to other space and the various movement with respect to various functions inside the space termed as inter - circulation. For example, water makes its own way of flow but it may or may not be useful to use. Therefore we make certain path and its flow, according to our use.

Man himself makes his way for his approach and he has got a tendency to adopt short way, for example, in an open field or in the hilly area, we can get lot of such paths, known as Pagdandies. It is for the planner to provide such paths which may be useful to human activities, various functions, space and natural surroundings.

Circulation means approach from one place to another. It must be easy and comfortable. At the same time it should neither affect the efficiency of the function nor should be harmful to others. So following points must be considered along with circulation:

1 Space which is going to be used, should be minimum possible i.e., economy in space

2 Circulation must be easy

Fig 1

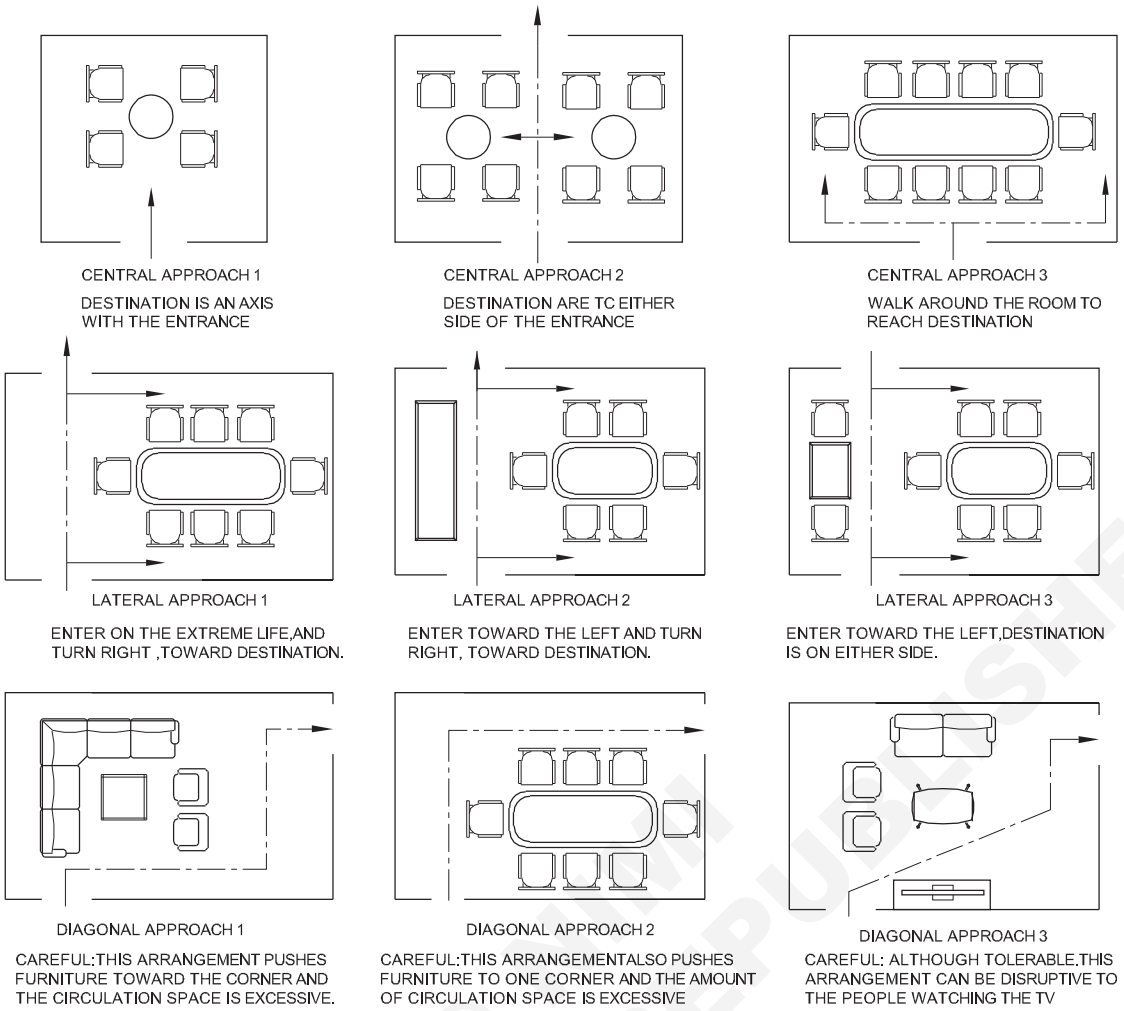


Fig 2

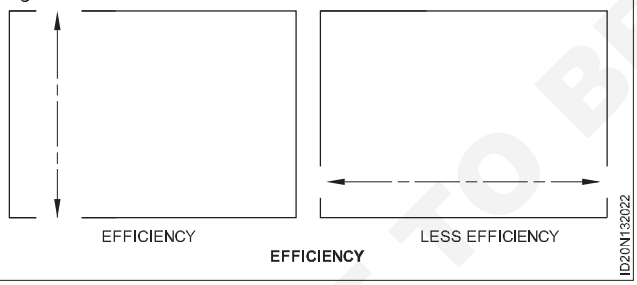
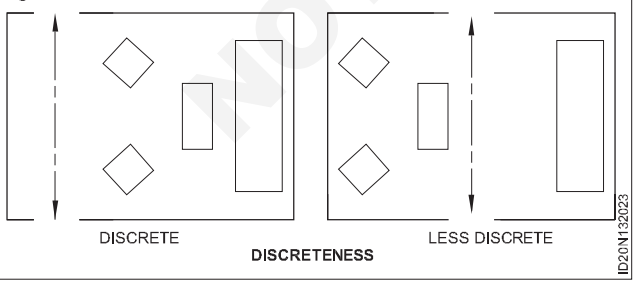


Fig 3



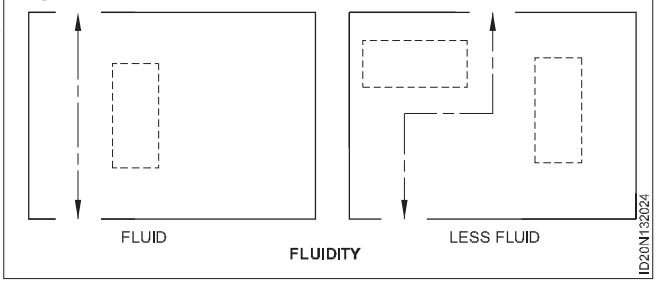
3 It must be comfortable

4 It must be according to the functions

5 It must fulfill all its functions

6 It must have full utility

Fig 4



7 It must be clear and easily approachable

8 It must define its purpose and importance

Importance of circulation in interior decoration : It entirely depends on the planner what type of circulation he is going to provide, for relative functions and actions of man. The circulation is always influenced by time, culture, function and nature of persons, who are going to use it. For example, the main entrance of Fatehpur Sikri which is a huge one with large number of steps, defines the personality and importance of king, i.e., his character and function existing at that time. If this type of entrance is provided in a house of middle class family then it will not be suitable with respect to the function.

Before planning, functions and the circulation have to be studied, so as to decide the circulation area.

In circulation area the following areas are included :

1 Area of the wall which shall not be more than 10%

2 Foyers

3 Corridors

4 Different linking spaces

This circulation area should not be more than 30% to 35% of the total covered area, 30% is the best.

It is always better to make the circulation diagram (circulation diagram is the pattern to show the proper link from one space to another as per their function and uses), before planning. As an example following are various circulation spaces of a small office's requirement.

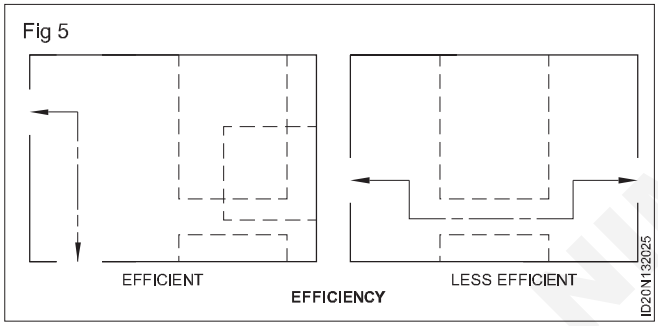
1 Foyer

2 Reception

3 Master chamber

4 P.A Chamber (Fig 5)

Fig 5



5 Steno

6 Toilet

7 General office

Example of various link are as follows :

1 Direct approach from entrance to foyer, then to reception

2 Direct approach for master room from foyer

3 Visitors approach from foyer to reception to p.A or staff has link to master through P.A

4 P.A has direct link to master as well as outsiders

5 Steno has direct link to master only

6 Staff must have direct link from foyer and master and P.A or staff has link to master through P.A

B Factors to be Considered in Selection of Furniture

Factors to be considered in selection of furniture need to be discussed in detail as this once in life - time purchase can be carefully made.

1 Utility : The furniture which you choose should have some use in your home. Every object is designed to suit a particular function or purpose. If you need a piece of furniture then only you should buy. There is no need to crowded your rooms with furniture which have hardly any utility.

2 Beauty : The beauty of line, form and texture is better than decoration placed on it. If the structural design of furniture is well proportioned it would look pleasing. The natural beauty of the grain of wood does not need a lot of decoration. Simplicity is the key to beautiful furniture.

3 Character : The furniture should be chosen keeping in mind the general character of the room. An informal room, for example, should be furnished with furniture which is informal in design. The size, shape and style of furniture should be such that it gives an informal appearance. Natural finishes, horizontal lines, rounded curves etc. give an informal appearance.

4 Convenience : The furniture you choose should be in proportion with the room in which it is going to be placed. In a small room large sofa would look out of place. The furniture should be of convenient height and shape too. An easy chair for study purpose is not convenient to work. It should have a straight backed chair with table of appropriate height.

5 Comfort : Both the design and material used for furniture should be comfortable. It should be of suitable height and width so that you can use it without any strain on your body. A too high chair would leave your feet dangling and a tool deep one would not allow you to sit back comfortably. The fabric used on upholstered furniture should feel good to touch and the softness of bed and sofas should be according to your standards of comfort. The tables should have enough knee room and the storage units should be planned so that heavy things can be placed at level where they would be used and the most frequently used items are within easy reach.

6 Flexibility : The furniture should be chosen keeping in mind its flexibility to use. Multipurpose furniture is the need of the day. The modern homes are becoming smaller day-by-day and furniture which can serve only one purpose would be liability than asset. A sofa -cum -bed or a divan is more practical than only sofa- set.

7 Movability : The furniture should be light in weight and easy to grasp so that you can move it. This is necessary when you want to have a change in furniture arrangement from time to time. For a family who is constantly being transferred from one city to another heavy furniture becomes a liability. The furniture which can be easily moved, is folding type to can be taken up into pieces and joined together easily is more practical.

8 Space : Modern homes have less space therefore furniture which occupies more space then necessary if of use. The distribution of space is very important. If a piece of furniture occupies a certain amount of space it should justify its allocation. Small scale and simple design in furniture is necessary.

9 Harmony : Furniture should harmonize with the other pieces of furniture which are already there is a room, and with the general scheme of decoration. It should harmonize in size, colour and texture.

10 Cost : Check prices at various shops so that you get best item within your budget. The cost of furniture should be seen not only in terms of its initial cost but also its cost of upkeep. The time, cost as well as money costs should be considered. Ease of cleaning is of prime importance for a busy housewife. The carved and attractively finished furniture require a lot of time and effort and should be used where they are not likely to need daily attention or where there is army of staff to care for it.

11 Durability : The physical and psychological durability should be considered. The physical durability is judged on the basis of material used, joints and finishes. The furniture should be made of durable wood, or any other material. It should be properly finished from all sides, i.e back, bottom and inside should also be neatly done. Drawers should slide smoothly. Door should open without much pulling and pushing, and movable or folding parts should be easy to operate. Furniture should stay firm and rigid under pressure. The surface should be smooth and edges be well rounded. The use of screws rather than nails in joints would have better construction. It should not be too delicate in construction. Out door furniture should not be damaged easily by sun or rain.

Psychological durability is concerned with the amount of satisfaction it gives you. Cheap furniture of poor design and material would not give lasting satisfaction. A well proportioned and good quality furniture can give you pleasure throughout your life. The changing needs of family should also be kept in mind, then furniture would last for generations.

Staircase

Objectives: At the end of this lesson you shall be able to
- **define stairs**
- **enumerate on technical terms used in staircase**
- **describe types of staircase**
- **describe R.C.C staircase.**

Definition of stairs : A stair is a system of steps by which people and objects may pass from one level of a building to another".

A stair is to be designed to span large vertical distance by dividing it into smaller vertical distances, called steps.

Requirements of a Good Staircase

1 Stairs should be so located that it is easily accessible from the different rooms of the building.

2 It should have provision for adequate light and proper ventilation.

3 It should have sufficient stair width to accommodate number of persons in peak hours or emergencies. Generally for interior stairs the clear width may be required to be atleast 50 cm is one and two family dwellings, 50 cm is hotels, motels apartment building and industrial buildings and 1.1 m for other type of occupancy.

4 The number of steps in a flight should generally be restricted to a maximum of 12 and minimum of 3.

5 Ample head room should be provided not only to prevent people from injuring their head, but to give a feeling of spaciousness. Vertical clearance should never be loss than 2.15 m.

6 Risers and treads sizes should generally be proportioned from comfort point of view. Treads should be 25 to 32.5 cm wide, exclusive of nosing. Treads less than 25 cm width should have nosing of about 2.5 cm. The most comfortable height of riser is 17.5 cm to 18.5 cm. Generally the following formulae should be used.

   i Product of riser and tread must lie between 400 to 410.

   ii Riser plan tread and twice the riser must lie between 60 cm to 43.5 cm.

   iii Sum of the tread and twice the riser must lie between 60 cm and 64 cm.

7 Stair width depends upon purpose and importance of building. In case of residential building it should be kept as 1 m.

8 The number of stairways required should be controlled by the maximum floor area contributory to a stairway. The number of persons that may be served by stairs per 55 cm unit of stair width, should be 15 for such buildings as hospitals and nursing homes, 30 for other institutional and residential buildings, 45 for storage buildings,60 for mercantile, business, educational and industrial buildings, theatres and restaurants, so for church concert halls and museums and 320 for stadium and amusement structures.

9 The minimum width landing should be equal to the width of the stairs.

10 The maximum and minimum pitch should be 40° and 25° respectively in any type of stairs.

11 The winders should be provided at the lower end of the flight only when it is essential. Generally the use of winders in a staircase should be avoided.

12 In open well stairs, balustrades should be provided to avoid accidents.

13 The live loads to be considered on stairs have been stipulated by IS: 875-1964. The stairs and landings should be designed for a live load of 300 kg/m2 in buildings where there are no possibilities of overcrowding. In case of public buildings and warehouses, where overcrowding is likely, live load may be taken as 500 kg/m2.

14 Railings should be designed for a horizontal force of 55 kg/m and vertical force of 70 kg/m applied at top of rail. But neither force should be taken as less than 90 kg.

Fig 1 a, b showing different components of staircase.

Basic Terminology of staircase

1 Baluster : It is vertical member of wood or metal supporting the hand rail.

2 Handrail : The inclined rail over the string is known as a handrail.

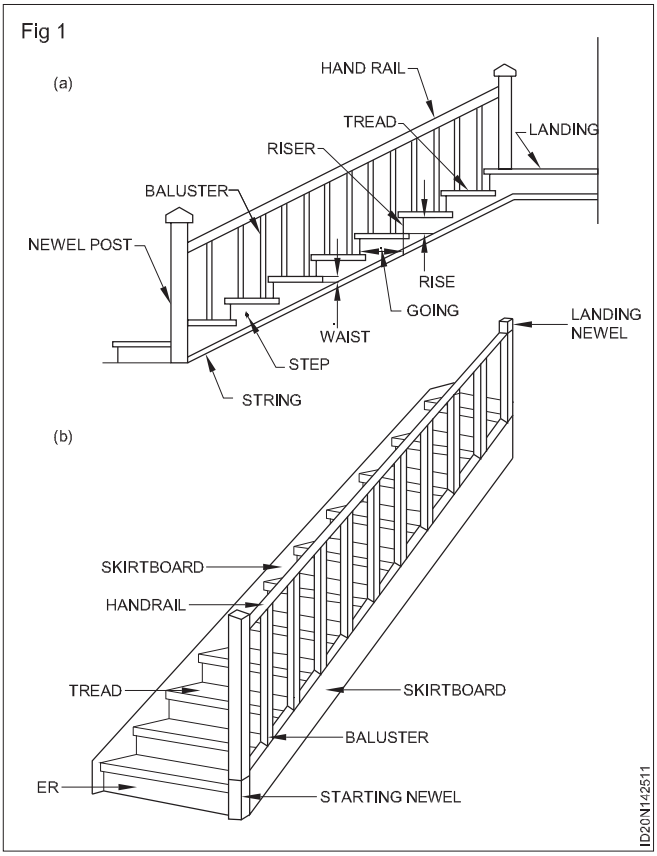
3 Newel post : This is the vertical member which placed at the ends of flights to connect hand rail.

4 Soffit : It is the underside of a stair.

5 Waist : The thickness of structural stab in case of an R.C.C stair is known as waist.

6 Nosing : It is the projecting part of the tread beyond the face of the riser.

7 Scotia : It is a moulding provided under the nosing to improve the elevation of the step.



8 Step : It is a portion of stair which permits ascent and descent. It is comprised of a tread and riser.

9 Tread : It is the upper horizontal portion of a step upon which the feet is placed while ascending or descending.

10 Rise : It is the vertical distance between two successive tread faces.

11 Going : It is the horizontal distance between two successive riser faces.

12 Flight : A series of steps without any platform, break or landing in their direction.

13 Landing : It is the level platform at the top or bottom of a flight between the floors. Generally, alter 10 to 12 steps a landing is to provided. A person can comfortably walk 10-12 steps without getting haunted. A landing can be given after a maximum of 16 steps and not more than that.

14 Run : It is the total length of stairs in a horizontal plane, including landings.

15 Headroom : It is the minimum clear vertical distance between the tread and ceiling.

16 Pitch or Slope : It is the angle which the line of nosing of the stair makes with the horizontal.

17 Riser : It is the vertical portion of a step providing a support to the tread.

18 Line of nosing : It is an imaginary line touching of each tread and is parallel to the slope of the stair.

19 Winders : These are tapering steps which are provided for changing the direction of a stair.

20 Strings or stringers : These are the sloping wooden members which support the steps in a stair. They run along the slope of the stair.

There are two types of string:

i a cut or open string

ii a closed or housed string

In the cut or open string, the upper edge is cut away to receive the ends of steps.

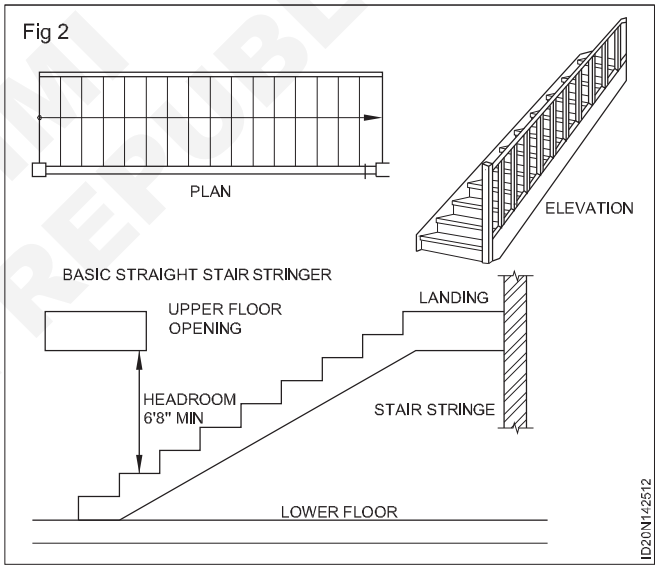
In the closed or housed string, the ends of steps are housed between straight parallel edges of the string.

21 Balustrade or Barrister : The combined frame work of hand rail and balusters is known as the balustrade or barrister.

22 Walking line : The approximate line of movement of people on a stair during ascending or descending is known as a walking line and it is situated at a distance of about 450 mm from the centre of handrail.

23 Final : The decorative cap to the top of a newel post of a stair.

Types of staircase (Fig 2)



1 Straight Stairs

- All steps lead in one direction.
- Simplest form of stair arrangement.
- It may consist of one or more flights.
- They are used when space available for staircase is long but narrow in width.
- The width and the length of the landings should be equal.

2 Turning Stairs

a Quarter Turn stairs

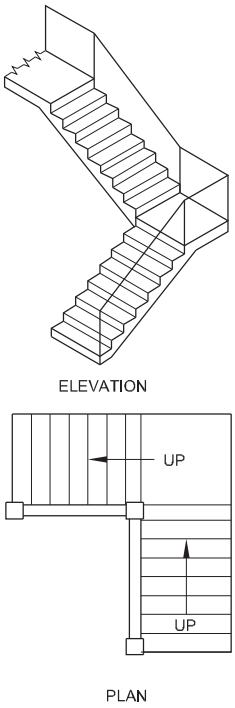
b Half-Turn stairs

c Three Quarter Turn stairs

In case of turning stairs, flights take turn. The types of turning stairs are:

a Quarter turn stairs (Fig 3)

Fig 3



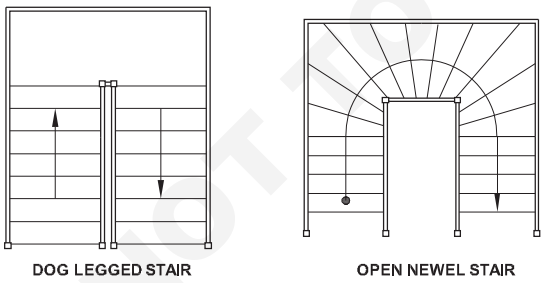
i A stair turning through one right angle is known as Quarter turn stairs shaped.

ii Bifurcated stairs (Fig 4) : These stairs are so arranged that there is a wide flight at the start which is sub divided into narrow flights at the mid-landing. The two narrow flights start from either side of mid landing. Generally these stairs are more suitable for modern public buildings as shown in Figure.

Fig showing plan and elevation of bifurcated staircase.

b Half Turn Stairs (Fig 5) : A stair turning through right angle is known as Half Turn Stairs.

Fig 5



A half turn stair may be of dog-legged type of open newest type.

i Dog-legged stair

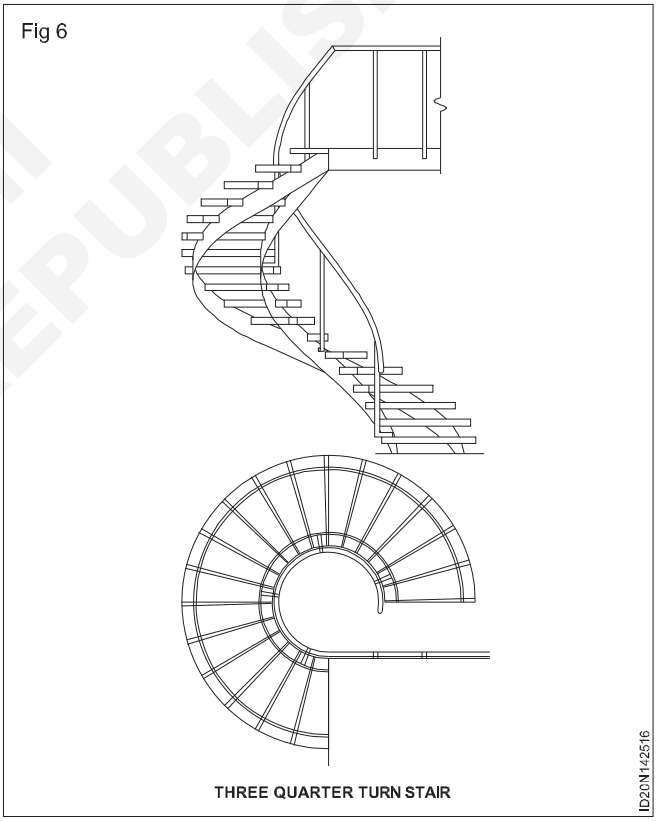
- Two short flights with a half space landing between them.
- In case of dog-legged stair, the flights run in opposite directions and there is no space between them in plan.
- Its name is derived from its appearance in the sectional elevation.
- This stairs are useful where total width of space available for the staircase is equal to twice the width of steps.

ii Open Newel Stair

- Space between the upper and lower flights causes half space landing to be longer.
- In case of open newel stair, there is a well or hole or opening between flights in plan.
- This well may be rectangular or of any geometrical shape and it can be used for fixing lift.
- These staircase are useful where available space for staircase has a width greater than twice the width of steps.

c Three quarter turn stair (Fig 6) : A stair turning through three right angles is known as a three quarter stair.

Fig 6



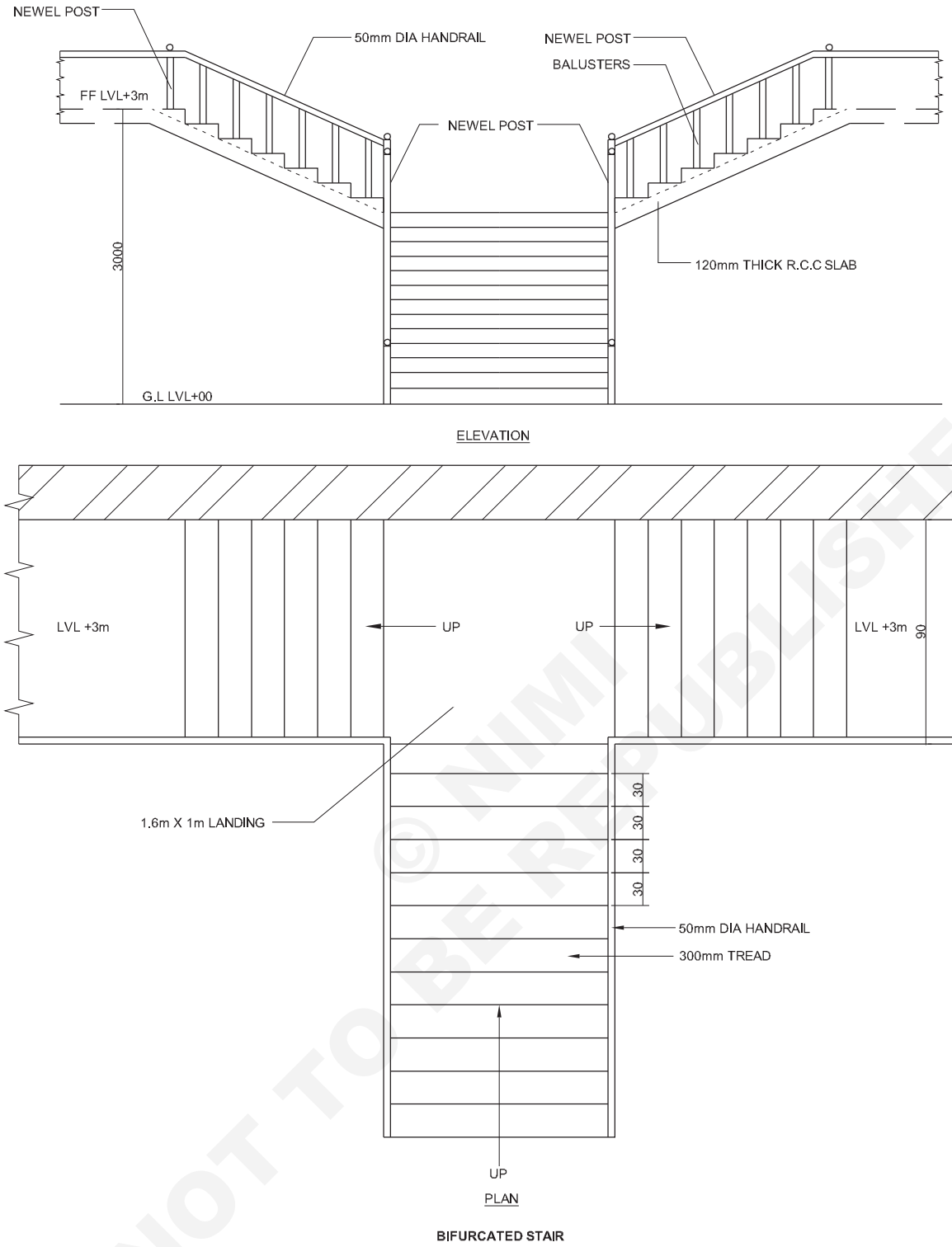
In this case, an open well is formed. This type of stair is used when the length of the staircase is limited and when the vertical distance between the two floor is quite large.

3 Circular or helical or spiral stairs (Fig 7) : The steps radiate from the center and they do not have either any landing or any intermediate newel post

Features

1 Flights consist of winders only and may be continued through any number of turns.

Fig 4



2 May be constructed of a cast iron or mild steel or concrete. Usually its structural design and construction of are complicated in nature.

3 For concrete spiral stairs, the steel reinforcement is heavy and form work is complicated. These make the concrete spiral stairs expensive.

4 The core of spiral stair may be solid or hollow and the stair may be provided with cut or closed strings.

5 The spiral stairs are useful where the space available is limited and where the traffic is less. Eg., shops

6 The treads and riser are supported on the angles which are connected to the stringers.

7 The spiral stairs of cast-iron consist of a cast-iron newel fixed in the centre around which the cast-iron steps are fixed.

Geometrical Stairs (Fig 8)

1 “Continuous stairs that turn or wind about a central well hole which has rounded corners or is circular or elliptical and that have the strings and rails arranged upon geometric principles and running continuously from top to bottom”.

Fig 7

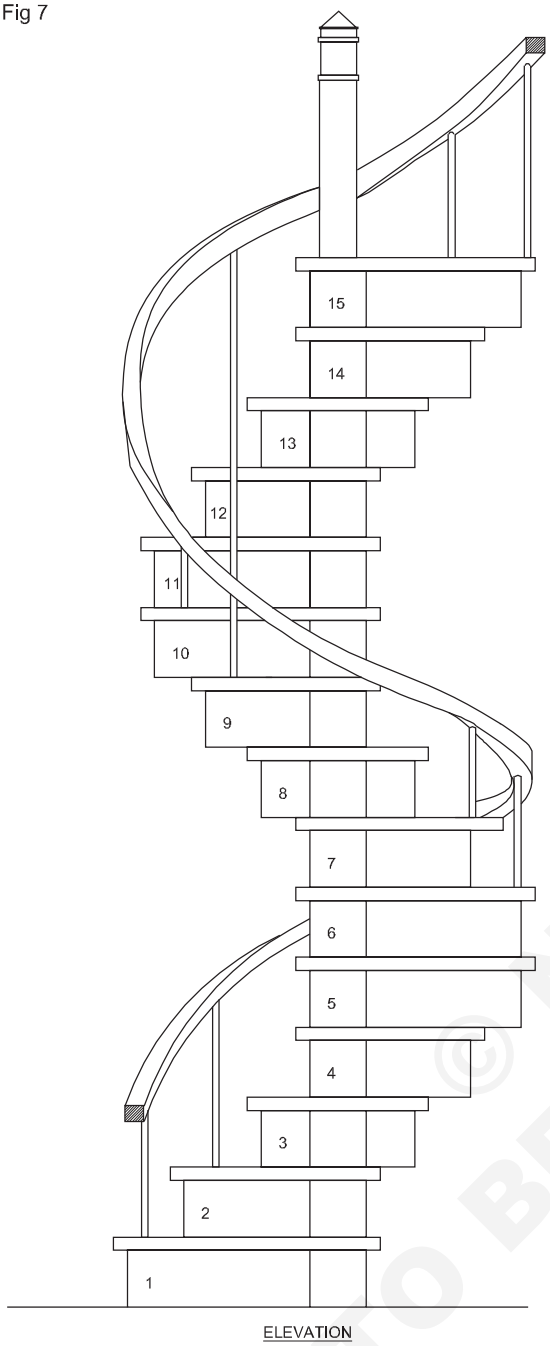
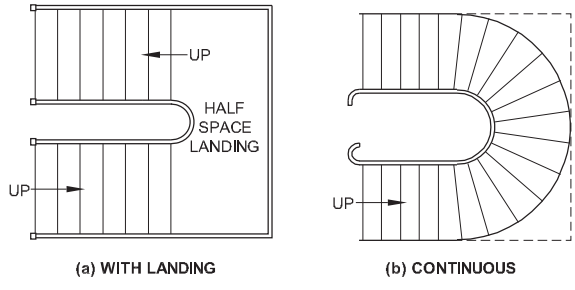


Fig 8



2 Any geometrical shape requires no newel posts.

3 The hand rail continues without interruption and without any angular turns.

4 Its construction requires considerable skill and it is weaker than corresponding open newel stair.

Stairs of different materials

Concrete Stairs : Concrete stairs are becoming very popular these days because of their advantages such as strength, durability and the fire resistance. Moreover, they are constructed in many forms. The plain concrete stairs are used in place of stone stairs these days. They are mainly suited for entranced of the building. The steps are mostly of spandrel type and are supported as in the case of stones stairs. They may be cast in site or recast steps may be used. Reinforced concrete stairs are mostly used at present. The advantages of reinforced concrete stair construction are:

- It can be easily molded into any desired geometrical shape.
- It is more fire resistance.
- It needs less bulky sections so that more are head room is available.
- It is less noisy.
- It has more attractive appearance if suitable finished are used.
- It can be kept clean.

For small building, composite type of stairs envisaged the use of plain concrete and reinforced concrete are used. In such a type, the stringers can be of R.C.C.beams, the top slope being cut in a shape to suit the riser and the treads. The treads are of precast plain concrete slabs and the raiser is of small, recast concrete blocks. One end of the stringer is resting on the base and the other rests on the wall. A precast concrete slab is used as landing the handrails are made of wood and the blusters are steel pipes.

R.C.C Staircase

Introduction : R.C.C. stairs may be the most common stairs widely used than any other types of stair. These stairs can be easily moulded to any desired shape and are better wear and fire resistant. The steps of R.C.C. stairs are made by using ordinary cement concrete. Besides ordinary cement concrete, some other superior finishing

materials are also used such as marble, terrazzo, tiles etc., to give them better appearances.

Features of R.C.C. stairs

The features of R.C.C. stairs are as following:

1 R.C.C. stairs are better fire resistant than any other stairs.

2 They are adequately strong and more durable

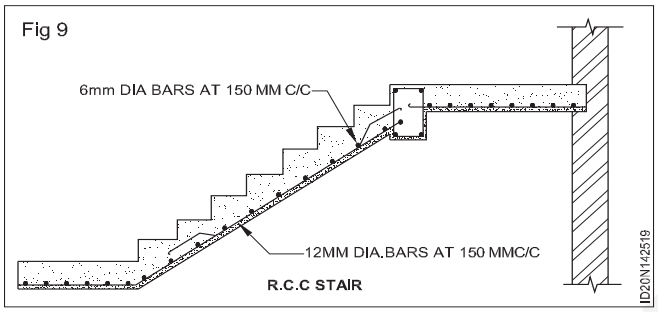
3 The steps are non-slippery

4 They offer better and pleasant appearances

5 The stairs can be designed for greater widths and longer spans.

Types of R.C.C Stair

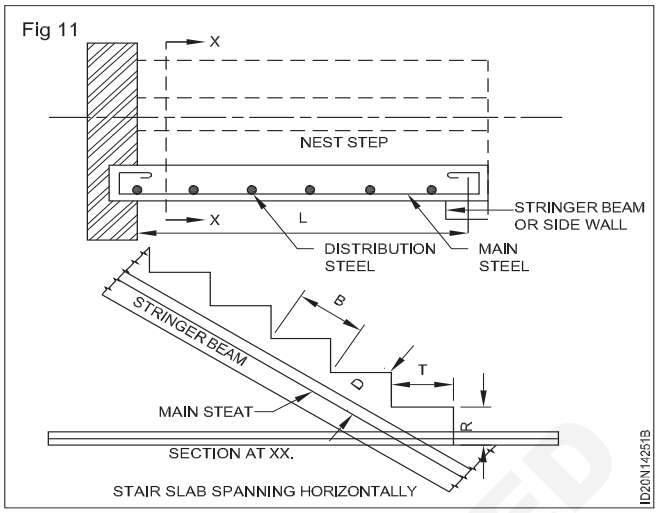
a Single straight flight stairs (Fig 9) : These stairs are simple in design and the flight behave as simple supported slab, spanning from landing to landing.



b Inclined slab stairs with half space landing [stair with slab spanning longitudinally] (Fig 10)

This type of stairs gives more compact plan layout and better circulation than single straight flight stair. The half space or 180° degree landing is introduced at midpoint of the total riser and gives equal flight spans, reducing effective span, hence the landing span crosswise to load bearing wall or beam and the flights span from landing to landing.

c String beam stairs[stair with slab spanning horizontally] (Fig 11)



A stair in which the steps are designed to act as slabs between the two stringers or a side wall and a stringer beam.

d Cantilever staircase (Fig 12) : In which R.C.C steps are cantilevered for the wall. The reinforcement is placed at the top of the thread and the few bars are placed at the bottom of the riser, suitable cover being given.

Precast R.C.C stairs (Fig 13)

- The detail and placing of reinforcement will naturally depend on the design of R.C.C. stair.
- The steps may be cast-in-situ or pre-cast.

Fig 10

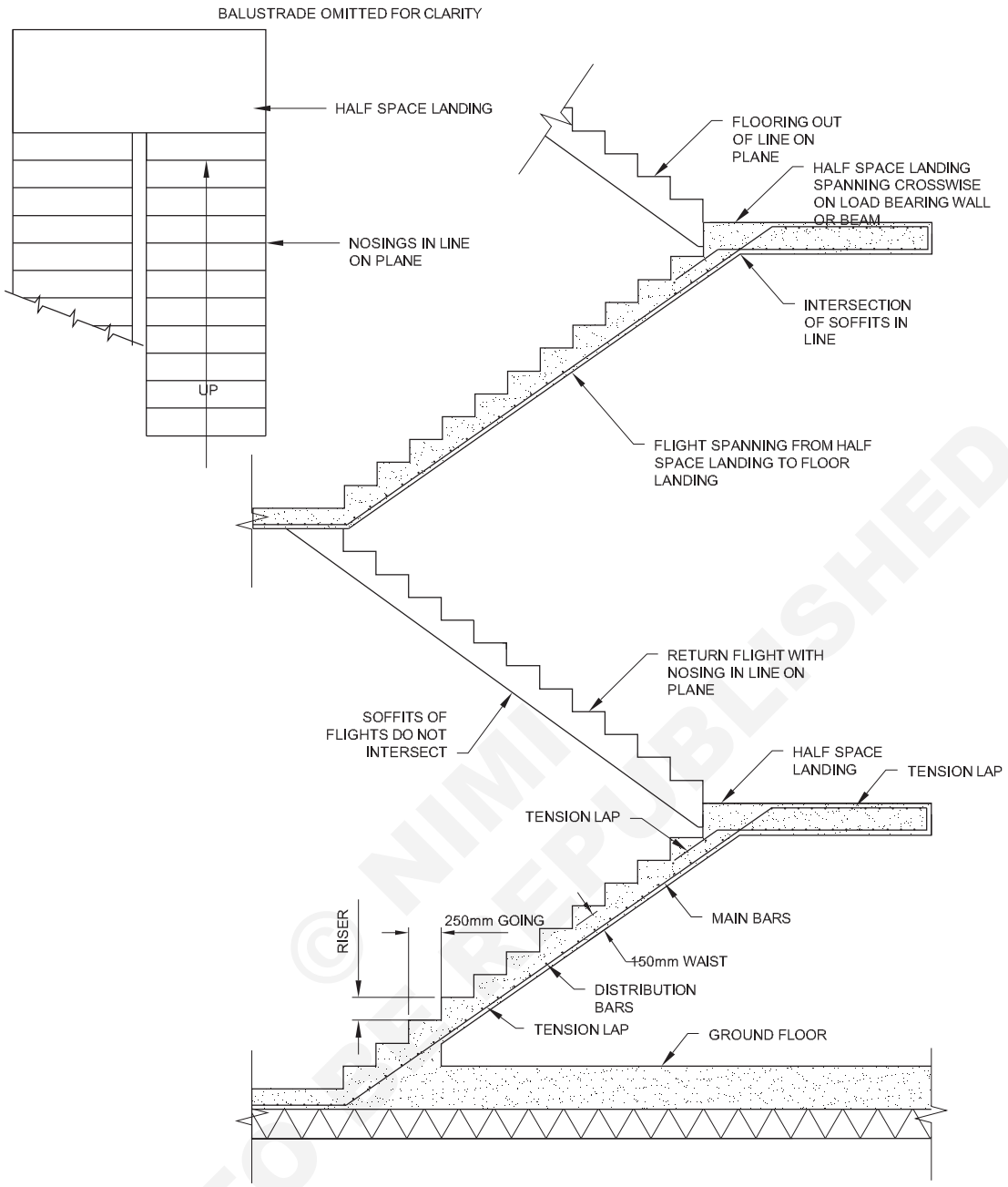


Fig 12

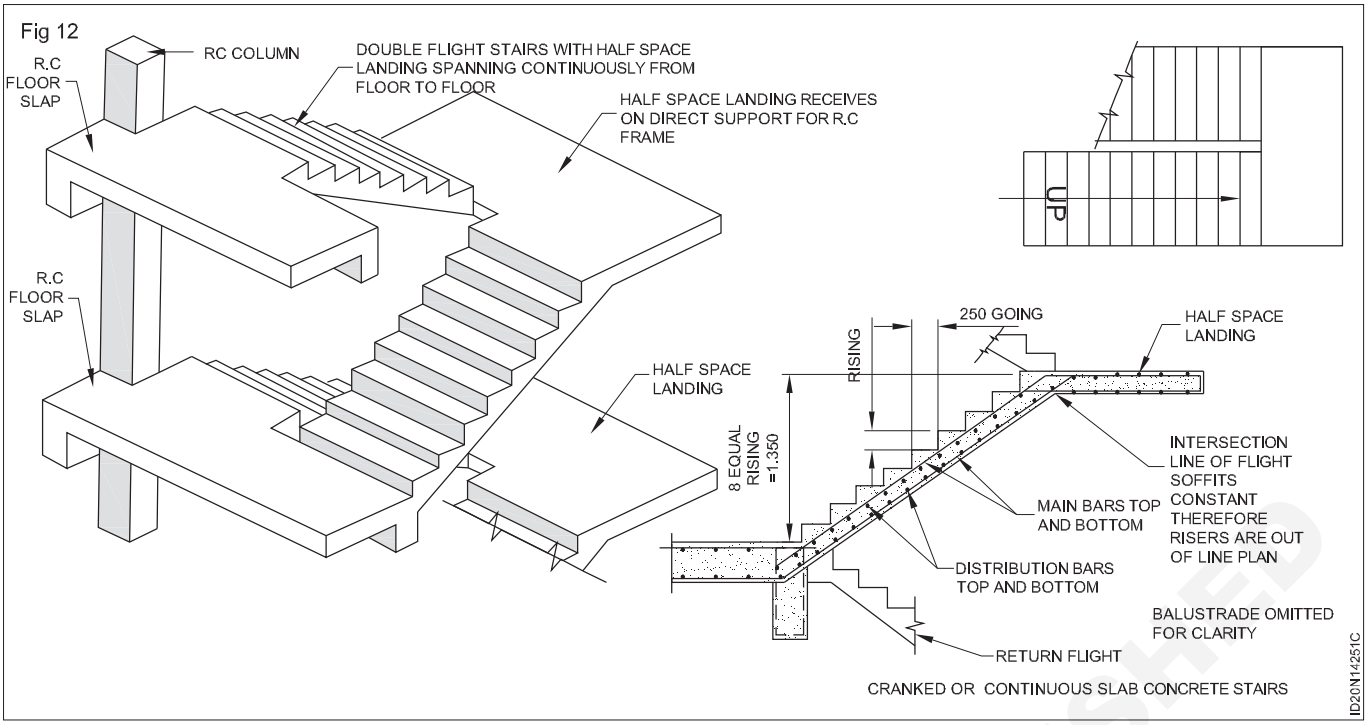
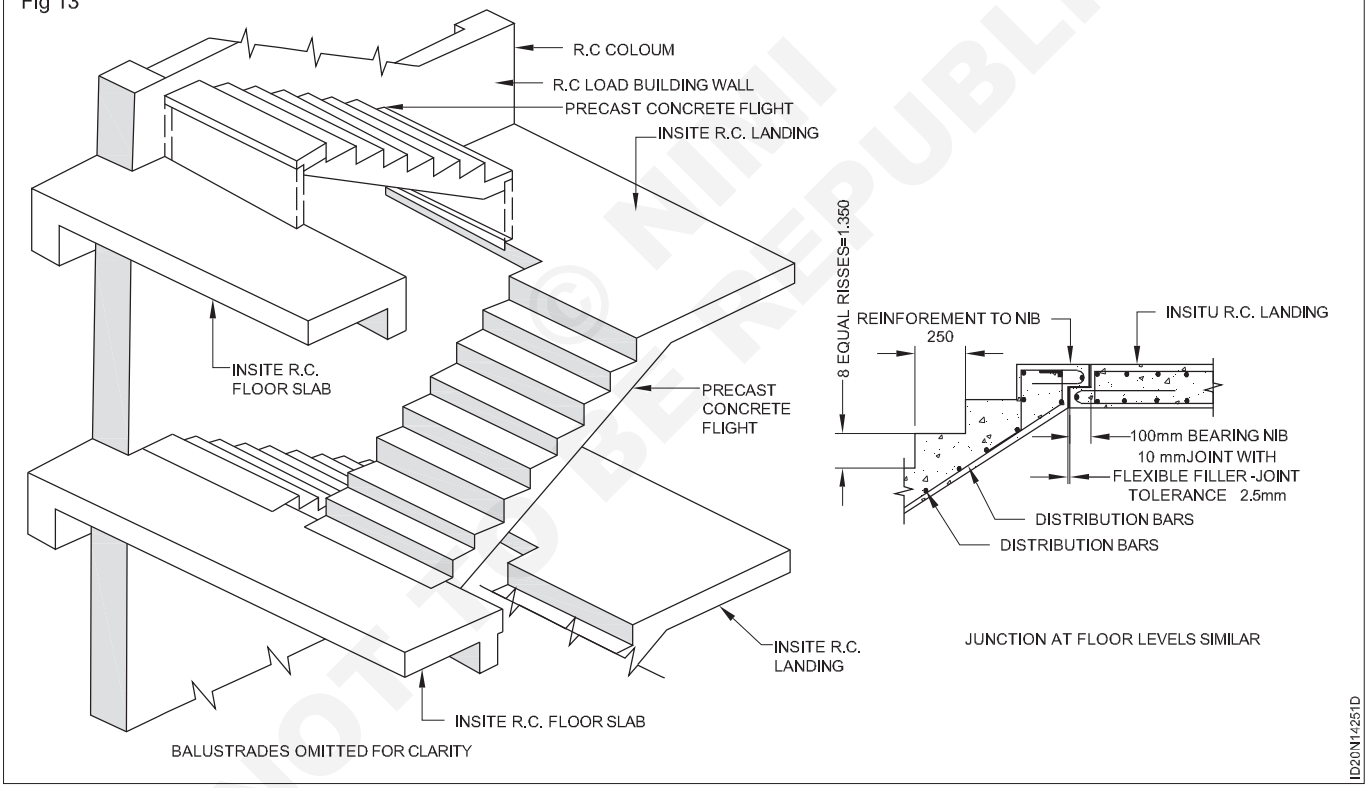


Fig 13



Construction — Related Theory for Exercise 1.4.27

Interior Design & Decoration - Civil components

Demonstration of RCC stair case with respective models

Objectives: At the end of this lesson you shall be able to

- **demonstrate the RCC stair case.**

Refer Ex.No. 1.4.25 & 26

Mezzanine floor, masonry, lintels, arches and foundation

Objectives: At the end of this lesson you shall be able to
- **state the type of floor, masonry, lintels, arches and foundation and uses.**

Mezzanine floor : The word mezzanine refers to a small floor that is in between two major floors (An intermediate floor) in a building. It is partly open to the double height vilinged floor below. (placed halfway up the wall on a floor). It may have lower-than normal ceilings due to their location.

Application : Mezzanine floors can be used for variety of applicators, such as work was, storage spaces, offices, theatres etc.,

Features

1 They are quick, clean and easy to install.

2 They can be completely disassembled, all parts can be raised and their structure, size or location can easily be modified.

3 There are wide ranges of mezzanine floor types based on construction system and client needs.

Types of mezzanine floor

a Semi permanent

b Temporary

a Semi permanent (Fig 1) : This type of mezzanine floor may be installed (rather than built as part of the structure) in high ceilinged spaces such as residence, warehouses and offices. These semi permanent structures are usually freestanding. It can be dismantled and relocated easily.

These mezzanine structures can be supported by wood, structural steel, columns and elements, or by racks or by shelves. Depending on the span and the run of the mezzanine deck. Some of these mezzanine may also include enclosed, paneled office space on their upper levels.

Fig 1

For example in residence a semi permanent mezzanine floor enables as a extra storage space for privacy purpose..

Temporary mezzanine floor (Fig 2) : These type of mezzanine floors are based on type of work and other factors. These can be dismantled and early placed. Usually materials like wood and metal are used.

An example is industrial area for life break ventilation and other requirements.

Fig 2

Masonry : Masonry may defined as the construction of building units bonded together with mortar. The building unit (commonly known as masonry unit) may be stone bricks are precast blocks of concrete. When stones are used as the building unit or building blocks we have stone masonry. Similarly, in brick masonry, bricks are used as building units. A composite masonry is a construction in more than one type of building units.

Depending upon the type of building units used, masonry may be following type

- Stone masonry
- Brick masonry
- Hollow concrete brick masonry
- Reinforced brick masonry
- Composite masonry

Technical terms used in masonry

1 **Course :** A course is a horizontal layer of masonry unit. Thus in a stone masonry the thickness of a course will be equal to the height of the sides plus thickness of one more mortar joint. Similarly, in brick masonry, the thickness of a course will be equal to the thickness of modular brick plus thickness of one mortar joint.

2 **Header :** A header is a full stone unit or brick which is to laid that its length is perpendicular to the face of the wall. Thus the longest length of the header lies at the right angles to the face of the work. In the case of the stone masonry header is sometimes known as through stone. In the case of modular bricks, a brick header will show its face measuring 10 cm x 20 cm on the face of the wall.

3 **Header course :** A course of brick work showing an only header on the exposed face of the wall is known as header course or heading course. Thus a header course of bricks will show all the brick units measuring 10 cm x 10 cm of the wall.

4 **Stretcher course :** A course of brick work showing only the stretchers on the exposed face of the wall is known as a stretcher course or the stretching course.

5 **Bed :** This is the lower surface of a brick or stone in each course. This is the surface of stone or brick perpendicular to the line of pressure.

6 **Natural bed :** Building are obtained from rocks which have distinct planes of division along which the stones can be easily split. This plane is known as natural bed, in stone masonry the direction of natural bed should be perpendicular to the line of pressure.

7 **Bond :** Bond is the term in masonry, applied to the over lapping of bricks or stones in alternate course, so that no continuous vertical joints are formed and the individual units are tied together.

8 **Quoins :** The exterior angle or corner of the wall known as quoin. The stones or bricks forming the quips are laid in such manner that its width is parallel to the face of the wall, it is known as quoin header. If, however, the length of the quoin is laid parallel to the face of the wall, it is called as quoin stretcher. Quoin stones are selected sound and larger and their are properly dressed.

9 **Face :** It is the surface of the wall exposed the weather.

a **Stone Masonry :** The stone used in the stone masonry has to be quarried from the rock formations. The quarrying of stone may be done by using hand tools or with the help of explosives. The stone quarried from quarries cannot be used directly for masonry work as they are quite irregular. Hence before use, the quarried stone blocks will have to properly cut and dressed. Rough dressing of the stone block is carried out at the quarry site as stone freshly quarried has lot of moisture called “quarry sap” and in this state they are softer and can be easily worked upon. Quarry dressed stones are thus economical and the reduced weight of the dressed blocks results in still further economy in transportation and handling cost.

Dressing of stones (Fig 3) : Stones after being quarried are cut into suitable sizes and with suitable surfaces. This process is known as dressing of stones.

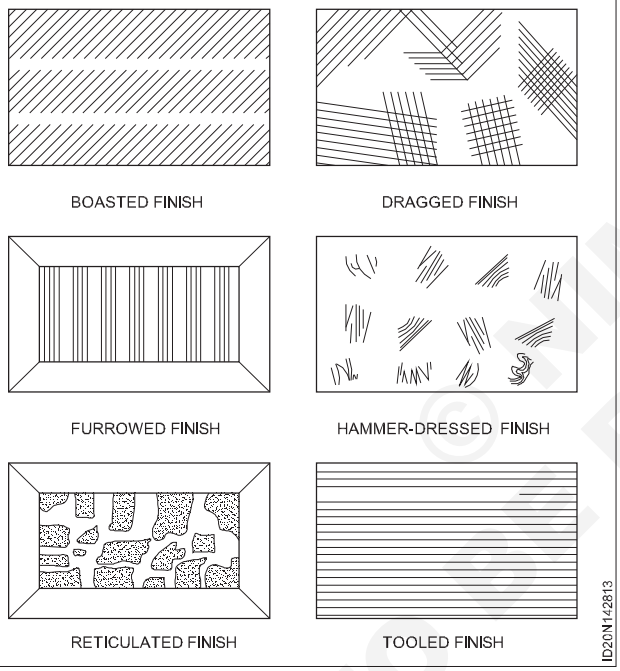
Following are the variety of finishes obtained by dressing of stones.

- **Boasted or droved finish:** Non continuous parallel marks on the stone surface.
- **Dragged or combed finish:** A drag or a comb is rubbed on the surface in all directions. This finish is suitable for soft stones only.
- **Furrowed finish:** A margin of about 20mm width is sunk on all the edges of stone and the central portion is made to project about 15mm. A number of vertical or horizontal grooves about 10mm wide is formed in this projected portion.
- **Hammer - dressed finish:** Stones are roughly square or rectangular by means of a Waller’s hammer.

Type of Stone

S. No.	Classification	Uses
1	Basalt	Road metal, for rubble masonry, foundation work, etc.
2	Gnesis	Street paving rough stone masonry, etc.
3	Granite	Steps, sills, facing work, walls, bridge piers, columns, road metal, ballast, etc. Not suitable for carving.
4	Laterite masonry	Building stone, road metal, rough stone work etc.
5	Limestone	Floors, steps, walls, road metal, etc.
6	Marble	Flooring, facing work, columns, steps, Ornamental work, etc. it can take nice polish. It can be sawn and carved.
7	Sandstone	Steps, facing work, columns, flooring, walls, road metal, ornamental carving,
8	Slate	Roofing work, sills, damp-proofing courses.

Fig 3



- **Polished finish:** Surface of the stones such as marbles, granites, etc. can be polished either with hand or with machine.
- **Punched finish:** Depressions are made by using a punch. Surface of the stone takes the form of a series of hollows and ridges.
- **Rubbed finish:** Obtained by rubbing a piece of stone with the surface or by rubbing the surface with the help of a suitable machine.
- **Reticulated finish:** Has a net-like appearance.
- **Tooled finish:** Parallel continuous marks either horizontal or inclined or vertical.

Aggregate : Aggregate is a general term applied to all inert materials which when bonded together with cement form concrete. Commonly used aggregates are sand, crushed rock and gravel.

Properties : A good building stone should be hard, tough, compact grained and uniform in texture and color.

Stone should be properly seasoned by exposure to the air before they put in a structure.

All stones should be wetted before use.

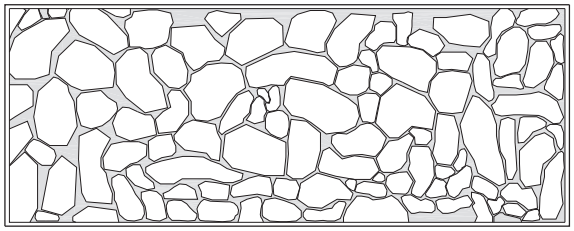
Classification of Stone Masonry : Stone masonry can be done using well shaped and well dressed regular stone blocks for using undressed and irregular stone brick. Depending upon the degree of fitness adopted in shaping, dressing and arranging stone blocks, stone masonry can be classified broadly into following two categories.

1 Rubble masonry

2 Ashlars masonry

Rubble Masonry (Fig 4) : In this masonry stone are not dressed. They are used in the masonry as they are obtained from the quarry may be slightly shaped with the help of hammers, just by removing excess projections before they are used in the masonry. This masonry consumed lot of mortar as space left in irregularities of stone blocks is filled with mortar and small size stone chippings.

Fig 4



Rubble masonry types

- Random rubble masonry

  Uncaused

  Built to courses
- Square rubble masonry

  Uncaused

Built to courses

Regular coursed

- Miscellaneous types

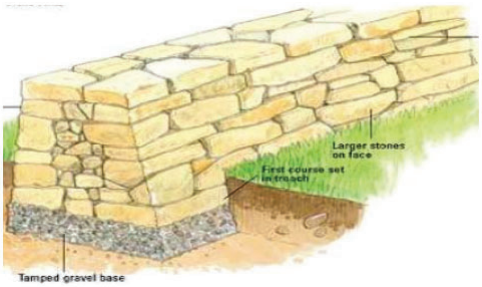
Polygonal walling

Flint walling

Dry Rubble masonry

Dry rubble masonry (Fig 5) : This masonry constructed in the same manner as coursed random rubble masonry except that no mortar used in it. Dry masonry may be coursed or uncoursed. This masonry used for pitching work or for temporary walls. This masonry is the cheeped but requires more skill, it is extensively, used for compound walls. To impart more stability to this wall, 2 or 3 top courses and also some length at the ends can be built in mortar.

Fig 5

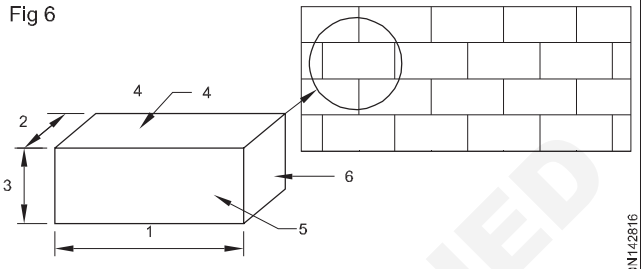


Points to be remembered during construction of stone masonry

- The stone to be used should be strong, rough, hard and well reasoned.
- The stone should be well-watered before use so that they do not absorb moisture from the mortar.
- All the stones should be used in masonry on their natural bed.
- Stones to be used should be dressed as per requirements of the work.
- No tensile stress should be allow to develop anywhere in the masonry as it is very week in tension.
- Masonry works as far as possible should be raised uniformly to avoid non-uniform distribution of load on the foundation.
- Very small size stones should not be used.
- The wall should be continuously checked for true vertically with the help of plumb bob.
- Masonry works may be done in mud mortar, lime mortar or cement mortar. But in case of basements or site subjected to water-logged conditions, cement mortar or hydraulic cement mortar should be used. However for stone masonry. lime mortar is the appropriate mortar.
- The masonry should be provided with adequate no. of threw stones.
- Quoins used to form the jambs for doors and windows should be full height of the course. Length and breadth quoin stone should respectively be twice and 11/12 times the depth of the stones.
- Hollows in stone masonry should be properly filled with mortar and stone chippings.
- When masonry works is to be started over dry and old masonry surface, it should be cleaned well by raking the old mortar and sufficiently wetted before construction is started over it.

Brick Masonry (Fig 6)

Fig 6



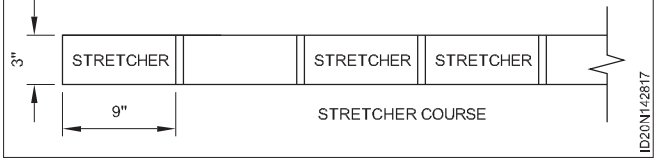
Definition : Construction of brick units bonded together with mortar is termed brick masonry.

The strength of brick work primarily depends upon quality and the strength of the brick, the type of mortar and method of bonding adopt, adopted in construction. In addition, the strength of brick wall is also dependent upon its slenderness ratio, lateral pressure due to wind and the degree of soundness in construction. Mortar not only acts as a cementing material but also imparts strength to the work by holding the individual brick together to act as a homogenous mass. Mortar is usual a mixture of three. For works of temporary nature, mud is generally used as a mortar and the construction is termed as kuccha pukka masonry. Cement mortar is used for the works of permanent character, where strength of work is of little importance. Lime mortar is used for all types of constructions.

Technical terms used in brick masonry

1 **Stretcher:** This is a brick parallel to wall face to its length. The surface of length and depth can be seen on wall face (Fig 7).

Fig 7



2 **Header:** If a brick laid perpendicular to the wall the breadth & depth can be seen on wall surface it is known as header . (Fig 8)

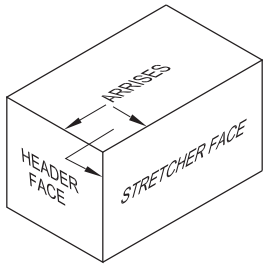
3 **Arises:** Arises is the edges of the bricks formed by the intersection of surfaces of it. (Fig 8)

4 **Frog:** The depression mark made during moulding of a brick is known as Frog. This is of two types.

1 Single frog bricks. (Hand moulded)

2 Double frog bricks.

Fig 8



DEFINITIONS

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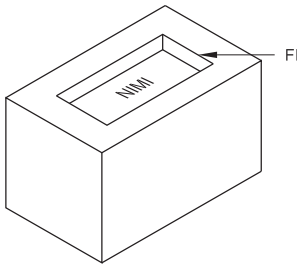
This acts as a key to mortar and give strength to the structure against lateral pressure. (Fig 9)

Fig 9



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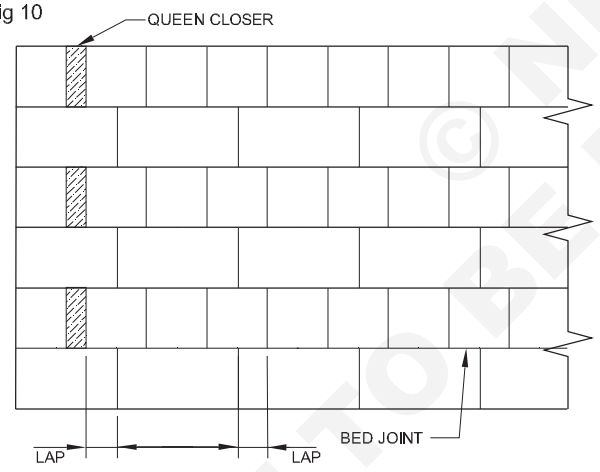
5 **Bed:** The lower surface of brick. Normally opposite side of the Frog mark.

6 **Bed joint: Lap:** The horizontal distance between two vertical joints of a successive courses is a known as lap. It is usually 5cm, This helps to avoid continuous vertical joints. (Fig 10)

Fig 10



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Closer (Fig 11): The pieces of bricks of various sizes 1/4brick, 1/2brick, 3/4 brick, 20,10, 5cm brick are used to close up the bond at the end of the brick wall; closer helps in preventing the joints of successive courses to come in a vertical line

This can be obtained by cutting the bricks by means of trowel (or) with bolster.

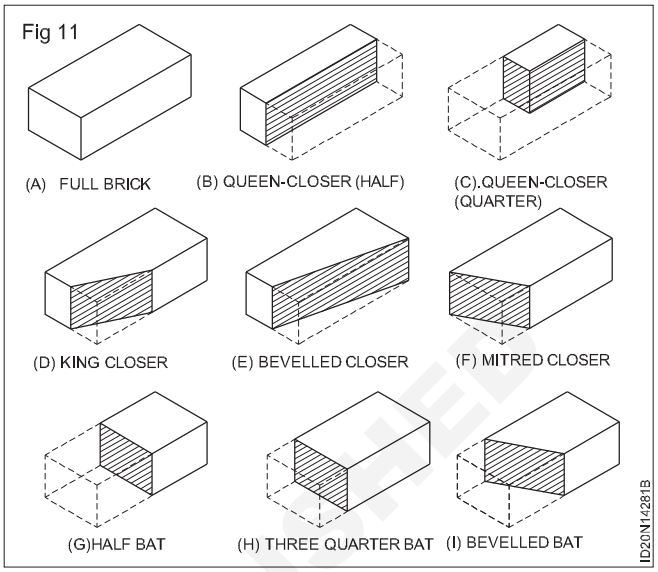
Queen closer: If the sie of 20x5x10cm is known to be queen closer. It can be obtained by cutting the brick in two equal parts towards its length.

This is placed next to quoin header to obtain required lap. (Fig b and c).

King closer: A full brick made cutting half of the length wise (or) structure and half of the width on the header face cut and removed as a triangular portion as shown in the (Fig d).

Beveled closer: Cutting the Full brick towards on corner to opposite header face of the middle point is called beveled closer. (Fig 11).

Fig 11



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This can be used for splayed brick work.

Mitered closer: This can be acquired by cutting a brick at an angle 45º to 60º with its length This can be used at corners & junctions etc. (Fig f)

Bat: This is a portion of a brick, Cut cross the width, thus a bat is smaller in length than the full brick, If the length of the bat is equal to half the length of the original brick. It is known as half bat.

A three quarter bat is the one having its length equal to three quarters of the length of a full brick of a full brick

if a bat has its width beveled it is known as beveled bat.

Perpend: It is that vertical point on the face of the wall, which lies directly above the vertical joints in alternate manner.

Bull nose: Bull nose is a specially manufactured brick with one rounded edge used as coping and plinth course

Types of Bonds: on account of their uniform size and shape, the bricks can be arranged in a variety of manner is known as types of bonds.

Sizes of bricks: Standard size =190mm x 90mm x 90mm is recommended by ISI

Modular size= 200mm x 100mm x 100mm

This nominal size of bricks includes the mortar thickness.

Weight of one brick = 3.0 to 3.5 kg.

First class bricks: These are all best quality bricks. Normally are taken in moulded and are of standard shape. They are burnt in kilns properly. The size is 190 mm x 90mm x 90mm

Uses: These are all used for superior Work or permanent works like. Construction of buildings, dams roads,sewers, bridge piers, tunnels, pitching works etc.

Second class: These are ground moulded and burnt in kilns.

Uses: These bricks are normally used at places where brick work is to be provided with a coat of plaster.

Third class bricks: These are ground moulded and burnt in clamps.

Uses: Used in important and temporary structures and at places where rainfall is not heavy.

Fourth class bricks: These are over burnt with irregular size and shapes and dark in colour.

Uses: Road metal, and as aggregate in foundation concrete.

Materials used in brick masonry:

1 Bricks

2 Sand

3 Cement mortar or lime mortar

1 Bricks: The bricks are obtained by moulding clay in rectangular blocks or to the required size and shapes and then by drying and burning these blocks.

Types of bricks based on material

1 Un burnt or sun dried bricks

2 Burnt bricks

1 Unburnt or Sun dried bricks : These bricks are used in the construction of temporary and cheap structures. These types cannot be used at places exposed to heavy rains

2 Burnt bricks: These are all used for construction works as load bearing structure walls. They are all of four categories.

1 First class brick 2 Second class brick

3 Third class brick 4 Fourth class bricks

Types of bricks based on size:

I Class bricks

Table moulded, wirecut, Fire bricks.

II Class bricks

Stock bricks.

III Class bricks

Country bricks,230mm x 115mm x 85mm

First class bricks: These are all best quality bricks. Normally are taken in moulded and are of standard shape. They are burnt in kilns properly. The size is 190 mm x 90mm x 90mm

Uses: These are all used for superior Work or permanent works like. Construction of buildings, dams roads, sewers, bridge piers, tunnels, pitching works etc.

Second class : These are ground moulded and burnt in kilns.

Uses: These bricks are normally used at places where brick work is to be provided with a coat of plaster.

Third class bricks: These are ground moulded and burnt in clamps.

Uses: Used in important and temporary structures and at places where rainfall is not heavy.

Fourth class bricks: These are over burnt with irregular size and shapes and dark in colour.

Uses: Road metal, and as aggregate in foundation concrete.

Types of Bonds

- Stretching bond
- Heading bond
- Garden wall bond
- Raking bond
- English cross bond
- Zig-zag bond
- Silver lock bond

1 English bond (Fig 12)

The bond consists of alternate course of headers and scratches in this arrangement the vertical joints in the header course come over each other and the vertical joints in the stretcher course are also in the same lime. For the breaking of vertical joints in the successive course. The following additional point should be noted in English bond construction.

i A heading course should never start with a queen closer as it is liable to get displaced in this position.

ii In this stretcher course, this stretcher should have minimum lap of 1/4 their length over the headers.

iii Walls having their thickness equal to an odd no. of half bricks, ie., 1 Brick thick wall, 2 Brick thick wall, 3
Brick thick wall and so on. present the same appearance on both the face i.e., a course consisting of headers on front face will show headers on the back face also.

iv In walls having their thickness equal to an odd no. of 1/2 bricks i.e., 1 1/2 bricks thick wall or 2 1/2 bricks thick walls and so on, the same course will show stretcher on one face and headers on the other.

v In thick walls the middle portion is entirely filled with header to prevent the formation of vertical joints in the body of the wall.

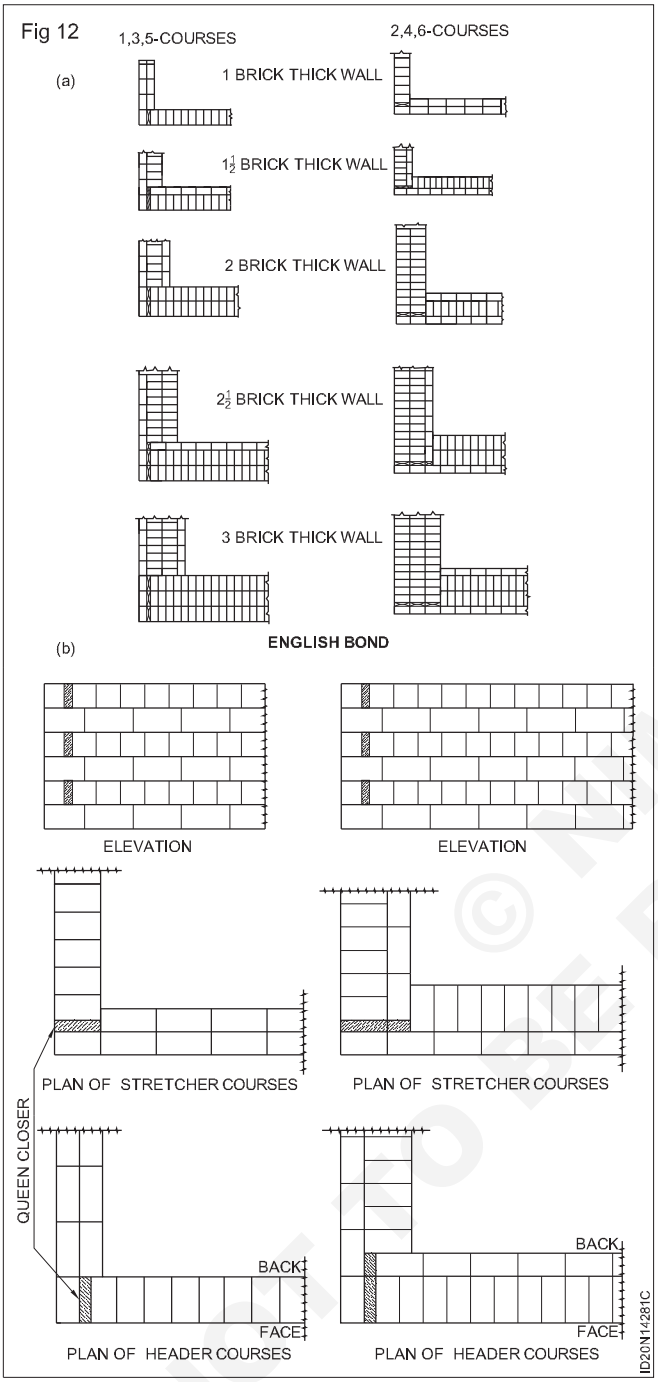
vi Since the no. of vertical joints in the header course is twice the no. of joint in the stretcher course, the joint in the header course are made thinner than those in the stretcher course.

2 Flemish bond : In this arrangement of bonding brick work, each other consists of alternate headers and stretches. The alternate header of each course is centered over the stretchers. Every alternate course, closer are inserted in alternate courses next to the quoin header. Involves having their thickness equal to

odd members of half brick, bats are essentially used to achieve the bond.

Flemish bond is further divided into two different types that is single Flemish Bond and Double Flemish Bond.

Fig 12



a Single Flemish Bond (Fig 13) : The bond is the combination of English and Flemish Bond. In this work the facing of the wall consists of Flemish bond and backing consists of English bond in each course. This type of bonding cannot be adopted to present the attractive appearance of Flemish bond with an effort to ensure full strength in the brick work.

b Double Flemish Bond (Fig 14) : In this system of bonding brick work, each course presents the same appearance both in the front and back elevation. Every course consists of header and stretcher laid alternately this type of bond is best suited from consideration of economy and appearance. It enables the one brick wall to have flush and uniform faces on both sides. This type of bonding is comparatively weaker than English bond.

Fig 13

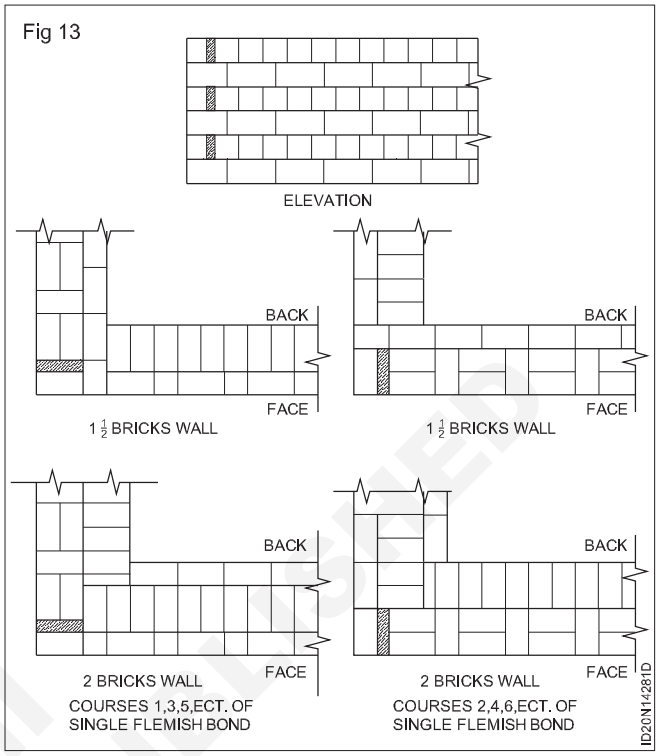
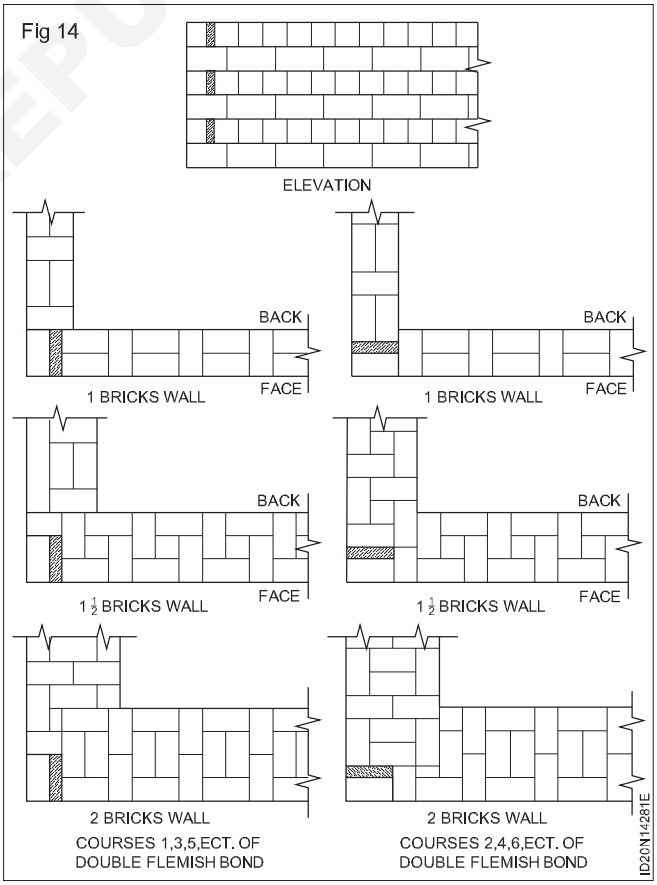


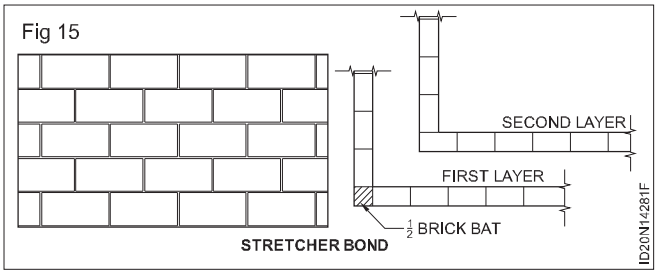
Fig 14



3 Stretching bond (Fig 15) : In these arrangements of bonding, all the bricks laid have stretchers. The overlap which is usually of brick,in obtains by commencing each alternate code wtih a 1/2 brick bat. Stretching bond is used for 1/2 bricks wall only. The bond is also

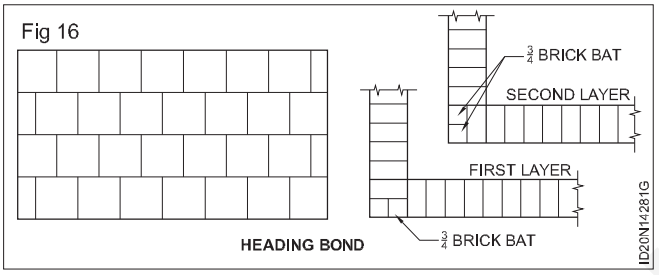
turned as running bond and is commonly adopted in the constructionof 1/2 brick thick levels of cavity walls, partition walls, etc., since there is no headers, suitable reinforcement should be used for structural bond.

Fig 15



4 Heading bond (Fig 16) : In this type of bonding all the bricks are laid as headers on the faces. The overlap which is usually of half the width of the bricks is obtained by introducing a three quarter bat in each alternate course at quoins, this bond permits better alignment and as such it is used for walls curved on plan. This bond is chiefly used for footings is foundations for better transverse distribution of load.

Fig 16



5 Garden wall bond : This type of bond is suitable adopted for iron bricks thick wall which may act as a garden wall or a boundary wall. In garden wall bond, it is possible to build uniform face for a wall without much labour or expenses. This type of boundary not as strong as English bond and its use is restricted to the construction of dwarf walls or other similar types of walls which are not subjected to large tresses. On account of its good appearance, this bond is sometime used for the construction of the leave of cavity walls.

There are two type of garden bond wall.

- English garden wall bond
- Flemish garden wall bond

a English garden wall bond (Fig 17) : The general arrangement of bricks is this type of bonding is similar to that of English bond except that the heading courses are only inserted at every forth or sixth course. Usually the arrangement consists of one course of headers to three courses of stretchers. A queen closer is placed next to quion header of the heading course to give the necessary lab.

b Flemish garden wall bond (Fig 18) : This consists of alternate course composed of one header to three or sometimes even five stretchers in series throughout the length of the courses. Each alternate course contains a three bad placed next to the quoin header and the header is laid over the middle of each central stretcher.

Fig 17

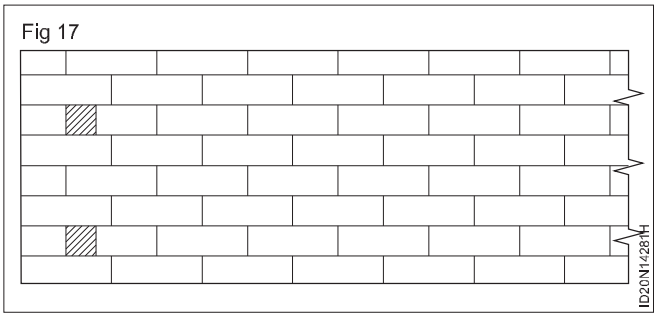
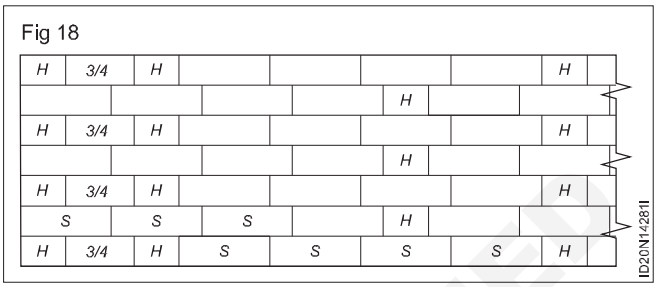
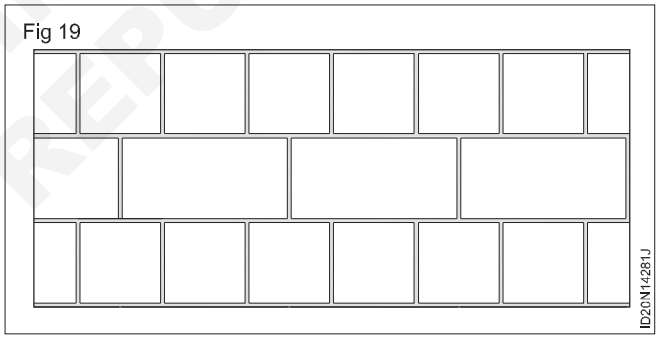


Fig 18



6 Facing bond (Fig 19) : This arrangement of brick is adopted for thick walls, where the facing and backing are desired to be constructed with bricks of different thickness. This bond consists of heading and stretching courses so arranged that one heading course come after several stretching courses. Since the no. of joints in the backing and the facing differ greatly, the load distribution is not uniform. This may sometimes need to unequal settlement of the two thickness of the wall.

Fig 19



7 Raking bond : This is a bond in brick work in which the bonding bricks are at any angle other than zero or 90°. This arrangement helps to increase the longitudinal stability of thick walls build in English bond. In this arrangement of bonding, the space between the external stretches of wall is filled with bricks inclined to the face of the wall. This bond is introduced at certain intervals along the height of a wall.

There are two common forms of raking bond.

a Herring bone bond

b Diagonal bond

a Herring bone bond (Fig 20): This type of bond is best suited for very thick walls usually not less than four bricks thick. In this arrangement of brick work, bricks are laid in course inclined at 45 in two directions from the centre. This bond is also commonly used for brick pavings.

b Diagonal bond (Fig 21) : This bond is best suited for walls which are two to four brick thick. This brick is

introduced at every fifth or seventh course along the height of the wall. In this bond, the bricks are placed in two ends in such a way that extreme corners of the series remain in contact with the stretcher.

Fig 20

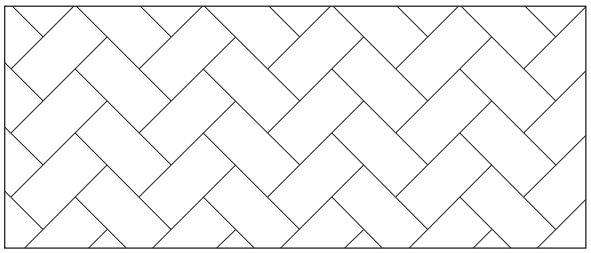


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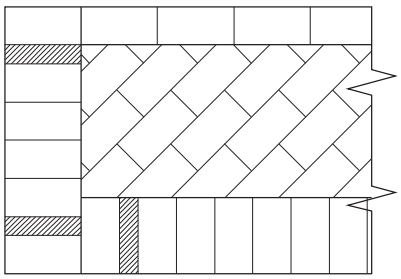
Fig 21



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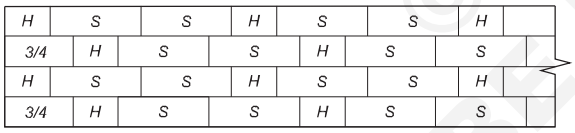
8 Dutch bond (Fig 22) : This bond is a modification of the old English cross bond and consists of alternate courses of header and stretchers. In this arrangement of brick work, each stretching course starts at the quoin with a three quarter beat and every alternative stretching course has a header placed next to the three quarter brick bat provided at the quoin.

Fig 22



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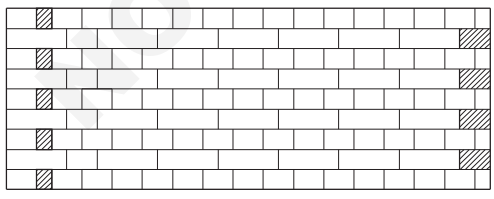
9 English cross bond (Fig 23) : This is similar to English bond and consists of alternate course of header and stretcher. However, in this bond, queen closer are introduced next quoin header and each alternate stretching course has header placed next to quoin stretcher. This bond is sufficiently strong and bears a good elevation.

Fig 23



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10 Zig zag bond (Fig 24): This is similar to herring bone bond with the only difference that in this case the bricks are laid in a zig zag fashion. This is commonly adopted in brick paved flooring.

11 Silver lock's bond (Fig 25) : This is a form of bonding brick work in which bricks are laid on edge. It is economical but weak in strength and hence it is only recommended for garden walls or partition walls. In this bond, the bricks are laid as header and stretchers in alternate courses in such a way that header are laid on bed and the stretcher are laid on the edge forming a continuous cavity.

Fig 24

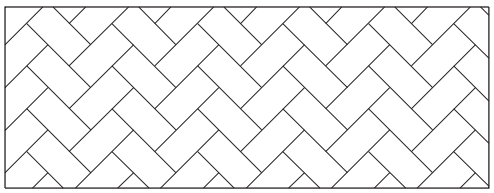

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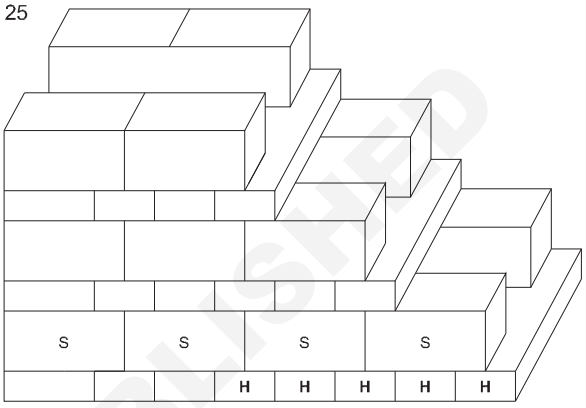
Fig 25



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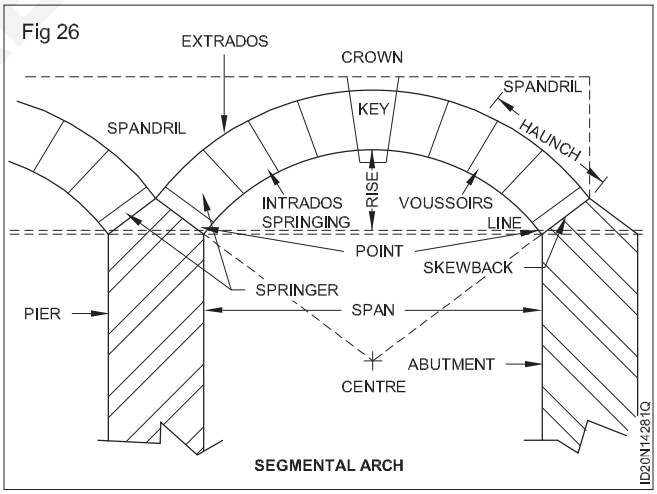
Arches (Fig 26) : An arch is a structure which is constructed to span across an opening. Usually, wedge shaped units are joined together with mortar to form an arch. Sometimes, an arch is formed as a single unit by using R.C.C or steel.

Fig 26



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Technical terms : The technical term used in connection with Arches are given below.

1 Intrados or soffit or bottom : It is the inner curve or surface of an arch

2 Extrados or back: It is the external or upper curve of an arch

3 Voussoirs: These are the tapered or wedge shaped units which form the courses of an arch.

4 Key: Key is the uppermost or central voussoir of an arch. In other words, it is the wedge shaped unit at the crown. Sometimes, it is made projected below

and above the outlines of an arch to improve the appearance of an arch.

5 **Crown:** The highest point of extrados is called as crown

6 **Abutment :** The end support of an arch is known as abutment

7 **Pier:** The intermediate support of an arcade is known as pier

8 **Skew back:** The inclined or splayed surface of an abutment or pier which receives the arch is known as skew back. In other words, an arch springs from skew back

9 **Springer:** This is the first voussoir on either side of an arch at springing level. It is laid on the skewback.

10 **Springing points:** These are the points from which the curve of an arch commences or springs.

11 **Springing line:** It is the imaginary horizontal line joining the two springing point of an arch.

12 **Span:** Span is the horizontal distance between the springing points.

13 **Rise :** It is the vertical measurement or distance between highest point on intrados and the springing line.

14 **Centre:** This is the geometrical centre point of the curve of an arch from which the arc of intrados or extrados is described.

15 **Ring or Ring rim or Ring course :** It is the circular course which forms the arch.

16 **Depth or height:** The perpendicular distance between intrados and extrados is known as depth or height

17 **Spandrel :** It is the irregular triangular portion between the extrados of two consecutive arches and the horizontal line drawn tangent to the crown

18 **Haunch:** The lower half portion of the arch between the crown and the skewback is known as haunch

19 **Arcade:** A series of arches which support the wall above and arc being supported by piers is known as arcade.

20 **Thickness or breadth of soffit:** It is the horizontal distance measured perpendicular between front and back faces of an arch. It is actually the thickness or breadth of masonry used to form an arch.

21 **Impost:** The projecting course at top of an abutment or pier is known as impost

Types of arches

The various types of arches can be classified as follows:

1 According to shape

2 According to number of centres

3 According to workmanship

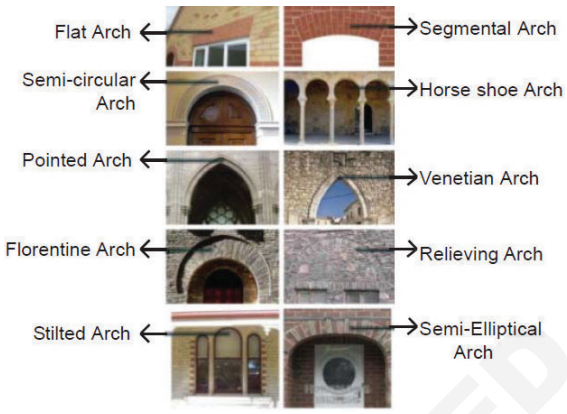
4 According to materials used for construction.

Construction

Arches

1 According to shape (Fig 27)

Fig 27



i Flat arch

ii Segmental arch

iii Semi-circular arch

iv Semi-Elliptical arch

v Inverted arch.

vi Pointed arch.

vii Relieving arch

viii Horse-shoe arch

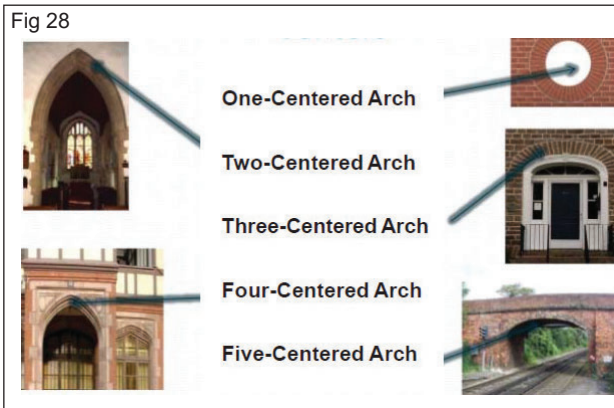
ix Stilled arch

x Venetian arch

xi Florentine arch.

2 According to number of centres (Fig 28)

Fig 28



i One-centred

ii Two centred

iii Three centred

iv Four centred

v Five centred

3 According to workmanship

i Rough arch

ii Axed or rough cut arch

iii Gauged arch

iv Purpose made brick arch.

4 According to materials of construction (Fig 29)

Fig 29

Stone Arch

Brick Arch

Concrete Arch

i Stone arches

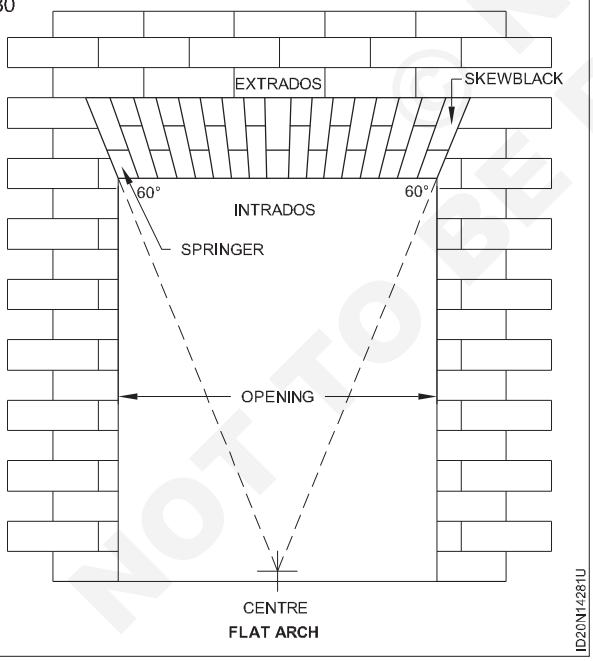
ii Brick arches

iii Concrete arches.

Classification of arches according to shape

1 Flat arch (Fig 30)

Fig 30



- The shape of the arch is flat and the skew back forms an angle of 600 .
- Although the arch is flat, to allow the settlement of arch masonry, the following slight rise (camber) is provided in the arch.

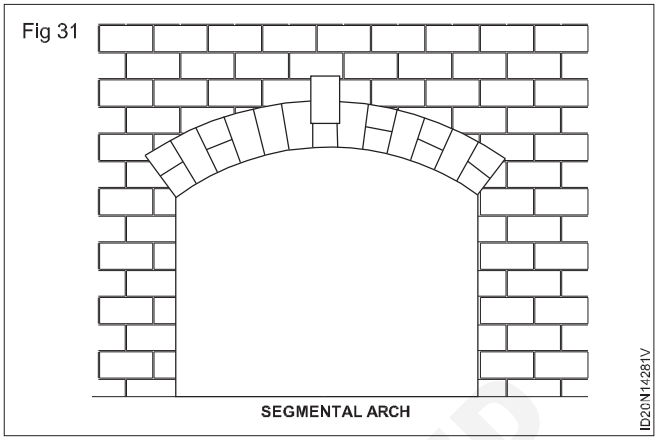
  a 10mm to 15mm per meter width of opening in intrados

  b Half the camber of intrados in extrados

- The flat arches are comparatively weak and they can be used for light loads and for spans upto 1.50m

2 Segmental arch (Fig 31)

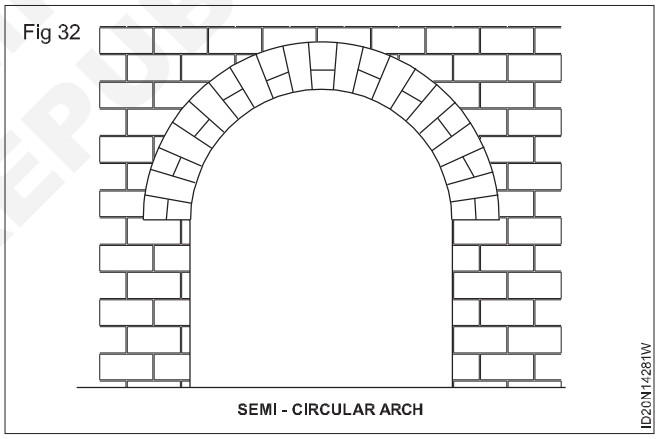
Fig 31



- The centre of the arch lies between the springing line.
- The thrust due to loads is transferred to the support (pier or abutment) in an inclined direction
- This is the common type of arch provided in buildings

3 Semicircular arch (Fig 32)

Fig 32



- The arch centre lies at the midpoint of springing line and the shape of the arch is a semicircle as shown in Fig 46
- The skewback is horizontal. Hence, the thrust acts in the vertical direction.

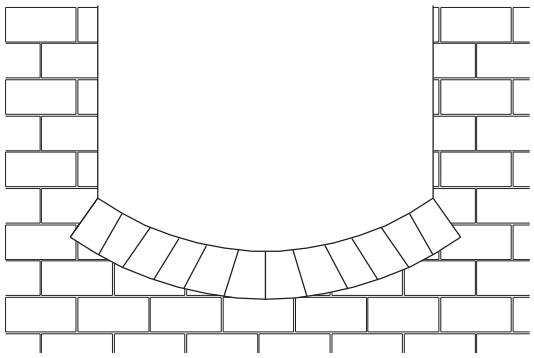
4 Inverted arch (Fig 33)

- The arch is constructed in inverted position so that,
  the crown of the arch is below the springing line and
  the centre of the arch above the springing line.
- The inclination of skewback is 600
- The inverted arches are used to distribute the loads of the piers uniformly over the entire length of foundation.

5 Pointed arch (Fig 34)

- Two curves of same radius form this type of arch. The curves meet at the apex of a triangle

Fig 33



INVERTED ARCH

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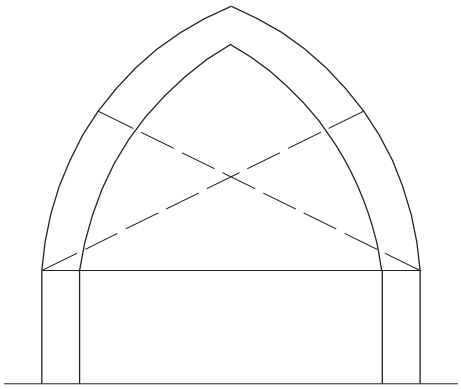
Fig 34



POINTED ARCH

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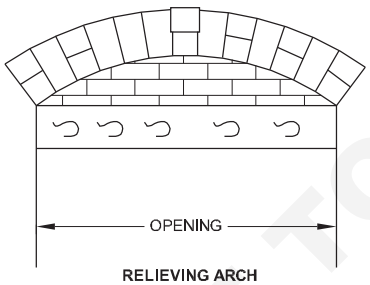
- The triangle formed may be an equilateral triangle as shown in Fig 33.
- The triangle formed may be an isosceles triangle It is known as Lancet arch.

6 Relieving arch (Fig 35)

Fig 35



RELIEVING ARCH

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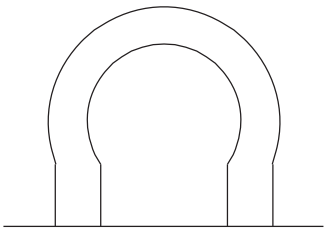
- Relieving arch is constructed over a wooden Lintel or flat arch to carry the load above the opening. Therefore, the wooden Lintel or flat arch is relieved from carrying the load.
- Sufficient bearing on both sides are given to the relieving arch
- This type of arch is also known as discharging arch.

7 Horse -shoe arch (Fig 36)

- This arch is in the shape of horse -shoe
- The arch is more than a semi circle and the centre of the arch lies above the springing line.

Fig 36



HORSE - SHOE ARCH

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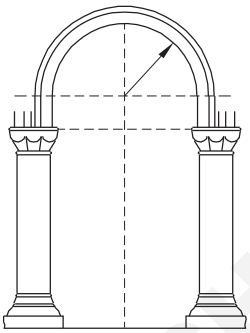
8 Stilled arch (Fig 37)

Fig 37



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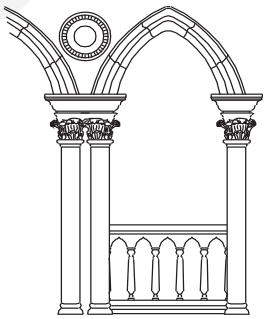
- In this type of arch, a semi circular portion is placed on top of two vertical portions.
- The springing line of the arch passes above the vertical portions and centre of the arch.

9 Venetian arch (Fig 38)

Fig 38



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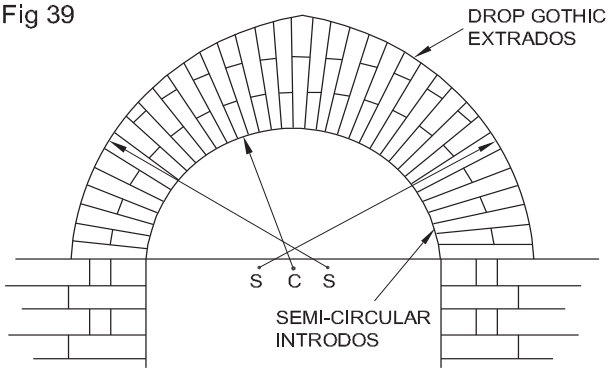
- The venetian arch has four centres which are all located on springing line.
- The depth of arch at crown is more than that at support.

10 Florentine arch (Fig 39)

Fig 39



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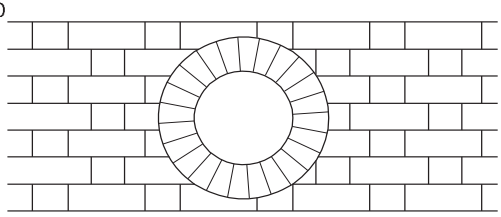
- Florentine arch has three centres, all located on springing line.
- The depth at crown is similar to venetian arch but, the intrados has the shape of semicircle.

Classification of arches according to number of centres

1 One-centred arch (Fig 40)

Fig 40



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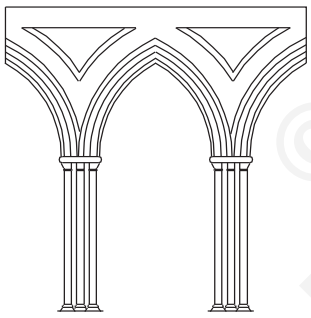
- The curve of this arch is formed from one centre only
- The flat, segmental, semi circular, horse-shoe and stilled arched are examples of one centred arches.
- Sometime, to improve the appearance of the building, circular windows are provided. In such case, a Bull's eye arch or circular arch is constructed.

2 Two centred arch (Fig 41)

Fig 41



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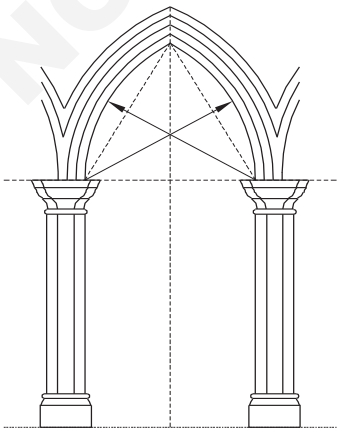
- The arch has two centres. The pointed arches are examples of two-centred arches
- The Elliptical arch has two centres which is used to improve the architectural elegance of a building.

3 Three centred arch (Fig 42)

Fig 42



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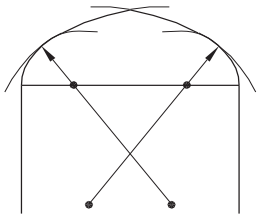
- As this type of arch has three centres, it is in the shape of a semiellipse
- The florentine arch is also a three-centred arch

4 Four centred arch (Fig 43)

Fig 43



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- This type of arch has four centres
- a four centred pointed arch which was developed in Tudor arch

5 Five - centred arch

- This arch as five centres and the shape of the arch looks like an exact ellipse
- The construction method of this arch is already explained.

Classification of arches according to workmanship

1 Rough arch (Fig 44)

Fig 44

- This type of arch is constructed with normal size of bricks. The stretcher is not visible in elevation. Only the headers appear in elevation. Therefore the height of arch consist of several rays
- The mortar joints are in wedge shape.
- The thickness of mortar joint is more at extrados than at intrados.
- This type of arch will not carry heavy load.
- Moreover, this type of arch is used where the appearance is not important.

Axed or rough cut arch (Fig 45)

- The ordinary or standard bricks are roughly cut to wedge shape units by means of bricklayer's axe
- The bricks may be rough axed or fine-axed
- The thickness of mortar joints varies from 3 to 6mm

- These arches are stronger than rough arch.

Fig 45

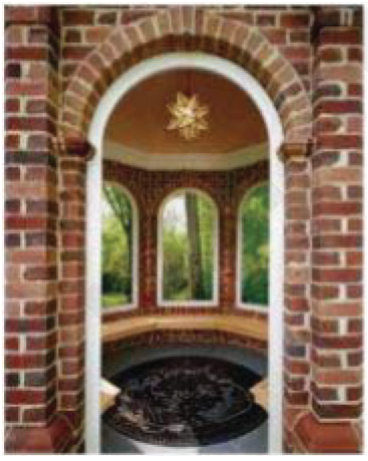
Gauged arch (Fig 46)

Fig 46

- Gauge means measure, the arch is constructed with bricks which are finely cut by means of a wire saw.
- Thus the joist of a gauged arch are very fine, thin and truly radial. The mortar joints are as thin as 1.5mm to 0.75mm
- For a high class work. special bricks are used, which can be cut and worked to the required forms.

Purpose made brick arches (Fig 47)

Fig 47



- Purpose made bricks are used to construct these arches.
- The mortar joints are fine and thin

  This type of arch is used where the elevation is important

Classification of arches acccording to materials of construction

Stone arches (Fig 48) : The two kinds of stone arches are

a Rubble arches

b Ashlar arches

Fig 48

a Rubble arches: They consist of rubble stones which are roughly hammer dressed to the required size and shape and laid in cement mortar

In this type of arch. all the stone need not be of the same size. This type can be used up to a span of 1.00m

It is used only for interior work.

b Ashlar arches: Properly dressed wedge shaped stone are used to form this arch. A stone arch may be constructed as a segmental arch. Semi circular arch and Flat arch

Ashlar arches have a good appearance and are used for superior work.

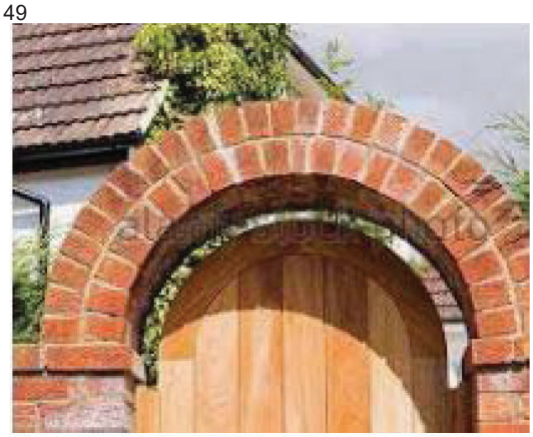
In both Rubble and Ashlar arches, care should be taken to lay the stones with their bedding planes normal to the direction.

Brick arches (Fig 49) : Brick arches are classified into four forms according to the quality of workmanship and the bricks used. They are a) Rough brick arches, b) Axed brick arches, c) Gauged brick arches and d) Purpose - made brick arches.

Concrete arches

Concrete arches are classified into a) concrete block arches and b) Monolithic concrete arches

Fig 49



a Concrete block arches (Fig 50)

Fig 50

- In this type pre-cast concrete blocks are laid in cement mortar.
- The block are pre-cast and water cured for 15 days. The mix used is 1:2:4 Generally, reinforcement is not used.
- The method of construction of block arches are similar to stone or brick arches.

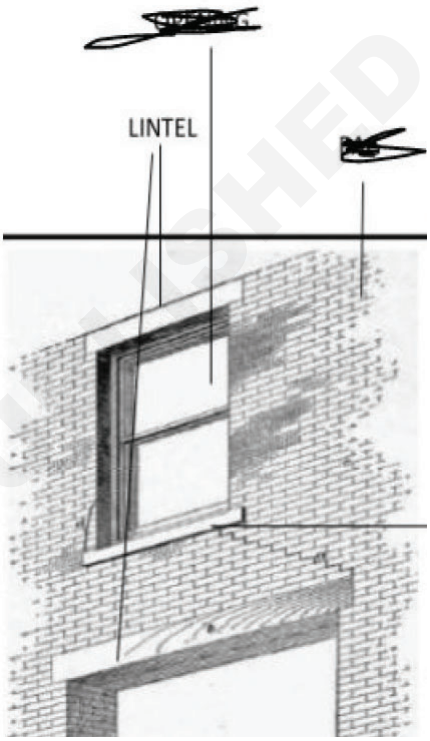
b Monolithic concrete arches (Fig 51)

Fig 51

- These are cast in situ type which are generally used for culverts and bridges.
- Generally they are constructed in PCC. If the span is large R.C.C is used to construct these arches.
- Necessary form work is provided to support fresh concrete until it hardens sufficiently to support its own weight and the load above. Curing is carried out for 15days.

Lintels (Fig 52) : Openings for door, windows or cupboards, etc., must be bridge over by some means to support the super imposed masonry. The support to the load above the opening is usually given by providing an arch or a lintel.

Fig 52



Lintel acts like a beam and transfers the load vertically to the supporting walls the ends of lintel are build into the masonry so as to convey the weight carried by them to the masonry in jambs. The amount of bearing which supports provide for the ends lintel is an important factor. As a general rule the bearing of a lintel as its ends should be 10 cm (depth of one brick) or 3.8 cm, for every 30 cm of span, whichever is greater? Lintel are made of various materials, such as wood, stone, brick and reinforced brick. Steel and reinforced cement concrete.

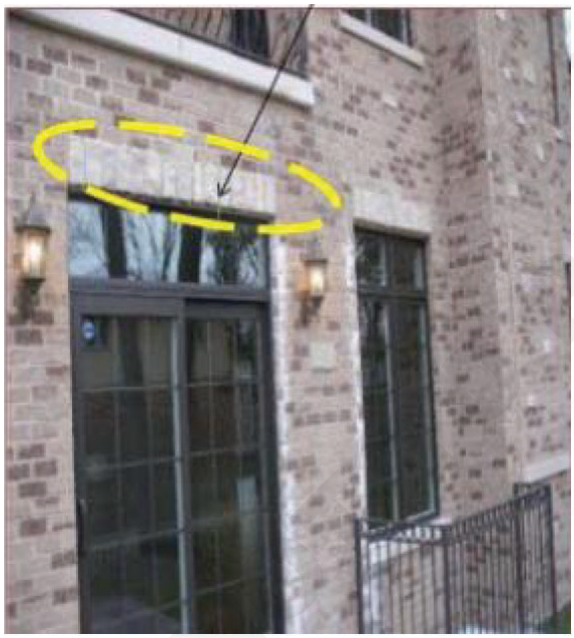
a Stone lintels (Fig 53) : The use of stone lintels is very common in stone lintels is very common in stones. In general stone lintel, on account of high cost of the material and its inability to withstand excessive transverse stresses, is rarely used. The minimum thickness of stone lintel is kept 7.6 cm and as a thumb rule, the thickness is taken as 3.8 cm per 30 cm length of span.

b Brick lintels (Fig 54) : They are constructed with hard well burnt, first class bricks laid on end or on edge. Depending upon the span, their depth varies

from 10 cm (depth of one brick) to 20 cm (depth of one brick) They are considered suitable for small openings (generally not more than 90 cm in span) with light loading conditions. Bricks having frogs are more suitable for the construction of lintels the frigs, when filled with mortar, form joggles which increase the shear resistance of the end joints and ultimately result in increased strength of lintel.

Fig 53

Fig 54



c Steel lintels (Fig 55) : When a large opening carry heavy wall load is to be spanned by a lintel, an R.C. lintel will work out to be very deep. If due to architectural reasons, the depth. If due to architectural reasons, the depth of the lintel is to be restricted, it is economical to use steel lintel. Steel lintel consists of section of rolled steel joists, used singly or in a combination of 2 or 3. Built up lintel consists of three R.S.Js spaced together and connected to each other by bolds passing through them at intervals. This system is embedded in concrete is cured like R.C. lintel.

Fig 55

Bearing of Lintel

It should be considered the minimum of the following

1 10 cm

2 Height of Lintel

3 1/10th to 1/12th of the span of Lintel

Material used in Lintel

1 Wooden Lintel or Timber Lintel

2 Stone Lintels

3 Brick Lintels

4 Steel Lintel

5 Reinforced brick Lintels

6 Reinforced cement concrete Lintel

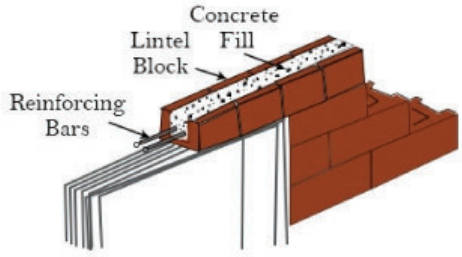
d Wooden Lintel (Fig 56) : In hilly areas, where timber suitable for the constrction of lintel is easily available, wooden lintels are commonly used. In plains, the use of wooden lintel is very rare on account of high cost of the material. Timber is not probably ventilated, is liable to decay. Wood being combustible, wooden lintels cannot be recommended for fire proof construction. The minimum depth of the lintel should be 7.6 cm. Sometimes a roof arch is constructed above a lintel to relieve the later span the lintel should be properly design as a timber beam, simple support at its ends.

Fig 56

Reinforced brick lintel (Fig 57) : When brick lintels are required to be provided over large spans they are reinforced with mild steel bar. The depth of the lintel is limited to 10 cm (depth of the brick) or a multiple of one brick thickness. Bricks are so arranged that 1.9 cm - 3.8 wide spaces is left length wise, for the insertion of

reinforcement. The gap is than filled with rich cement mortar or cement concrete.

Fig 57



Reinforced cement concrete lintel (Fig 58) : An account of their durability, strength and fire resisting properties, reinforced concrete lintels are very common in use. They are economical and easy in construction. They can be used for bigger span and heavy loading conditions. R.C.C lintels are constructed with 1:2:4 cement concrete reinforced with mild steel bars. They may be pre cast or cast in situ. For smaller spans, up to 1.2 m pre cast lintels are preferred.

Fig 58

They are manufactured and cured well in advance and as such prove economical since the same mould can be use a no. of times. The use of pre cast R.C.C. lintels expedites the construction, as no more time is required for their curing. While laying a pre cast intel special care should be taken to see that the marked space of the lintel (soon after pouring concrete in the mould, in the top of the concrete surface is marked space of lintel (soon after pouring concrete in the mould, in the top of the concrete surface is marked with some points or tar so as to distinguish it from bottom face) is keep at top. If the lintel is placed. For larger pans, lintels are cast-in-situ. As pre cast lintels will have to be provided with additional reinforcement to guard agains the lifting stress. For lintels overlarge span subjected to heavy loadings, the depth of the lintel and the area of the reinforcement should be accurately computed.

Depth of lintel for ordinary loading : Up to 1.2 m length of span, a 15 cm depth lintel is found to be safe. As a general rule and 25 mm for every additional 30 cm span.

Reinforcement of lintels for ordinary loading : The no. of main bars of lintels depends upon the load from the wall to be carried above and the span of the opening. As a general for each 10 cm (of bricks) thickness of wall, one main bar should be provided. The diameter of the bar varies with the span. Upto 1.2 m span 10 mm bar if bar; from 1.2 m to 2 m span - 12 mm f bar and from 2-3 m span - 16 mm f bar will be found adequate.

Foundation

objectives: At the end of this lesson, you shall be able to,

- **define foundation**
- **state types of foundation**
- **explain purpose of foundation**
- **explain various loads on foundation**
- **describe causes of failure of foundation and its remedies.**

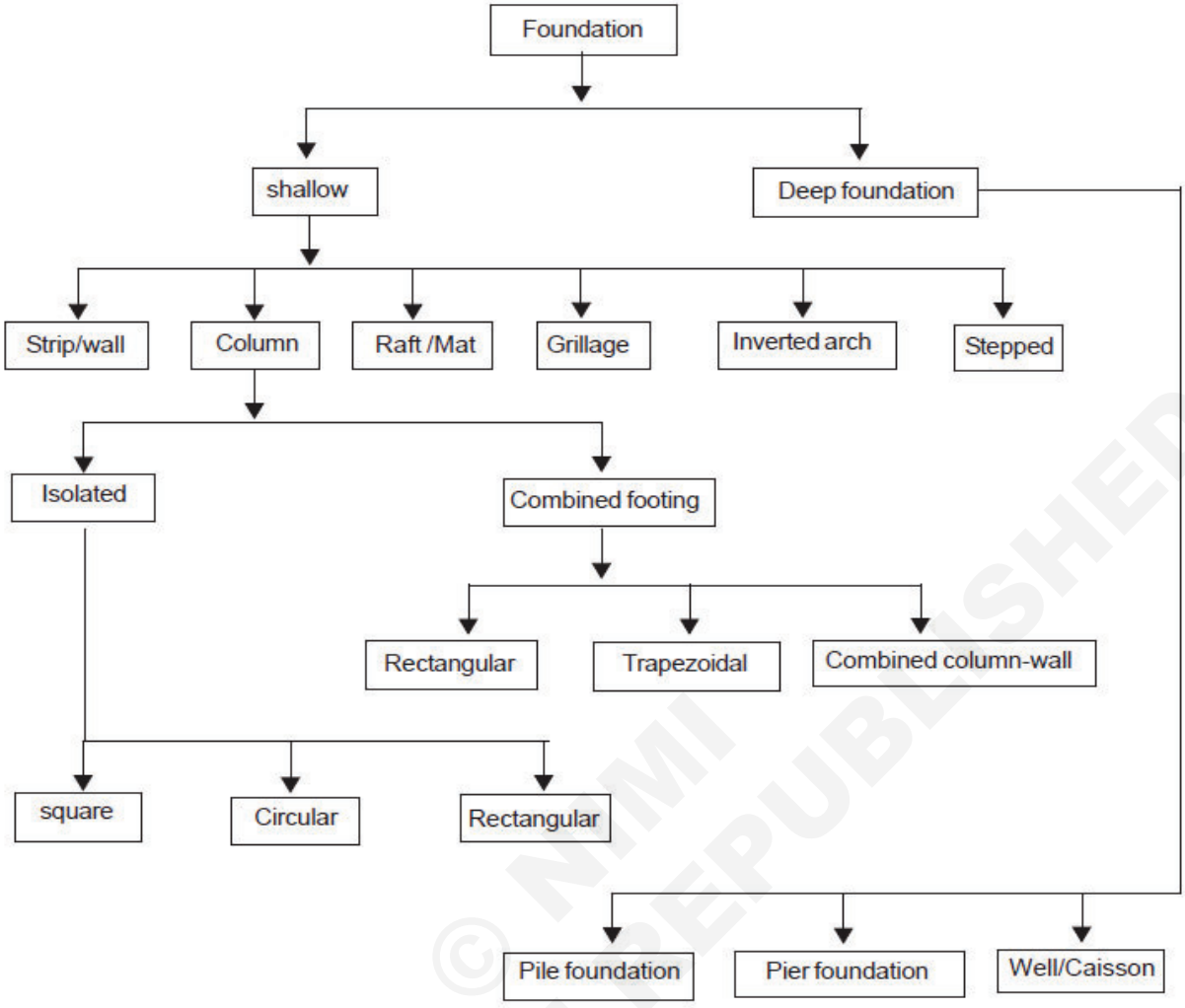
Introduction

Every structure consists of two parts, namely foundation and super structure. Foundation is the lowest part of a structure which transmits the weight of the structure, together with the effect of live loads and pressure, to the material on which the structure rests in such a manner that the underlying material is not stressed beyond its safe bearing capacity.

Definition

The lowest artificially prepared part of the structure, usually located below the ground level, which transmit the load of the superstructure to the ground is known as substructure or foundation.

Types of foundations



Types of loads

1 Dead load 2 Live load 3 Wind load 4 Snow load

Causes of failure of foundations and its remedies

Causes	Remedies
1 Unequal settlement of the subsoil	Foundation should rest on rigid strata. Design of foundations should be appropriate to the nature of subsoil.
2 Unequal settlement of the masonry	Using mortar of proper strength. Masonry work should be raised evenly. Proper Curing.
3 Withdrawal of moisture from the subsoil	Provide drive piles up to the hard rock.
4 Lateral pressure on the superstructure	Provide sufficient wide base.
5 Horizontal movement of the earth	Construct retaining walls to prevent the escape of earth.
6 Transpiration of trees and shrubs	Foundations should be sufficiently deep. Trees should not be planted near the building.
7 Atmospheric action	Provide suitable underground drains. Providing gentle ground slope away from the wall.

1 Dead Load

This is the load of the material used for the various components of a building such as wall, floor, etc., All permanut loads are this included in that load, sometime a dead load of 10kg/m2 of the floor area is allowed for construction of a partition wall.

2 Live load

This is the movable load on the floor and hence it is variable. It is also sometime know as super imposed load. It includes load of person standing on a floor, weight of material temporarily stored on a floor. Live load is known superimposed or simply super load. Foundations shall be disgned to carry 60% of the assumed live load in addition to the dead load, wind load and snow load.

3 Wind load

Incase of tall building the effect of wind should be consider. The exposed sides and roofs of such building are subject to wind pressure and it affect is it reduce the presssure on the foundation on the wind ward side and to incerase the pressure on the foundation on the Lee ward side. The wind pressure will depend on the velocity the of the ground.

4 Snow load

The snow loads are acted in snow region and hills where snow falls.

Hardware fittings in doors and windows

Objectives: At the end of this lesson you shall be able to
- **describe hardware fittings in doors and windows.**

Hardware for doors and windows : Windows and doors are important in any building interiors. They are moving elements façade of a building and can improve ventilation and serve purpose of circulation.

To ensure that a door/window operates smoothly and function for years, it is essential to provide hardware's.

Hardware selection meet minimum functionality safety and should meet the requirements, design for doors and windows. Right kind of hardware should be chosen carefully for life safety, emergency egress, loss prevention and security for building occupants.

Any hardware used should have reliability, technical performance, aesthetic appear and value for money. Hardware are primarily based on specification and suitability for variety of styles finishes , and aesthetic needs.

Evolution of door and window hardware : The evolution of doors and window hardware has close relation to door window types and opening styles.

At 19th century very ordinary hardware such as simple knobs and roses gave way to eleborate brass and bronze sets that left no surface undecorated. The best and most expensive sets (fittings) where made of cast brass, bronze /iron with crisp details accented by various finishes.

However after world war 2, these products gave way to meet needs of post-war building room, hardware cased when early to install and simple.

In modern times, the door and windows hardware has to balance style with function.

Hardware fittings and accessories

DOORS

- Deadbolts
- Door knobs
- Door levers
- Door hangs
- Electrical door locks
- Door handle
- Door bells
- Door bolts
- Door chinar
- Door closer
- Door stoppers
- Door push/pull plater

Windows

- Windows stays
- Window frame
- Fold down handles
- Crank window handles
- Window folding handles
- Window latch mechanism
- Folding window adjuster

Products that goes for any door/windows hardware includes handles, windows extensions, fasteners, hinges, locks, hooks, number plates, knockers and glass, entrance door hardware commercial pull handles, railing wardrobe.

These are the set elements or fitting which forms hardwares but essential hardwares for -

Doors - handles, locks, hinges, closers, stoppers, tower bolts and door chains

Windows - concealed handles and locks.

Factors to consider while specifying hardware for doors and windows

1 **Ease of assemblance :** Most hardware are in pre assembled format which will make installation using friendly by easy assemblance.

2 **Corrosion resistance :** Materials, committing used for hardwares are metal, glass, wood and leathers that needs to have property of corrosion resistance.

3 **Number of life cycles :** Hardwares are preferred for long life cycle with low maintenance.

4 **Maximum weight carrying capacity :** Heavy weight of hardware are good indication of better, quality product.

5 **Brand usability and quality :** Every hardware manufactured has unique standard of manufacturing and design, it should meet the organism performance and aesthetics.

Hardware used for doors and windows

Fixtures and fastenings for doors and windows : The study of various fixtures and fastenings can be grouped into the following head:

1 Hinges (Fig 1) 2 Bolts (Fig 2)

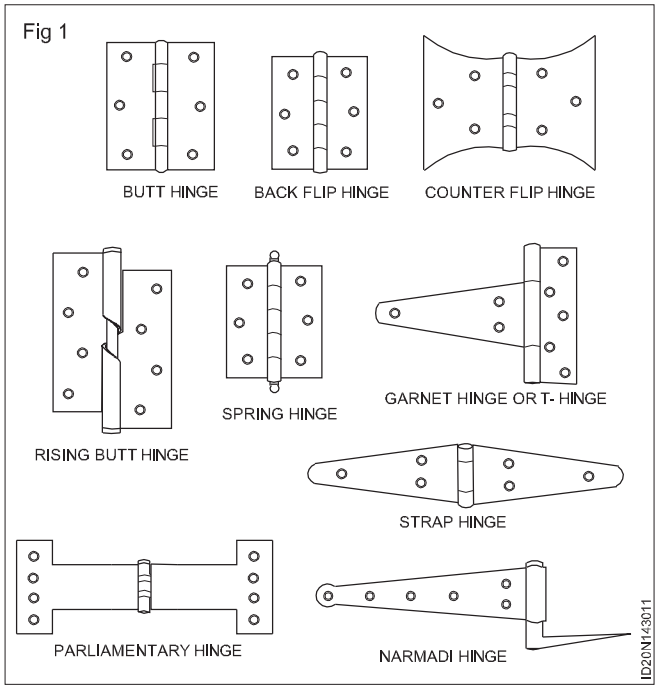
3 Locks (Fig 3) 4 Handles (Fig 4)

The above fittings will now be described and illustrated in serial order.

1 **Hinges (Fig 1):** The various types of hinges commonly used with doors and windows are illustrated in Fig 1 and are described below

   i **Butt hinges:** These hinges are most commonly used with windows and windows. They are screwed to the edges of the doors or windows and rebates in the frame. The flanges or wings of the hinges are made of either cast iron, malleable iron or steel,

and the wings have counter-sunk holes to receive the heads of the screws used to hold the wings to the door or window and frame, Their length varies from 1 to 29 cm.



ii **Back flap hinges:** These hinges are used where the shutters are thin and butt hinges cannot be fixed to the edges. These are fixed to the back side of the shutter and the frame.

iii **Counter flap hinges :** This type of hinge is formed in three parts and has two centres. This arrangement allows the two flanges or leaves to be folded back-to-back.

iv **Rising bull hinges (or skew butt hinges or lifting butt hinges:** These hinges are sometimes used in place of ordinary butt hinges. These hinges raise the door by about 10mm on being opened, as they are provided with the helical knuckle joints. These hinges also allow the door to close automatically. These hinges thus allow the door to clear obstructions like carpets, mat, etc. On being opened.

v **Strap hinges:** This type of hinge is fixed to the ledged and braced doors and other heavy doors, such as stable doors, gates, etc. This hinge consists of straps or long arms which are fixed to the folding shutters and rebate in the frame. This hinge is used as a substitute for garnet or T-hinge.

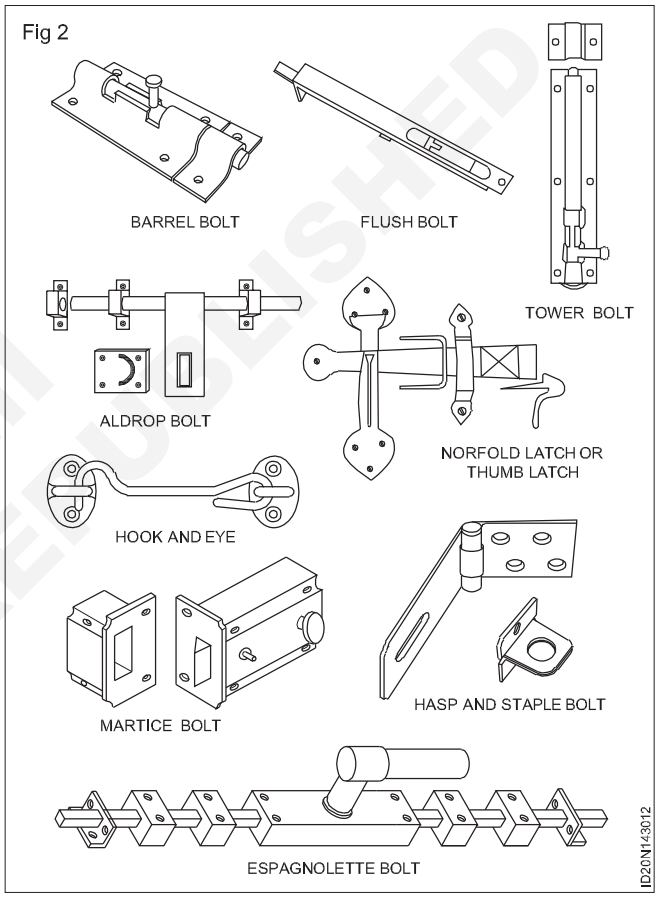
vi **Narmadi:** This is fixed on heavy doors. The pin on which the step rotates is fixed into the wall or frame.

viii **Garnet hinges or T-hinges:** This type of hinge consists of a wrought iron strap pivoted to a metal plate and has a length varying from 25cm to 60cm. The straps or long arms of the hinges are fixed to the folding shutters whereas the places of hinges are screwed to the door posts. These hinges are used on planked shutters such as ledged and battened doors, ledged and braced doors, etc.

viii **Spring hinges:** These hinges, either single-acting or double-acting are used with swinging doors. In this, the door or window shutters automatically close when not in use because of spring action.

ix **Parliamentary hinges:** This is a special type of hinge, which is used for hanging the doors, such that the shutters when opened do not cause any obstruction. This hinge enables the door shutter to rest against the wall when opened.

2 **Bolts (Fig 2):** The various types of bolts commonly used are illustrated in Fig 2 and are described below:



i **Barrel bolt:** This is used for fixing up the back faces of the external doors. The plate is screwed to the inside of the door and the bolt engages in a barrel or metal socket fixed on the door frame. This bolt is usually made of either iron, brass or bronze and has a length varying from 10 to 40cm.

ii **Tower bolt:** It is similar to barrel bolt and is used for fixing up the back faces of the doors, except that instead of barrel, there are two or three staples fixed on the door frame.

iii **Flush bolt:** This type of bolt is let into the doors either upon a face or on the edge such that it would flush with the face of the door. This bolt is used where the projecting bolt would be objectionable.

iv **Aldrop bolt:** This bolt, usually made of iron, is fixed on the external doors where a padlock is to be used.

v **Norfold latch or Thumb latch:** This consists of a lever pivoted at one end, with a hasp and staple fitted on the inside of the door. The lever is actuated by a trigger passing through the door and pivoted in the upper part of a vertical bow-handle. The latch can be released by pressing the trigger. This latch, which is used for securing the doors, is usually made of malleable iron or bronze.

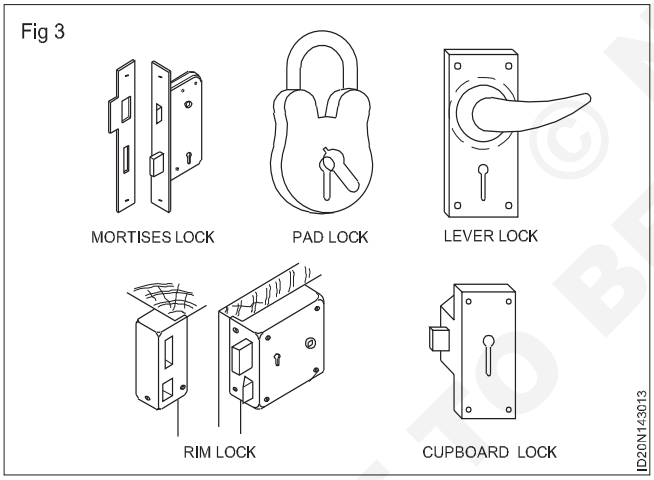
vi **Hasp and staple bolt:** This iron bolt is fixed on the external doors where a padlock is to be used. The staple is screwed to the door post and hasp is secured by two small bolts to the door.

vii **Espagnolette bolt:** This is an extension bolt which is generally used for securing tall doors and casement windows, the top of which cannot be easily reached. It consists of two long bolts, one of which secures the top and the other the bottom of the door or window shutter. Both bolts act simultaneously by turning the handle or level in the centre. This bolt is made of iron, steel or bronze.

viii **Hook and eye:** This is effectively used for keeping the window or door shutter open. The hook is fixed to the sill of door or window frame, and eye fixed to the bottom rail.

3 **Locks (Fig 3) :** The memo types of locks are illustrated in fig 3 and are described below

Fig 3



i **Mortise lock :** This type of lock is employed with doors having thickness 5cm and above. This lock is fixed on the edge of the door. Therefore, it is visible on the edge only.

ii **Cupboard lock :** This type of lock is used for securing the doors of minor importance of inferior work.

iii **Pad lock :** This type of lock is used for securing doors in temporary and common work when aldrop bolts or hasp and staple bolts are employed.

iv **Rim lock :** This type of lock is used for thin doors. This is fixed on the face of a door and screwed on its edge such that it has a projecting rim or flange.

Handles (Fig 4) : The handles commonly used on doors and windows are illustrated in fig 4 and are described below

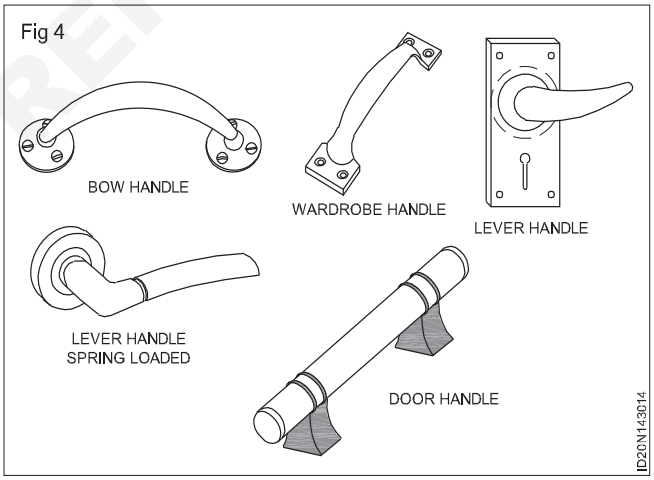
Bow handles : These are used to facilitate the opening of doors.

Lever handle : This handles is actuated by means of lever. The door gets closed automatically when the handle is released.

Wardrobe handle : This is used with wardrobe and has an elliptical shape. This is employed for better appearance.

The common varieties of fixtures and fastenings are described above. For superior work, special fittings are employed. The number of fixture and fastenings and their location on doors and windows are usually fixed by the architect or engineer in consultation with the owner. The fixtures and fastenings should be employed after considering several factors such as their effectiveness, appearance, durability, cost, working operation, safety against burglars, weather effects, material, etc.

Fig 4



Types of doors

Objectives: At the end of this lesson you shall be able to
- **describe different types of doors.**

Doors: A door may be defined as a framework of wood, steel, aluminum, glass or a combination of these materials secured in an opening left in a wall for the purposes of providing access to the users of the structures, it basically consists of two parts i.e. (i) A frame and (ii) shutter (leaf);

The frame is normally made up of timber. Shutters are generally made up of timber framework with panel inserts of glass, timber, plywood, block board or a combination of such materials. In case of steel doors, the shutters are made of frame work or rolled steel section with panel inserts of glass or steel plates. Next to steel, aluminum is the metal largely used in the manufacture of doors. Aluminum doors are considered to be the best as they are rust proof and present an elegant appearance. However since aluminum is costly as compared to timber or steel, use of aluminum doors is normally restricted to public building.

Location of Doors : The following guidelines should be kept in view while deciding the location of doors in a building.

1 Adequate air circulation within the room, should be provided .The doors should be provided in opposite walls facing each other.

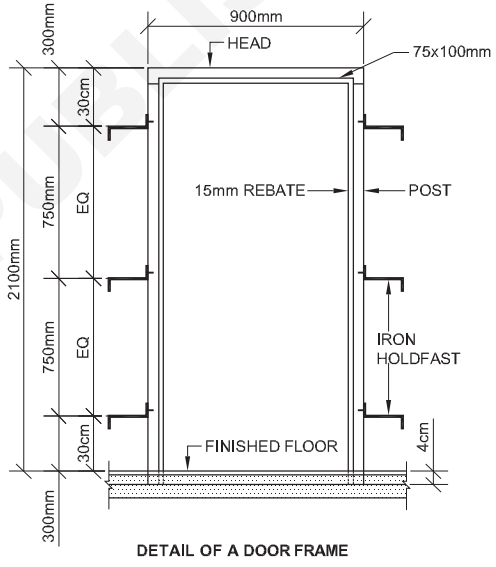
2 Doors should have proper utilization and privacy .Doors should be as far as possible. It can be located near the corner of a room ,but about 20cm away from the corner.

3 The location of the door should meet the functional requirement of the room.

4 The number of doors in a room should be kept minimum to achieve optimum utilization of space. Large number of doors besides causing obstruction, consumes more area in circulation.

Size of Doors (Fig 1) : The size of door to be adopted for a room depends basically upon the functional of the room. In case of W.C. or bath room where only one person is expected to go at a time a door width of 75cm is considered adequate. On the other hand, the size of a garage door should be such that it may permit a car to pass through. In general, the size of the door adopted should be such that it will permit the movement of the largest object likely to pass through the door opening. Commonly adopted size of doors for different types of buildings is given below.

Fig 1



Sl. No.	Types of building	Size of door in mm
1	Doors of Residential buildings (a) External door (b) Internal door (c) Door for W.C.	 1000 x 2100 900 x 2100 800 x 2100
2	Doors of public building like School, Hospital, Library etc.	1200 x 2100
3	Doors of garage for cars	2250 x 2250

Materials used for Doors : Materials used for door includes wood, glass, plywood and metals.

The wood is the most common material used for doors, as it can be moulded in a variety of shapes and can have a decent appearance.

The glass which is used for panels in doors admits more light.

Plywood can also be used as covering material.

Identify the parts of door (Fig 2)

1 **Frame (Fig 3) :** A door frame essentially consists of two vertical members known as posts and horizontal member at the top known as head.

BIS Recommended for Door size			
No.	**Designation**	**Size of opening (mm)**	**Size of Door frame (mm)**
1	8 DS 20	800 x 2000	790 x 1990
2	8 DS 21	800 x 2100	790 x 2090
3	9 DS 20	900 x 2000	890 x 1990
4	9 DS 21	900 x 2100	890 x 2090
5	10 DS 20	1000 x 2000	990 x 1990
6	10 DT 21	1000 x 2100	990 x 2090
7	12 DT 20	1200 x 2000	1190 x 1990
8	12 DT21	1200 x 2100	1190 x 2090

Fig 2

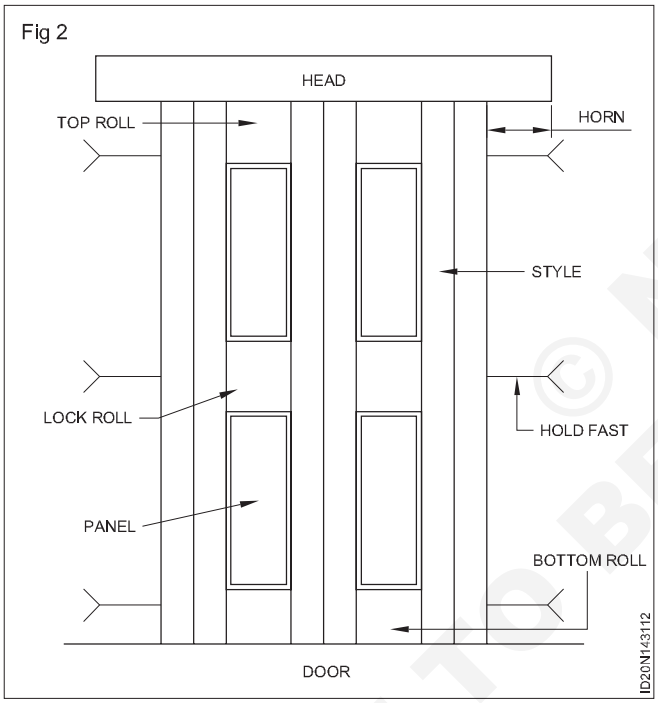
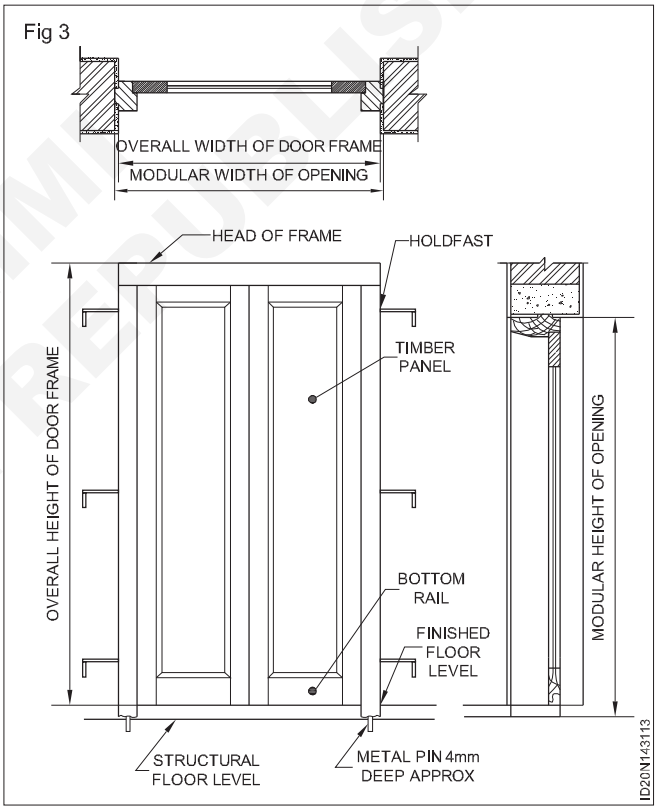


Fig 3



2 Hold Fasts (Fig 4): These are made of mild steel irons 30-40 mm side and 6m thick . The length of the hold fast is 20 or 30 cm.(Fig 4)

3 Horns: These are the projection of the head or sill on both the sides in the direction of hold fast. These are also embedded in the masonry work along with the hold fast for fixing the frame in position.

4 Shutters: These are the swinging parts of the door, which are fixed by means of butt-hinge with the frame.

5 Rebate: It is formed on the insides of the frame in all the jambs head and sill to receive the door shutter The main function of the rebate is to allow the lapping of the shutter with the frame and provide complete privacy inside the room when the door shutter is closed.

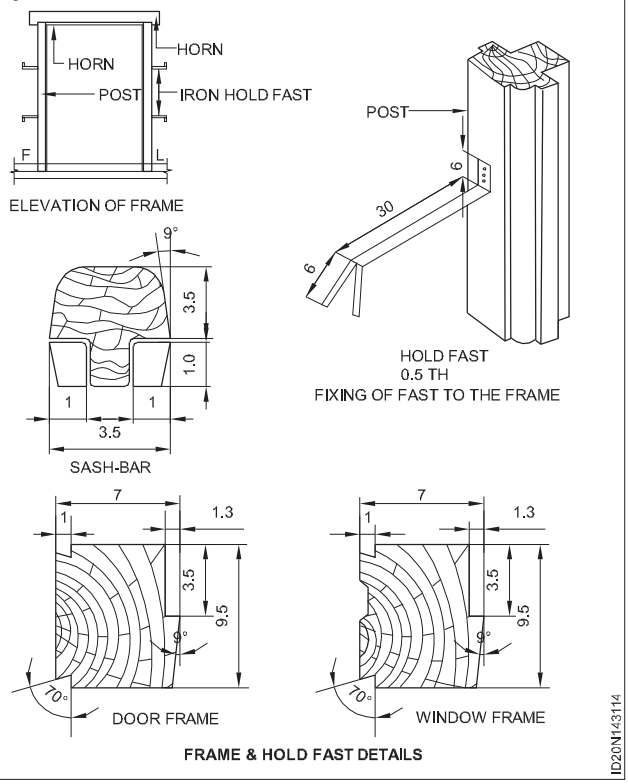
6 Style: Outside vertical members of shutters are known as styles.

7 Top-rail: It is the top most horizontal member of the shutter.(Fig 5)

8 Bottom-rail: It is the lower most horizontal member of the shutter.(Fig 5)

9 Lock-rail: The horizontal rail member of shutter provided at about 1/3 height from bottom, over which the sliding bolts or locks are fixed is known as lock rail.

Fig 4



FRAME & HOLD FAST DETAILS

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10 Mullion: It is the vertical member running through a shutter which sub-divides it vertically It is not provided in the entire shutter.(Fig 5)

11 Louvers: The inclined pieces of timber fixed in the shutter horizontally for admitting air, but obstructing the vision.

12 Panel: The part of shutter fixed insides the vertical styles and horizontal rails.(Fig 5)

Types of Door Frame

Door frame is made up of two vertical members known as jambs or posts and a flat member connecting the jamb at top called head. The cross-sectional dimensions of the jamb and the head are normally kept same. The size of door frame is worked out after allowing a clearance of 5mm., all-round for convenience of fixing the frame in the opening. Frames made from timber and steel are described below

1 Timber Door Frame (Fig 6) : In case of doors having one shutter, the size of the jamb or head is taken as 60mm. thick and 100 mm. wide in case of doors having two shutters, the width of the frame member is increased from 100mm. to 120 or 140mm.

Fig 5

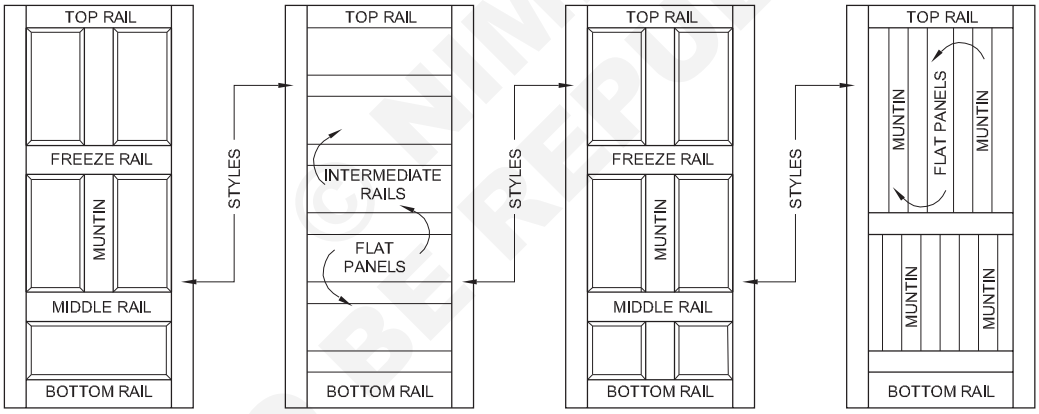

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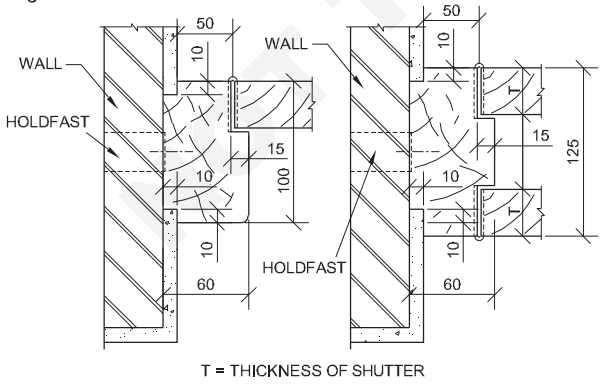
Fig 6



SECTIONAL PLAN SHOWING DETAILS FOR SINGLE AND DOUBLE SHUTTERED DOOR FRAMES

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The members are rebated for accommodating plaster and the shutter. The rebated for accommodating the shutter should not be less than 15mm. in width, the depth being equal to the thickness (T) of the shutter. Details of frames having (i) shutter on one side and (ii) shutters on either side (kitchen door having double shutter i.e., fly proof shutter on one side paneled shutter on the other).

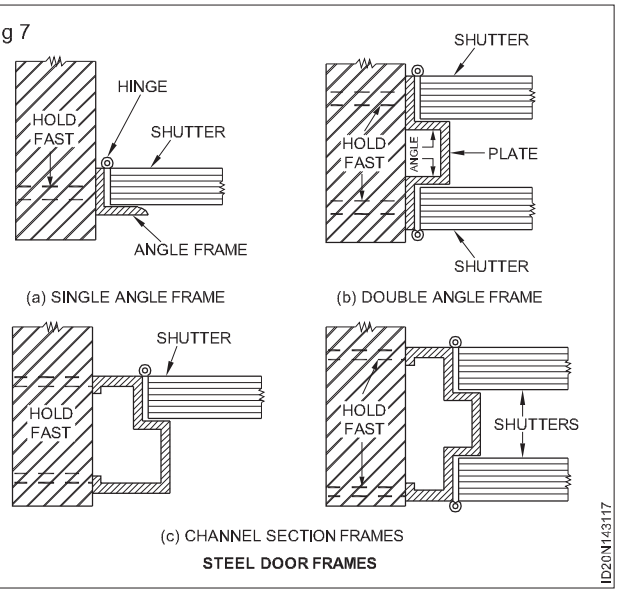
The jambs are usually tenoned into the head and wedge. Sometimes the head projects out by about 7cm. from the jambs. The projected portion is known as horn which helps in securing the frame head to the masonry. However a horn creates difficulties at time of repair or replacement of the frame and as such provision of horns is getting absolute these days.

Alternatively the head may be tenoned into the mortises made in the jambs and pinned with 8mm. F nails or 10mm. F hard wood bamboo pins.

2 Steel Door Frames (Fig 7) : Steel door frame can be made out of angle Tee, channel or pressed steel plates. As in case of timber frame, in this case too there are two jamb posts and a head. At the joints the members are either welded or rigidly fixed together by

mechanical means. Sometimes a horizontal member (angle iron) is also provided to fix the jambs at base at floor level. This member is known threshold. In case of steel frames the holds fasts or lugs and the hinges are invariably welded to the frame.

Fig 7



STEEL DOOR FRAMES

Types of Doors : Depending upon the type of material used, arrangement of different components, method of construction and nature of working operation, doors can be broadly classified into different types as under :

1 Battened and ledged doors

2 Framed and panelled doors

3 Glazed or sash doors

4 Flush doors

5 Revolving doors

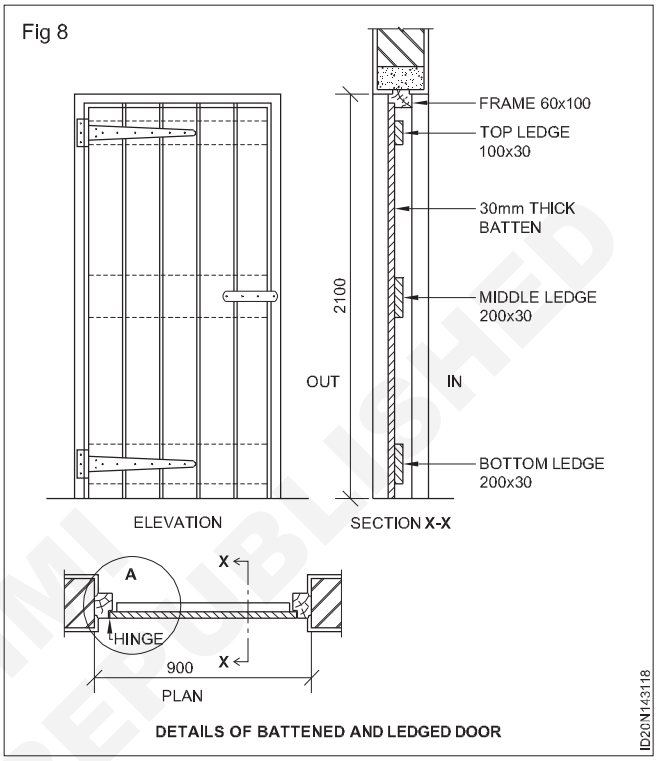
6 Sliding doors

1 Battened and Ledged Door (Fig 8) : This is the simplest form of door commonly used for narrow openings. The door consists of a series of vertical battens or board usually tongued and grooved and fixed together with horizontal battens known as ledges. There are three ledges one each is fixed near the top and bottom and third one is fixed in the middle of the shutter. The middle ledge is also known as lock ledge. The battens are 75 to 100mm. wide and 20mm thick. The thickness of ledges varies from 25 to 30 mm and generally the middle and bottom ledge are wider than the top one. The top ledge is 110mm. wide while the middle and bottom ledges are each 175 to 200mm wide. The door is hung on the frame by iron hinges (called T-hinges or cross garnets) fixed on the ledges.

This type of door, is recommended for W.C.'s bathrooms etc. in buildings where economy rather than the appearance is of main consideration.

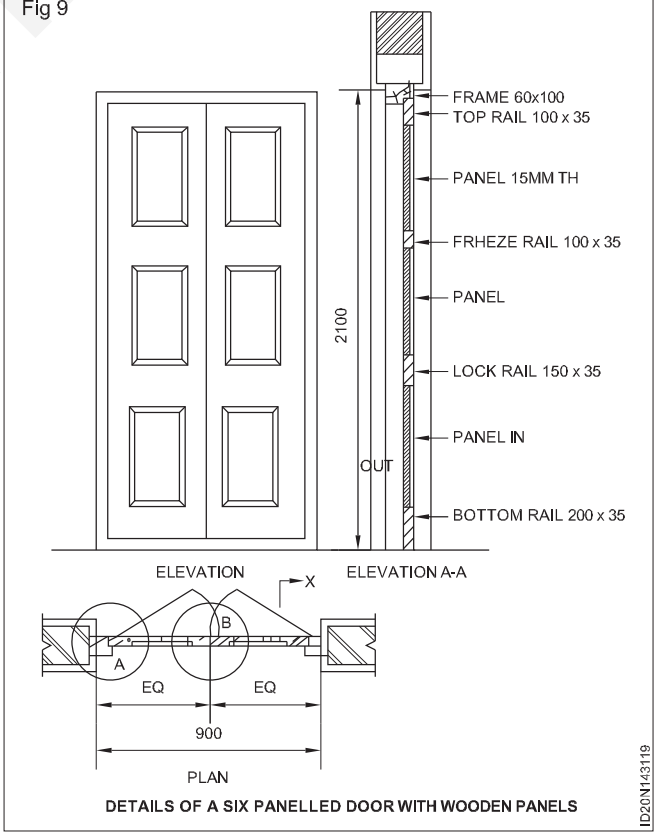
2 Framed and panelled door (Fig 9) : This type of door is commonly provided in all types of buildings. This door consists of timber frame work of styles and rails which are grooved on the inside to receive one or more panels. Framed and panelled doors are made in several designs to suit the functional as well as architectural requirements. The door may be single, double; three, four or six panelled and so on. The panels can be of timber, plywood, block board or hard board. Timber panels are fixed within the grooves in the frame. However, additional timber beading is also provided either on one or both sides to improve and panelled doors.

Fig 8



DETAILS OF BATTENED AND LEDGED DOOR

Fig 9



DETAILS OF A SIX PANELLED DOOR WITH WOODEN PANELS

A review of the figures will indicate the following important construction details.

1 The stiles are continuous from bottom to top

2 Different rails, i.e. top rail, bottom rail, lock rail and frieze rail are jointed to the styles.

3 Mullions or munitions, if any, are jointed to the rails.

4 Bottom and lock rails are of bigger size than the top and frieze rails.

5 The lock rail is so placed that its centre line is at height of 800mm. from the bottom of the shutter.

6 The stiles and the rails are mortised and tenoned.

7 In case, the panel inserts are of timber, the minimum
width and thickness of timber panel should not be less than 150mm x 15mm.

8 In case of plywood, particle board or hard board panels, there is no restriction or minimum or maximum size of panel. However, for single panel a door, the thickness of plywood, doors should not be less than 12mm.

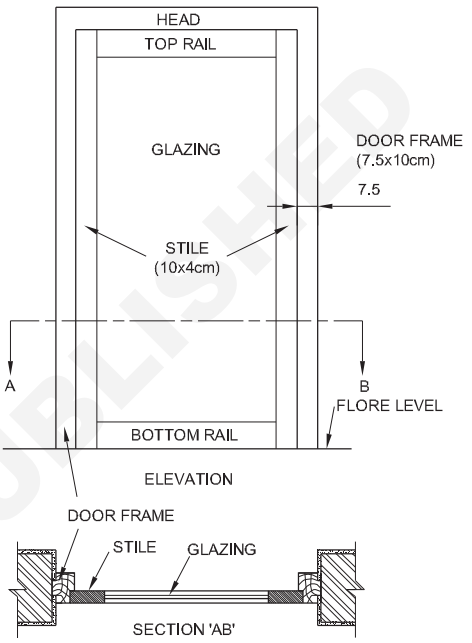
9 The width of stiles is normally 10cm, and the bottom and lock rail are 15cm. wide each. The thickness of shutter can vary from 3cm. to 5cm. depending upon the size of door, thickness of panels the situation of door and type of usage.

3 Glazed or Sash Door (Fig 10) : This type of door is used in residential as well as public buildings like hospitals, school or colleges etc. with a view to supplement the natural lighting provided by windows or to make the interior of one room visible from the adjacent one. Glazed or sash doors are made in several designs. they can be glazed fully or partly. Fully glazed door are recommended in situations where shopping or display centre, lobbies, entrance hall etc. In case of partly glazed doors normally the bottom 1/3rd height of the door is panelled and the remaining 2/3rd height is glazed. In case of partly glazed doors, the stiles are sometimes diminished at lock rail to improve the elevation and to permit more area of glazing in the process. The diminishing stiles are known as gun stock stiles.

4 Flush Doors : With the large scale production of plywood and face veneers, use of flush doors has become very popular these days. Flush doors have pleasing appearance, simple construction, high strength and durability and cost less as compared with panelled doors. These doors are commonly used in residential as well as public buildings. Flush door shutter consists of a solid or semi-solid framed skeleton (core) covered of both faces with either plywood or a combination of cross bands and face veneers giving perfectly flush and joint fewer surfaces. In case commercial type plywood or face veneer is used for the face panel the door is termed as commercial type plywood or face veneer is used for the face panel the door is termed as commercial type flush door. Similarly if decorative type of plywood or face veneer is used for face panel, the door is named as decorative type of flush door.

Decorative type flush doors cost more than commercial type flush doors. Flush door shutters are manufactured in standard thickness of 25, 30, 35 and 40mm. 25mm. thick shutter is considered suitable for door openings upto 30cm x 210 cm in size 30 mm or 35mm thick shutter is used for door opening of 90cm x 210 cm in size whereas 40mm thick flush door shutter is recommended for door openings ranging from 100cm x 210 cm to 120cm x 210 cm in size.

Fig 10



DETAILS OF FULL GLAZED OR SASH DOOR (SINGLE GLASS PANEL)

Types of Flush Doors

Flush doors can be broadly divided in following three types

1 Solid core type flush doors

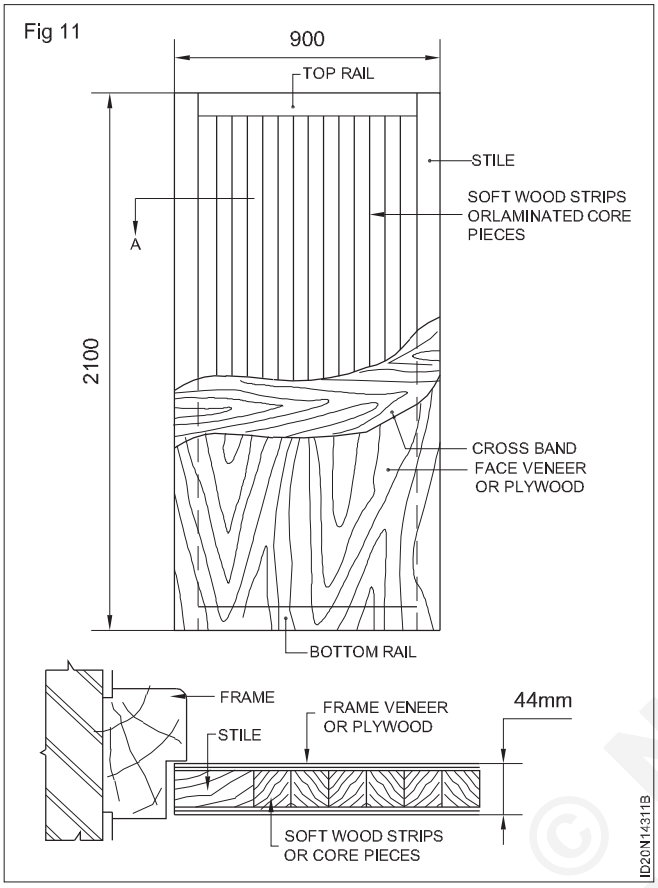
2 Cellular core type flush doors

3 Hollow core type flush doors

Solid Core Type Flush Doors (Fig 11) : In this type, the wooden frame used for holding the core consists of stiles, top rail and bottom rail, width of each member being not less than 5cm. The frame is made out of selected species of timber. Where it is not possible to use same species of timber for the frame, it is necessary to provide hard wood lapping around the frame to achieve required strength and durability. The width of lapping should be equal to the thickness of the core and its depth should not be less than 25mm. The solid core for the door consists of block board (laminated core), particle board or a combination of particle board and block board. The laminated core or block board. The strips can also be jointed, such joints should, however, be staggered.

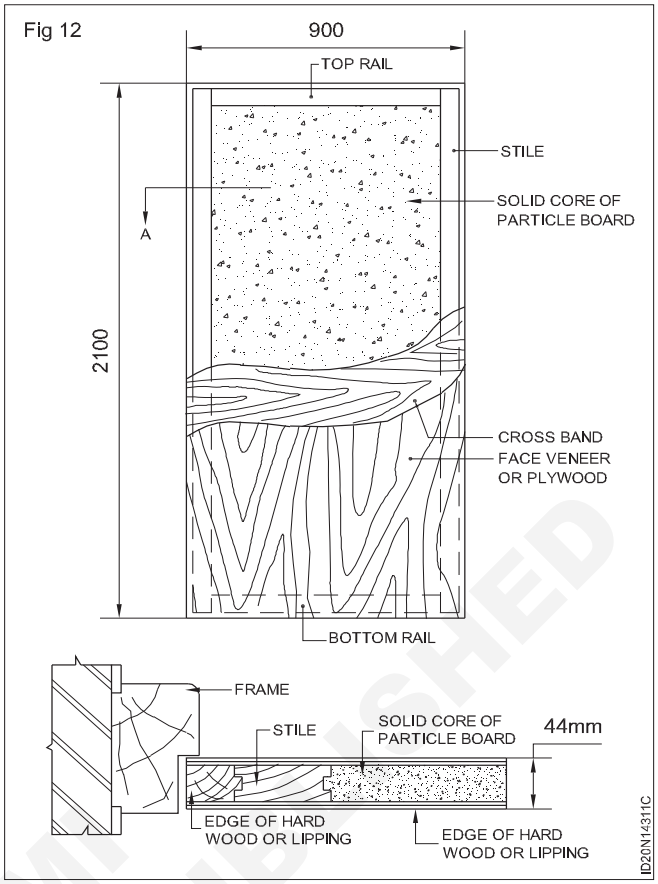
Plywood sheets are glued under pressure to the assembly of core housed in the frame on both faces. Instead of plywood sheets, separate cross bands and face veneers can also be used. However, when cross bands and face

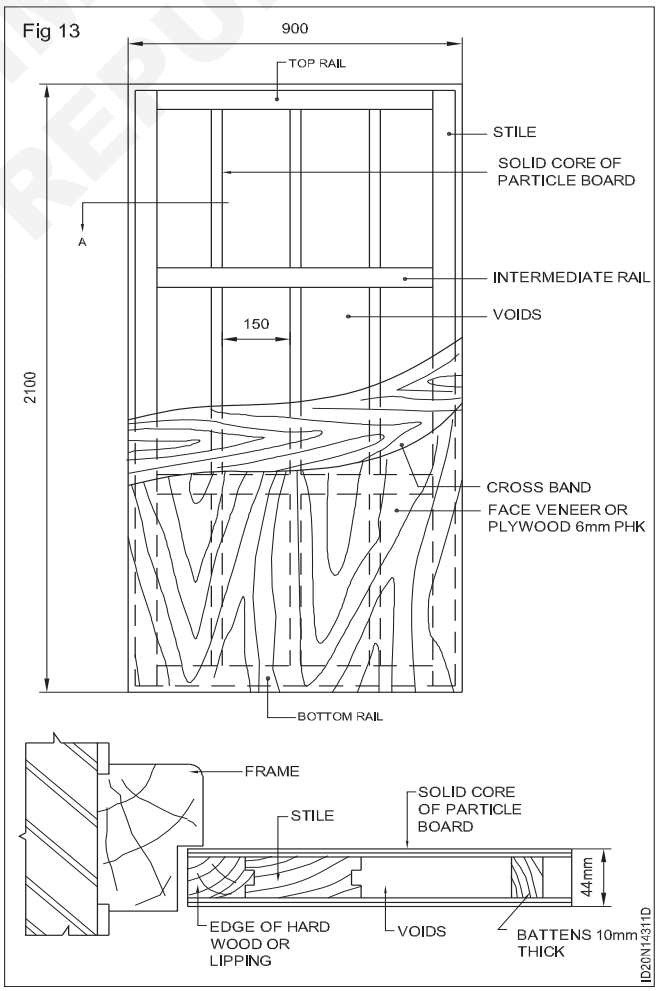
veneers are glued separately, the cross bands should be laid with their grains at right angles to those of the core and glued on its both faces Face veneers are thereafter laid with their grains at right angles to those of the cross bands and are glued to the cross bands. The thickness of the plywood or the combined thickness of cross band and face veneers should not be less than 3mm.



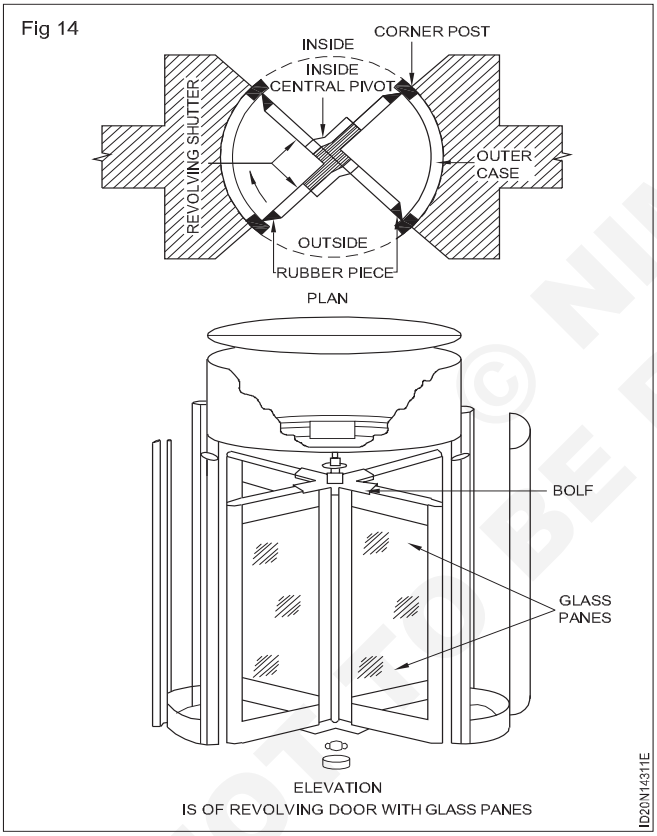
Cellular Core type Flush Doors (Fig 12) : In this type, the timber frame is constructed from stiles, top rail and bottom rail each not less than 75mm wide. The cellular core is formed by fixing wooden or plywood battens not less than 25mm. In width of the frame in such a manner that the voids formed do not exceed 25 cm2 in area. In addition the voids are uniformly distributed and total contents of the void is not more than 40% of the area of the shutter. The door shutter is formed by gluing under pressure, plywood sheets or cross bands and face veneers on both faces of core. The thickness of the plywood should not be less than 3mm.

Hollow Core type Flush Doors (Fig 13) : In this type, the frame consist of stiles, top rail, bottom rails and minimum 2 intermediate rails-each not less than 75mm. in width. The space between the stiles and the rails is divided by fixing wooden battens not less than 25mm. in width in such a manner that the voids are equally distributed and area of any void remains less than 50cm2. Instead of battens, rolls or strips of veneers can also be used for forming core. Plywood sheets or combination of cross-bands and face veneers are then glued under pressure on both faces of the core. The thickness of plywood used should not be less than 6mm. in this type of shutter. (Fig 13)

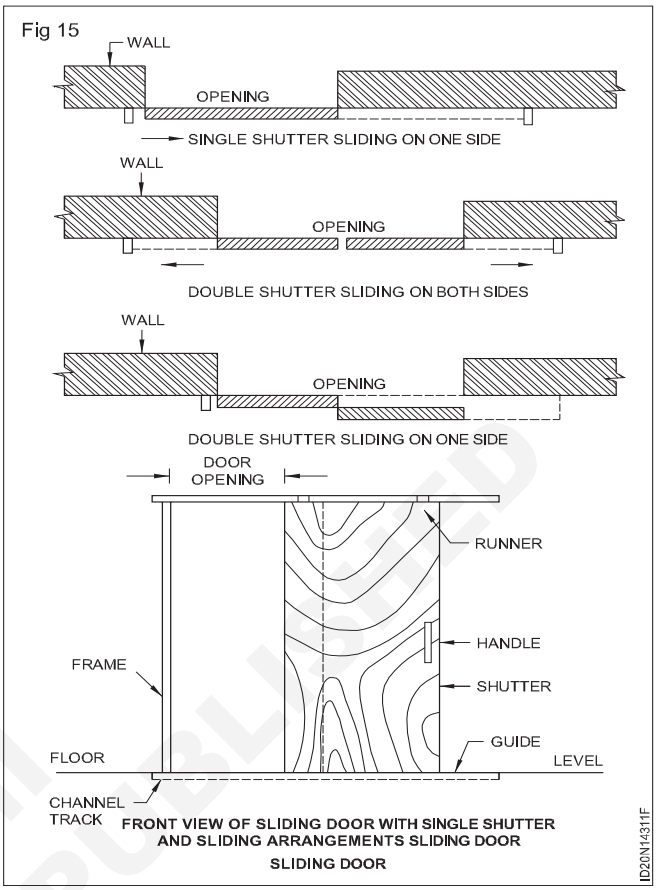




5 Revolving Doors (Fig 14) : Revolving doors provides entrance on one side and exit on the other simultaneously keeping the opening exclude the wind draught. This type of door is so assembled as to provided in places where there is a regular foot traffic of people entering in and going out of the building especially when it is air conditioned or situated in a place where strong winds blow for most part of the year. The door essentially consists of four leaves radically attached to the centrally placed mullion in a circular opening. The mullion or the central number is provided with ball-bearing at the bottom bush bearing at the top so as to enable the door to revolve smoothly without producing jerks. The leaves and the mullion are enclosed in a vestibule. At their edges the leaves are provided with rubber pieces which fit flexibly against the inside face of the vestibule. The attached leaves may be glazed, panelled or partly glazed and partly panelled. Such doors are commonly provided in hotels, banks, offices and other such important public buildings. (Fig 14)



6 Sliding Doors (Fig 15) : This type of door is considered suitable for shops, shades, god owns, garage, etc. and in places where the use of hinges for fixing the shutter is to be avoided. Depending upon the size of the opening, and the space available on either side, the door can have single, double or more number of leaves or shutters. The door is provided with top and bottom guide rails or runners within which the shutters slide. The guide rails run past the opening for a distance equal to the width of the shutter so that when the door is required to be opened. The door shutter occupies a new position parallel to the wall face and clear off the opening. The shutters are also provided with locking arrangements, handles, stopper etc. (Fig 15)



7 Louvered door (Fig 16 A, B, C, D)

- In Louvered doors, the spaces between the rails are filled by a series of wooden leaves (louvers) overlaying each other.
- The leaf being loosely pinned in the styles, so as to allow of an upward and downward motion to a certain extent.
- The louvers are arranged at such an inclination that the horizontal vision is obstructed.
- The louvers may be movable or fixed. In case of movable louvers a vertical piece of timber is provided to which louvers are attached.
- The movement of Louvers is activated by the vertical piece of timber.
- The louvers may be either of wood or glass.
- The louvers should be kept sloping away from the inner portion to prevent the entry of moisture.
- Louvered doors admit a free passage of air and light.

Uses: They are used for sanitary blocks of public buildings and residential buildings.

8 Wire gauged doors : In wire gauged doors wire mesh is provided in the panels. They are provided to check the entry of flies, mosquitoes, insects etc.

The door is formed of wooden frame work consisting of styles and rails.

The panel openings are fitted with fine mesh galvanised wire gauge.

Generally, the door has two shutters. Inner shutter is panelled while the outer shutter has wire gauged panels.

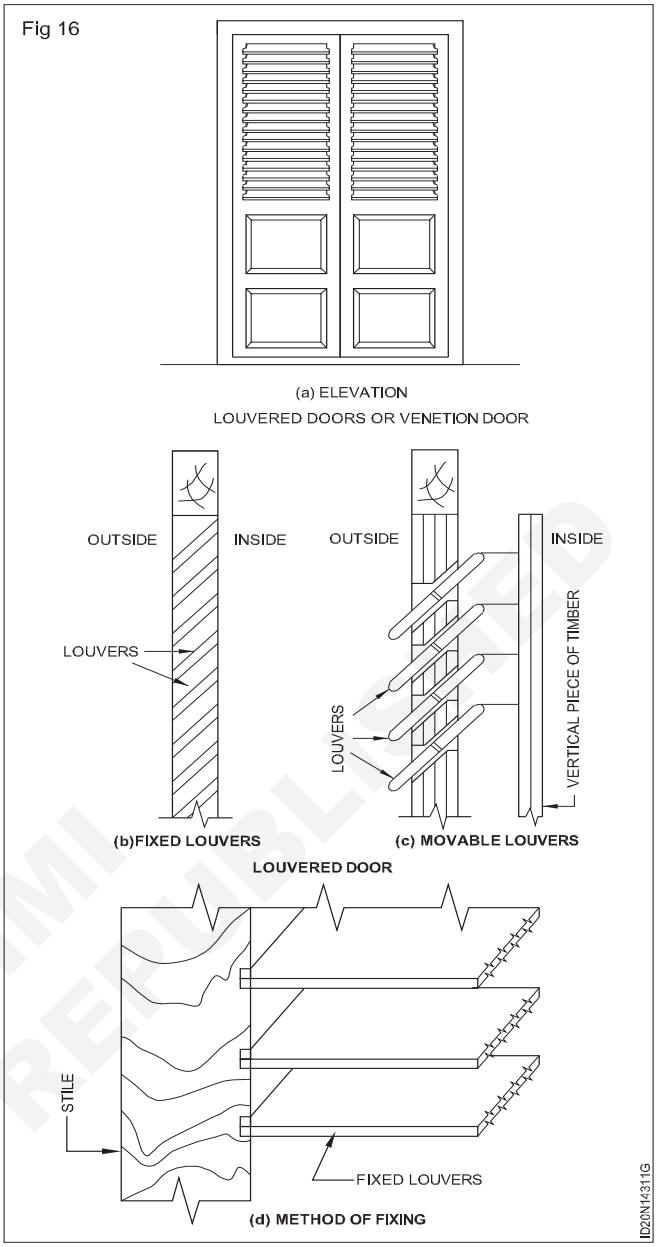
Uses: They are used for refreshment rooms, hotels, cupboards, containing food and eatables etc.

9 Swinging doors: Swinging doors, which may either the single acting type or double acting type, are used in passages in public buildings, like offices, banks, etc, and also in kitchen pantries, dining rooms etc.

In addition to the door swinging action in one or both the directions, they may have one leaf or shutter hinged on one edge or may have two leaves (or shutters). hinged on the opposite edges and meeting at the centre. The shutters are fixed with special hinges known as double action spring hinges which hold the shtter in closed position when not in use.

Since these doors open in both the directions by pushing, so it is desirable to provide glass panels to enable the users to see the objects on either side. This is essential to avoid the collisions among foot traffic. In case of glazed swinging doors, glazing should be carried out with wired plate or protected by suitable means so that glass panels do not come out due to repeated spring action during swinging. The meeting stiles of such doors should have segmental edges and should not be rebated.

Fig 16



Types of windows

Objectives: At the end of this lesson you shall be able to
- **describe windows and state its types**
- **describe ventilators**
- **describe fixtures and fastenings.**

Introduction: A window may be defined as an opening made in a wall for the purpose of providing day light, vision and ventilation. The construction of window is identical to that of door. Window consists of a window frame and shutter. The frame consists of two vertical members called jambs, one flat member connecting the jambs at top, known as head and another flat member connecting the jambs at their feet. Knows as sill. The windows can be fully glazed, panelled and glazed or panelled type. Windows are normally provided with two leaves. The selection of size, shape, location and the number of windows to be provided in a room depends upon the following considerations.

i Size of room to be lighted

ii Location of the room and its utility

iii Architectural treatment is to be given to the building

iv Direction of wind and its speed

v Climatic considerations of the site such as humidity, temperature variation etc.

Based on the above, following thumb rules have been framed to determine the area requirements for windows in a room. The size and hence the number of windows can thus be worked out, once total area required for window opening is known.

a Total area of window opening should normally vary from 10 to 20% of the floor area of the room. In hot and arid regions it could be 10 to 15% of the floor area. When the building is to be located in hot and humid regions, the area of window openings should vary between 15 to 20% of the floor area.

b In case of public buildings like, schools, offices, factories, hospitals etc. the minimum area of windows should be 20% of the floor area.

c For adequate natural light, the total area of glass panels in windows should be at least 8% of the floor area.

Design of Windows : The points to be kept in view while making provision for windows in a room are:

1 The size and number of windows should be sufficient to provide adequate light and ventilation in the room.

2 Windows should be located opposite to each other wherever possible. Windows provided on Northern side gives maximum day light without glare.

3 The windows sill should be placed at 75 to 100cm, above the floor level. This is considered reasonable height for the inmates to have a consistent look outside. In case of bath and W.C., and the other situations where privacy is desired, window sill should be kept at 1.75m above the floor level. The top of windows and doors should however be at the same light.

4 Buildings in humid region need special attention for adequate ventilation of the room. The area of window opening in humid region should be maximum and the window should be so located as to permit maximum ventilation of the apartment.

5 The shutter of windows in external walls should open outside. This checks entry of rain water inside the room.

6 All external windows, specially the one's on ground floor, should be provided with mild steel round or square bars or steel grills to safe guard against theft.

7 Windows in external wall should be provided with Chajja projections to prevent the entry of the rainwater in the room. Similarly it is desirable to slope the window sill towards the external face of wall. The sill should preferably be weathered and throated to throw the rain-water off the face of wall.

Recommended dimensions for windows

No.	Designation	Size of opening (mm)	Size of window frame (mm)	Size of window (mm) shutters
1	6 WS 12	600 x 1200	590 x 1100	500 x 1100
2	10 WT 12	1000 x 1200	900 x 1190	900 x 1100
3	12 WT 12	1200 x 1200	1190 x 1190	1100 x 1100
4	6 WS 13	600 x 1300	590 x 1290	500 x 1200
5	10 WT 13	1000 x 1300	990 x 1290	460 x 1200
6	12 WT 13	1200 x 1300	1190 x 1290	560 x 1200

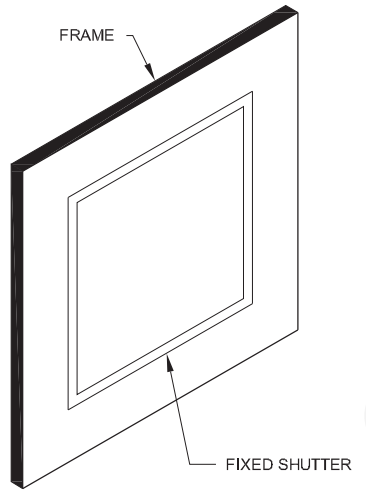
W - denotes window , S - denotes single shutter , T - denotes the two (double) shutter

Types of windows : Windows are classified as follows, based on the nature of optional movements of shutters, materials used and the manner of their fixing and their location.

1	Fixed window	2	Casement window
3	Sliding window	4	Sash window
5	Louvered window	6	Metal window
7	Bay window	8	Dormer window
9	Gable window	10	Skylight

1 Fixed windows (Fig 1) : In place of where the vision and light only required the fixed windows are recommended because the glass panes or the glazed shutter is permanently fixed in the openings of wall itself.

Fig 1



FIXED WINDOW

2 Casement windows (Fig 2) : It is a window whose shutters open like doors. The construction of this window is similar to the construction of a door. The window has a frame and shutters composed of vertical and horizontal sash bars styles, and horizontal rails. The window frame consists of jambs, head and stil. It may have additional central vertical member known as mullion. Additional horizontal member known as transomes are also sometimes used. Sometimes, wooden frame of door and window can be made in one unit when window is located just touching the door. Shutters are constructed just like door shutters.

3 Sliding window (Fig 3) : Sliding windows are horizontal, with sashes that slide back and forth rather than up and down like more traditional windows. They are essentially double hung windows turned on their side.

4 Glazed or Sash window (Fig 4) : It is just a casement window having its shutters fully glazed. All the sash bars and inside edges of the stiles and rails are rebated to fix glass panels in it. The glass panels are secured in position with the help of either nails or putty or by small glazing beads. This window admits more of light into the room and gives better look than the ordinary casement window.

Fig 3

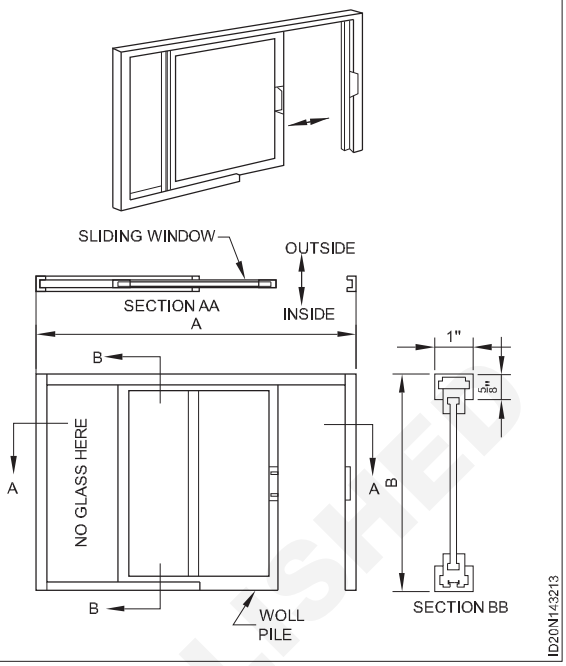
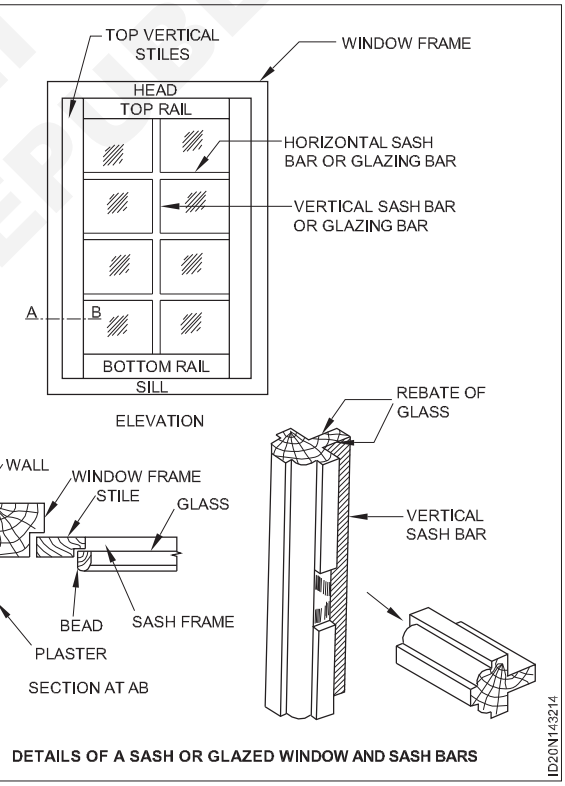


Fig 4

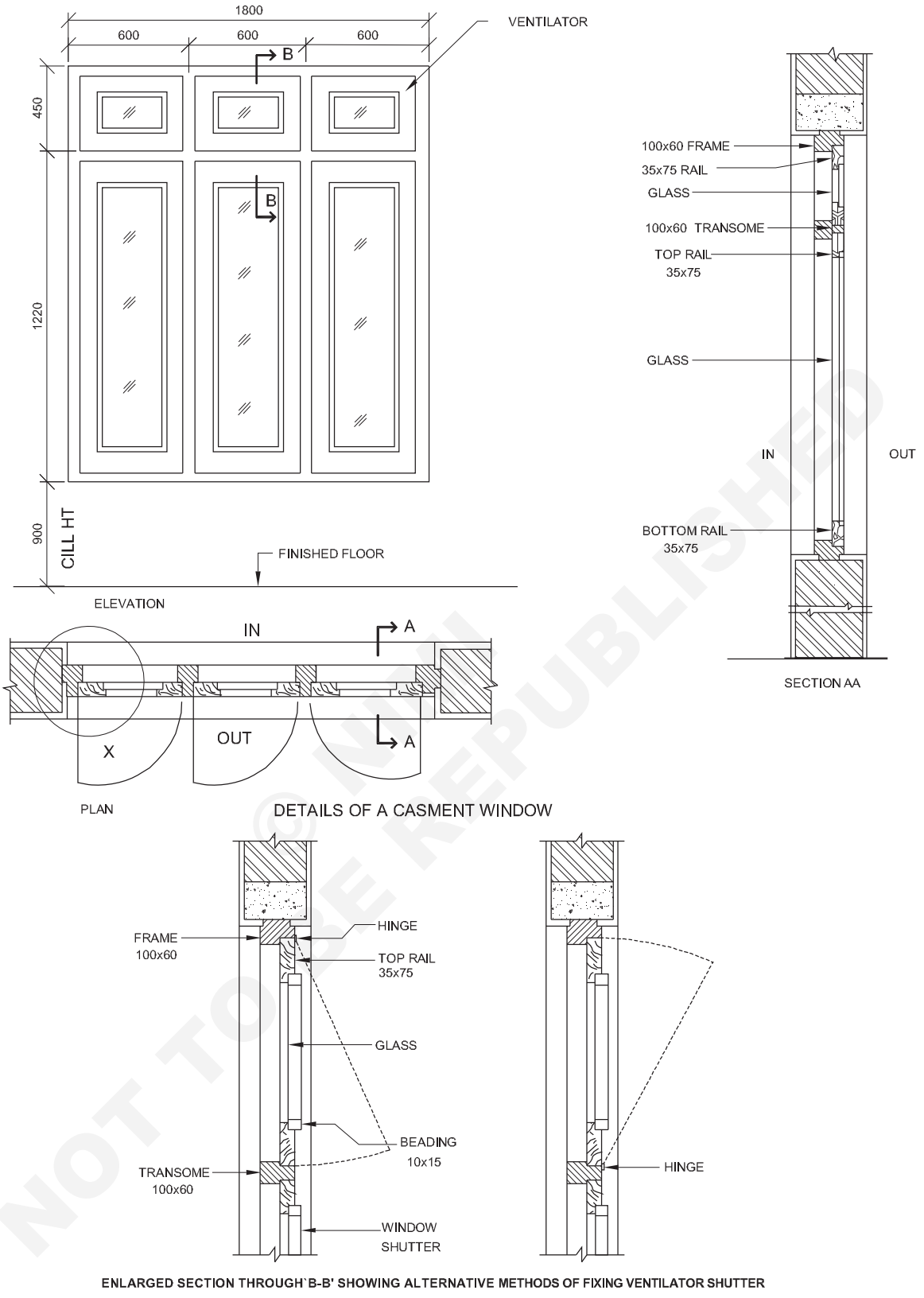


DETAILS OF A SASH OR GLAZED WINDOW AND SASH BARS

5 Louvered window (Fig 5) : The main purpose of this window is to receive both light and ventilation and privacy. Under the control of inmates when the opening is closed to regulate.

In this type the styles of shutters are grouped to receive a series of louvers as shown in Fig 5. This is noting but the save as louvered door. The sloped downward lower restricts the rain water and obstruct the horizontal vision.

Fig 2



The inclination is louvers are 45°. These windows are used at bathrooms, wc's and workshops.

Sometimes, the blades (louvers) are pivoted to the frame in addition every blade is connected by a small hinge in vertical pattern.

6 Metal windows (Fig 6) : Now-a-days windows made from aluminium,, bronze mild -steel etc, are coming increasigly in use in building construction industry. Aluminium and bronze windows being very costly can be used restictly in important works only. But use of mild steel window, has become very common. Mild steel windows are manufactured in wide range of standard sizes and shapes. Hence, window openings during construction of any building are left according to the size of the window desired to be fixed. These windows

come as full fledged unit and they can be fixed directly into the wall opening or through wooden frame. Metal windows are fixed during the construction of masonry work but they are fixed only after the masonry work is over and lintels above the window openings provided. This is done to avoid the possibilities of any structural load being transferred to the window ,which they are capable to withstand. Steel windows can be fixed in the openings by following methods:

Fig 5

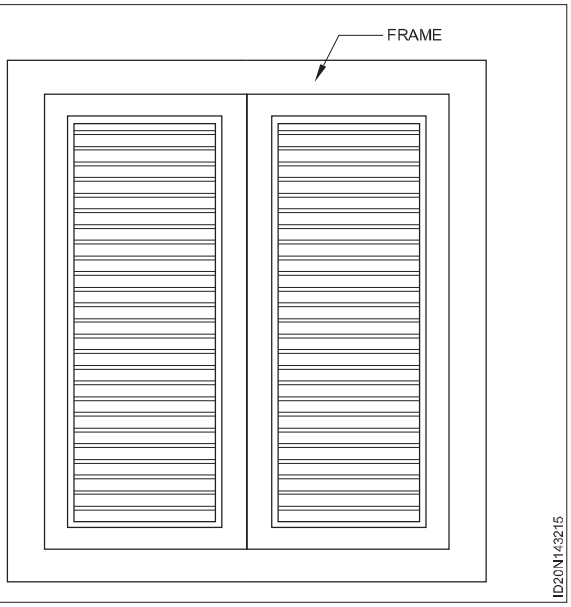
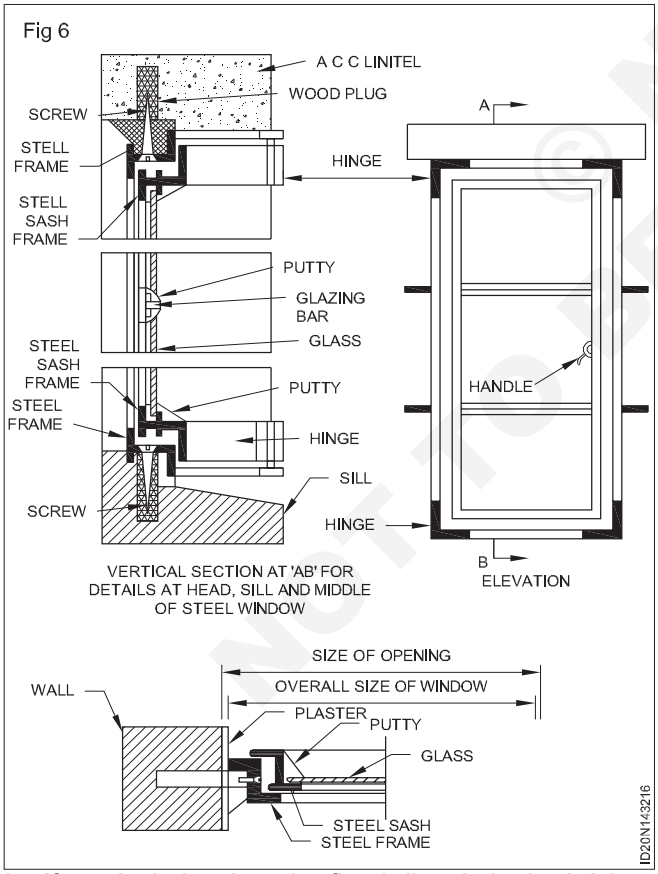


Fig 6



i If steel window is to be fitted directly in the brick or hollow concrete block mansory the positions of fixing holes are marked on the jambs. Holes are cut in the masonry and steel lugs are fixed in them tight with the help of cement, concrete of otherwise.

ii If window is to be fixed in R.C.C work or structural steel work ,the holes for fixing the window are left in the correct position in the opening at the time of construction.

iii In case window is to be fitted in a wooden frame,the wooden frame is rebated to fix the steel window. Window unit is set in the opening with the help of wooden wedges and lastly, fixed to the wooden frame with galvanized screws.

iv Window frames are made from special light rolled steel sections. The galvanized is fitted in the frame with the help of putty. One cost of primer should be applied to steel windows before they are installed in position. Another coat is given after fixing and last fine coat is applied after the glazing is fixed.Special Z sections are used for framework of steel windows and light T sections as sash bars

7 Bay window (Fig 7a,b) : The window projects outside the external wall of the room. The projection of bay window may start from the floor level or sill level. They may be square, splayed, circular or of any other shape. These windows provide increased floor level. They provide more of ventilation and admit more of light. They may improve the beauty of the building if numbers of such windows are provided in elevation.

Fig 7

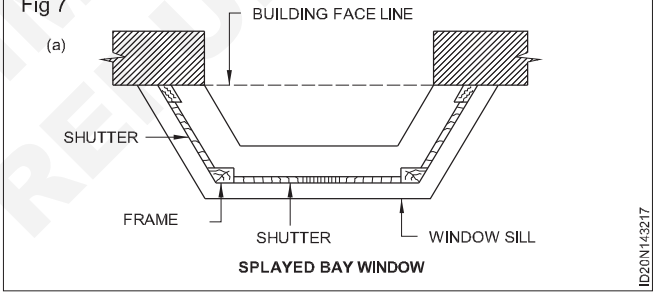


Fig 7 b

8 Dormer windows (Fig 8) : It is provided on the sloping roof of the building. The main purpose of providing dormer window is to admit light and air to rooms built within the slopes of the roof.

9 Gable window (Fig 8) : It is an ordinary window, which is fitted, in the gable end of the sloping roof.

Fig 8

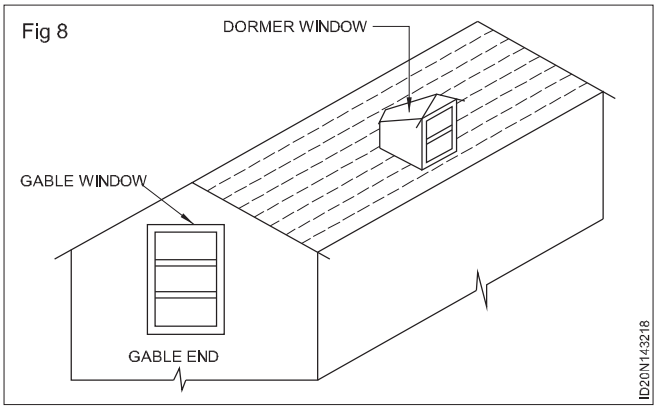
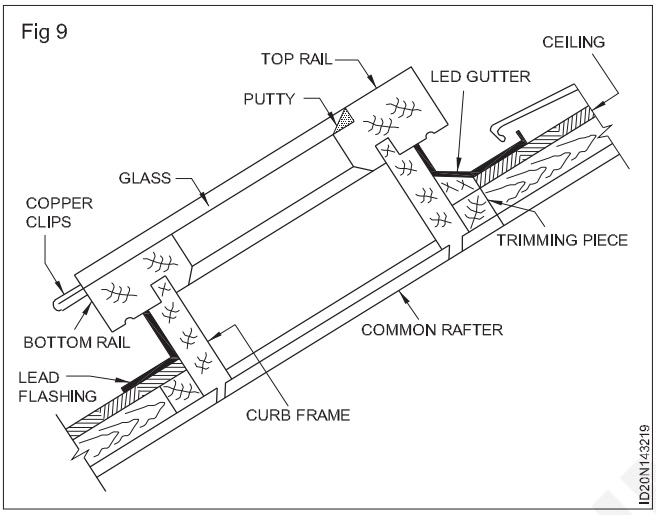
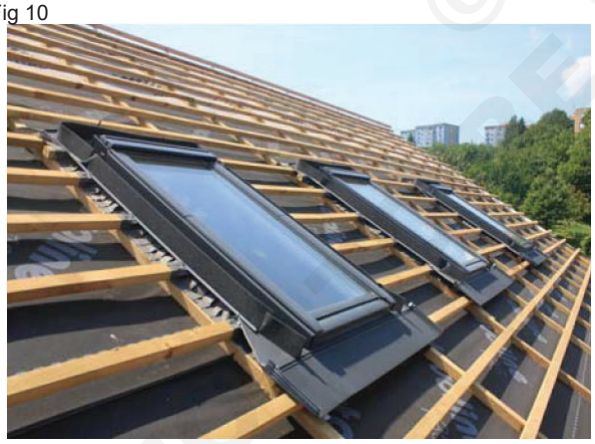


Fig 9



10 Skylight (Fig 9 & 10) : Skylight is the type of fixed window provided on the sloping surface of a pitched roof, the window being parallel to the sloping surface for light and ventilation.

Fig 10



The rafters are trimed to fix the skylight see.

The projecting top of frame is throated and lead flushings are provided for diverting rain water steel sky lights are now manufactured and are available in the market.

In mangalore or Allahabad tiled roofs, the purpose of a sky-light can be well sewed by glass tiles of the same pattern.

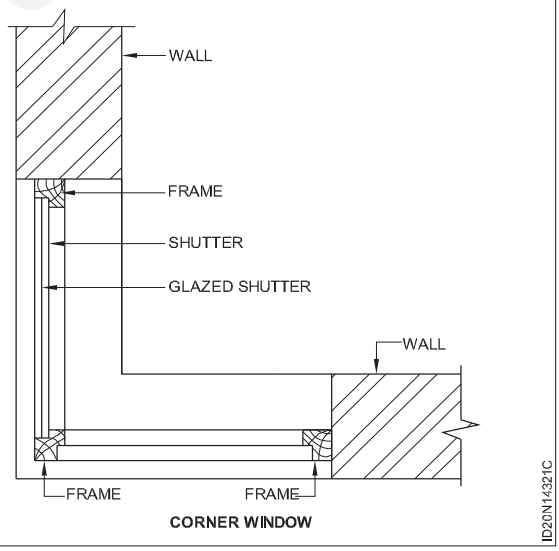
Ventilators (Fig 11) : Ventilators are narrow window near or just below roof level for ventilation purpose. Normally the shutter of the ventilator is horizontally.

Fig 11

Combined window and ventilator: The combination of windows and ventilators suitably made mainly for public buildings, which has larger floor area to provide more lighting and ventilation. Normally in this case the ventilators are of equal to the width of the window in this three panels, may be suited because control panel is of fixed type other than two by the sides can be operatable to open and close it may be centrally pivoted or top hung two cords from top and bottom rails provides the convenience of opening or closing as required.

Corner window (Fig 8) : These windows are provided at the corner of the room and thus they have two faces and two directions. Due to this there is entry of light and air from two directions and in many cases the elevation of the building is also improved. However special lintel will have to be casted at the corner and jamb posts of the window at the corner will have to be made of heavy section.

Fig 12



Fixtures and fastening

a Hinges

b Bolts

c Hardles

d Locks

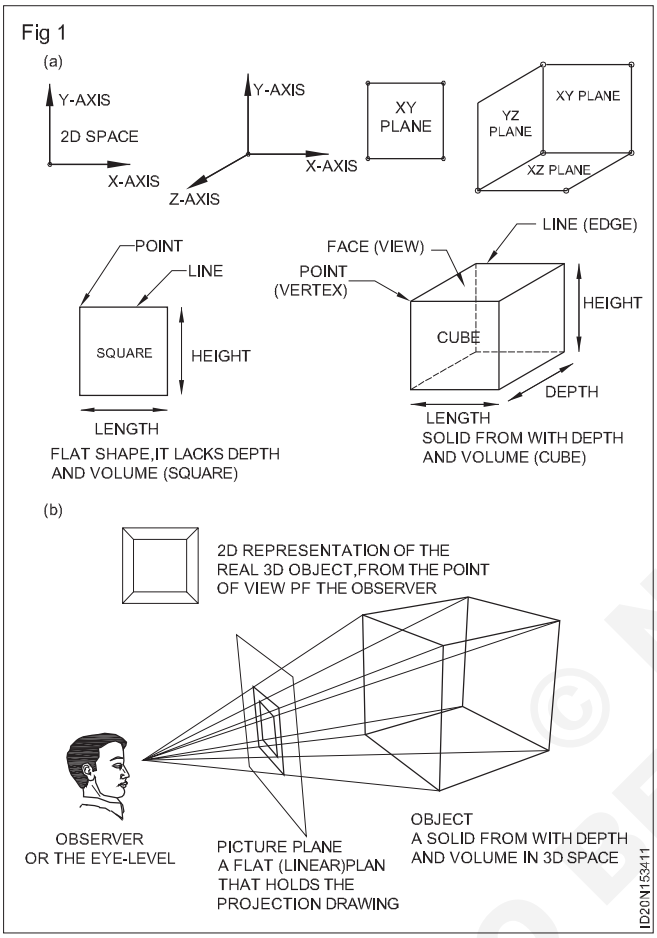
Refer Related Theory Exercise No. 1.4.30

Perspective

Objectives: At the end of this lesson you shall be able to
- **explain perspective**
- **describe perspective types - one point, two point and three point.**

Introduction (Fig 1)

Fig 1



2D Space (Two dimensional space XY) : Space which has 2 measurement units (axes): X-length axis, Y-height axis.

The intersection between the 2 axes is called the origin of the system.

This means a flat plane (XY) made out of points and lines

3D Space (3 Dimensional space (XYZ)

Space which has 3 measurement units: X-length, Y-height, Z-depth.

Means a 3D surface made out of 3 x2D planes (XY-YZ-ZX).

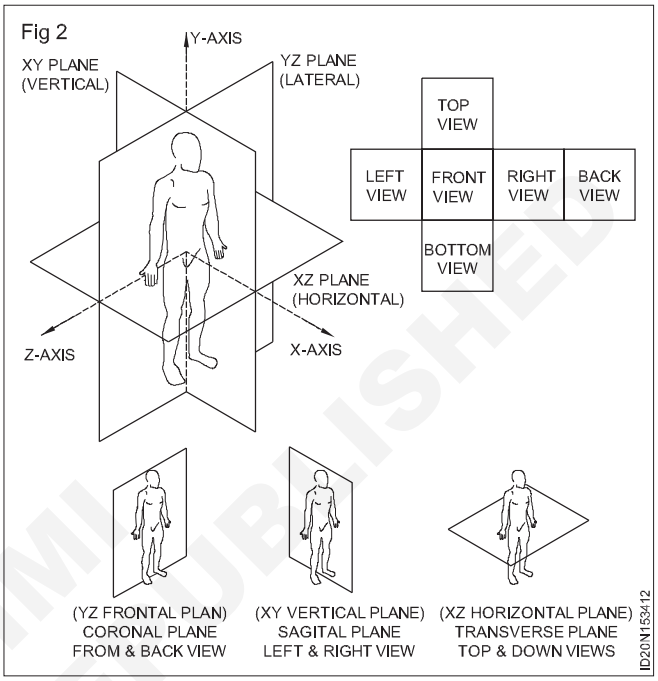
The intersection between the 3 axes is called the origin of the system.

Any 2 planes are arranged perpendicular to each other.

Planes used in anatomical construction (Fig 2)

- XY plane is the vertical plane, it divides the body into left & right sections.

Fig 2



- YZ plane is the frontal plane, it divides the body into front (anterior) & back (posterior) sections.
- XZ Transverse plane is the horizontal plane, divides the body into upper (superior) & lower (inferior) sections. Even though these 3-planes are theoretical, they are describing the anatomical motion as well, like the axis along which an action is being performed. For example, by moving through the transverse plane (XZ plane), movement travels from head to toe (vertical)

Perspective drawing : The word perspective comes from Latin and it means “through”, so we can say that the word “perspective” in a drawing can be interpreted as creating the illusion of depth by “seeing through geometric forms”.

Paper is a two dimensional medium .In order to represent a three dimensional object on paper the concept of perspective is used.

Perspective

Definition : Perspective is representation of three dimensional objects on a flat two dimensional surface. In other words it can be said as three dimensional object into a two dimensional plane.

Use of perspective : Perspectives are mainly made for the designer and then for the client. A designer can judge from a perspective about the concept which he has put in elevation and plan, whether it looks right or whether it has to be altered, etc. A designer uses the perspective to

give an idea to the client as to what the interior product will finally look like. The client will definitely be impressed by a will drawn perspective as he can relate the perspective to reality as better than plan and section. However, the perspectives should not be over decorated only for the sake of impressing. The perspective should be as accurate as possible. Perspective view gives the appearance of an object as it appears to the human eye. If such a view is drawn with help of drawing instrument on a plane, it is known as perspective projection.

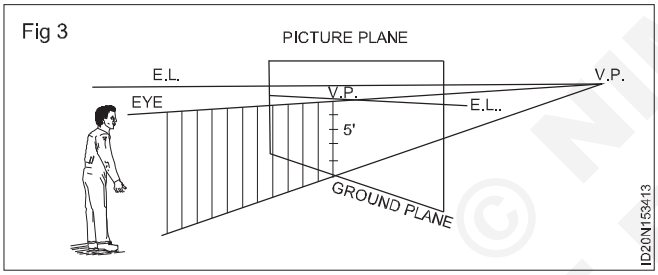
Technical terms used in perspective drawing : Observer eye: It is station point (SP), it is the position from where objects are viewed.

Perpendicular lines: Perpendicular lines are lines that run through or intersect the horizontal line at a right angle. They will never slant and they will never each other.

Parallel lines: Parallel lines are lines that are the same distance apart at every point. They extend in the direction and never coverage or meet, Remember that in perspective drawing parallel lines just look like they meet but they really don't.

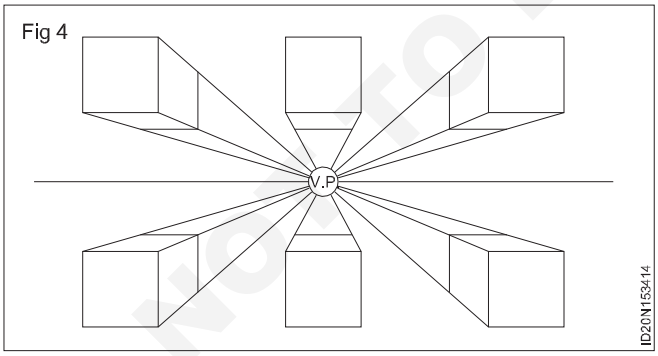
Picture plane (PP) (Fig 3) : Is the transparent vertical plane positioned normally in between the station point and the object to be viewed.

Fig 3



Eye level (EL) (Fig 4): It is a line at the eye-level of the observer and is represented by straight line. Its true height is observed from ground line.

Fig 4



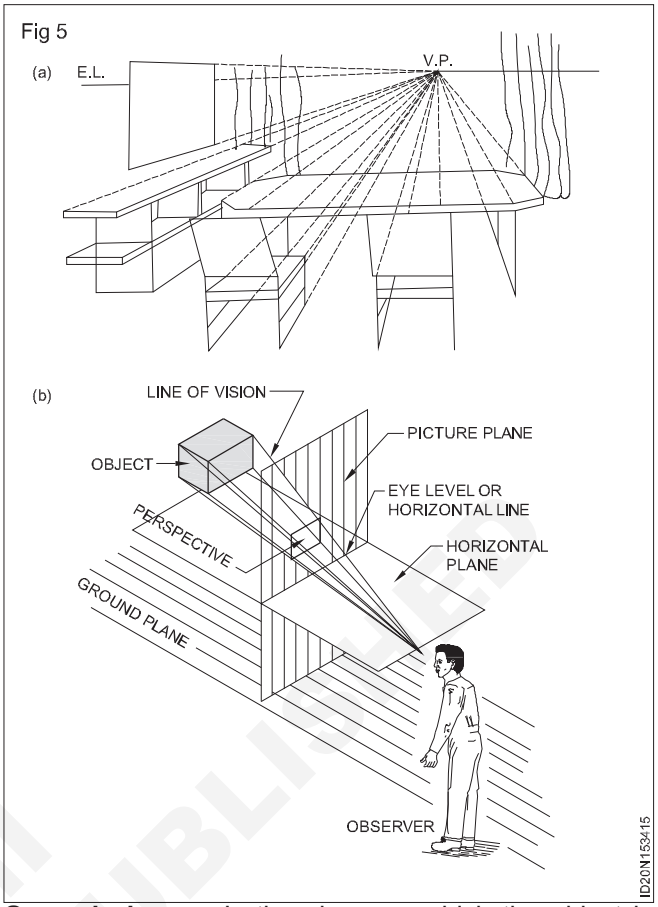
Horizon plane : It is the imaginary horizontal plane perpendicular plane to the picture plane and passing to the station point. This plane lies at the level of the observer.

Horizon : Horizontal line drawn through center of vision on the picture plane.

Vanishing point (VP) (Fig 5a) : It is a point on the picture plane where all the parallel lines appear to converge.

Center of vision (CV) : The point where the line of vision pierce the picture plane is centre of vision.

Fig 5



Ground plane : Is the plane on which the object is assumed to be placed.

Ground line (GL) : It is the line of intersection of the picture plane with the ground plane.

Basic rules of perspective (Fig 5b)

- All parallel lines will converge to the same vanishing point.
- Objects will appear to get smaller as they get closer to the eye level (Horizon line).
- In both 1 and 2 point perspective the (VP) vanishing points are always on the eye level.

Different views used in general drawings

Birds eye view: Where objects arae seen form also

Ants eye view: Where objects appear zoomed (large over head of viewer)

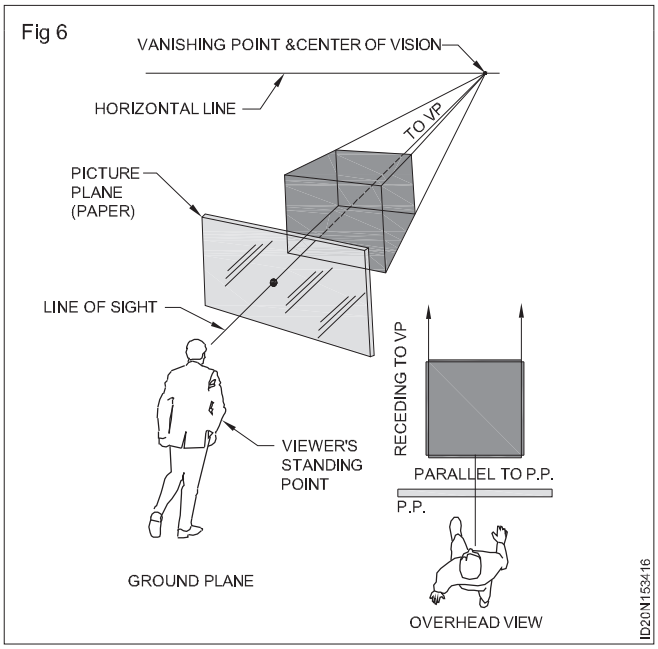
Identification/Type of perspective

1 One point perspective

2 Two point perspective

3 Three point perspective

One point perspective : When a drawing contains one vanishing points on the horizon line, it is said to be one point perspective. The advantage of one point perspective is that it may show the enter interiors focusing on wall, ceiling, floors, furniture etc. (Fig 6)



Basic rules for one point perspective

1 All parallel lines will converge to the same vanishing point.

2 Objects will appear to get smaller as they get closer to the eye level (Horizon line)

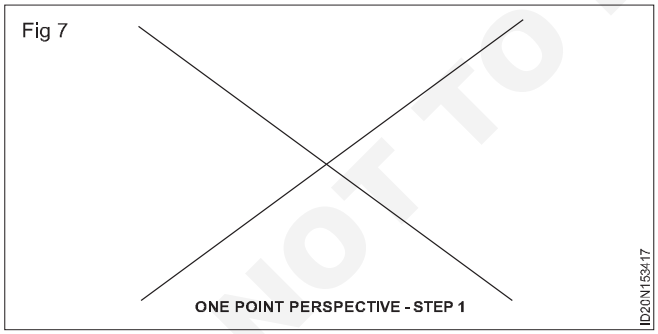
3 All vertical lines are perpendicular to the horizon or will form a 90° angle when intersecting the horizon.

4 All horizontal lines are parallel to the horizon never intersecting with the horizon.

5 All diagonal lines intersect at the point on the horizon.

Method for one point perspective

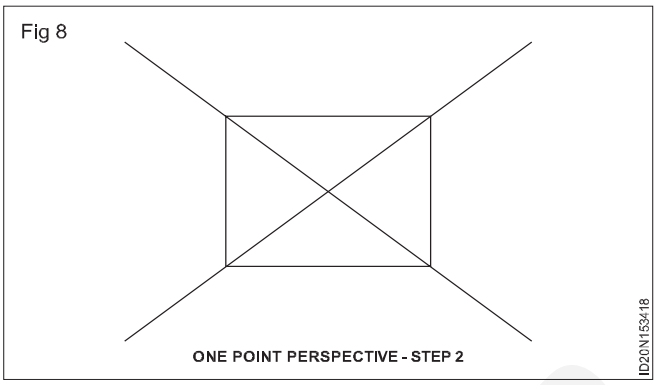
Step 1 (Fig 7): To begin your room in one point perspective using a pencil and a ruler, lightly make an X by connecting the right top corner to the left bottom corner of your paper and by connecting the top left corner to the bottom right.

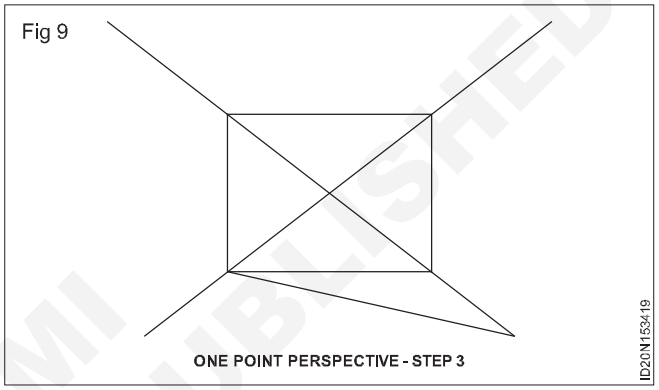


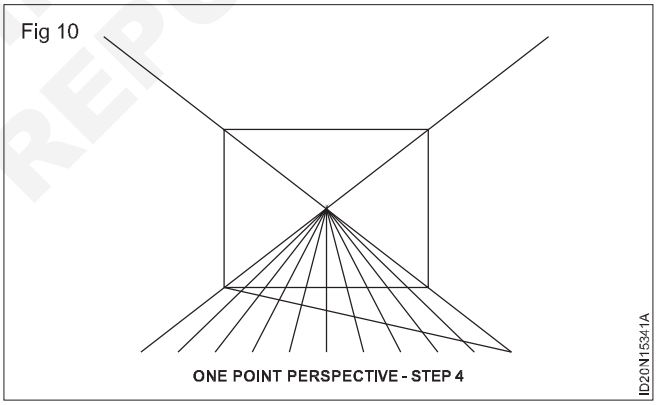
Step 2 (Fig 8): Using pencil and ruler, lightly make a rectangle on the X... be sure to make the vertical lines and horizontal lines of the rectangle parallel to the sides of the paper.

Step 3 (Fig 9): Now we will make a light oblique line from the left back corner of the room to the front right corner. Draw this lightly with pencil and use the ruler. This will be a "guideline" on adding tiles or boards for your floor.

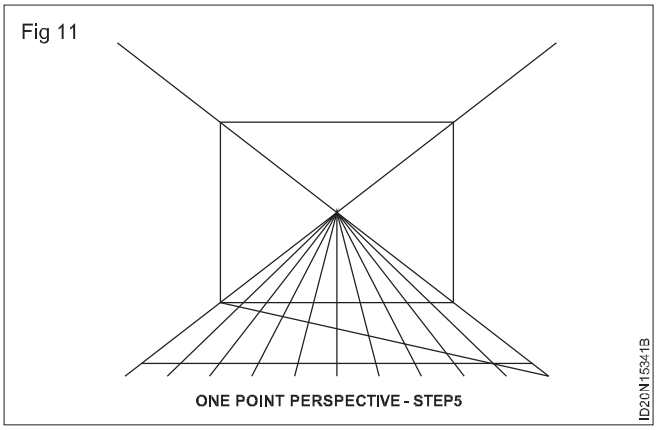
Step 4 (Fig 10): Next, using the pencil and ruler, lightly draw oblique lines from the center of the X (called the vanishing point) to the front of the floor which is at the bottom of the paper. These lines will be floor tiles, so you can space them like you want them... they could also be boards for a wooden floor.





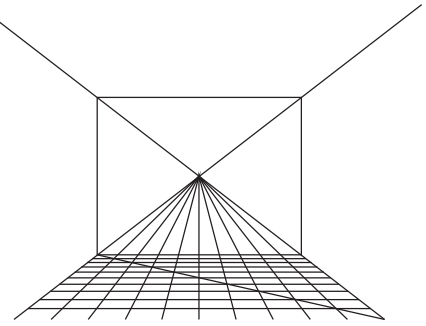


Step 5 (Fig 11): Now you can make tiles using the last lines you added in step 3 and 4. Lay the ruler parallel to the bottom of the paper and make a horizontal line across on the floor of the room where the guideline meets the first oblique line.



Step 6 (Fig 12): Continue adding the horizontal lines until the tile floor is created.

Fig 12



ONE POINT PERSPECTIVE - STEP6

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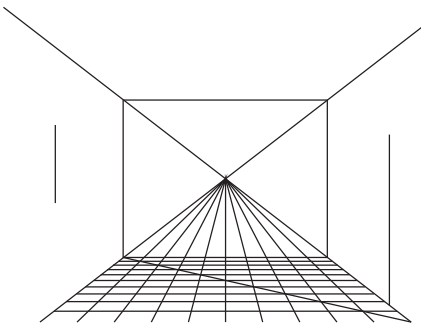
Step 7 (Fig 13): Now we'll add a window and a door. Start by deciding how tall the window and the door should be. Start these by making a vertical line on the two receding walls.

Fig 13



ONE POINT PERSPECTIVE - STEP 7

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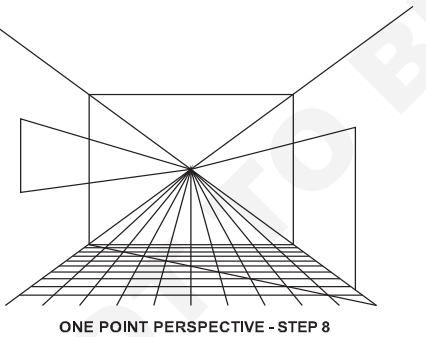
Step 8 (Fig 14): Continue the door by connecting the top of doorway to the vanishing point. Continue the window by connecting the window to the vanishing point.

Fig 14



ONE POINT PERSPECTIVE - STEP 8

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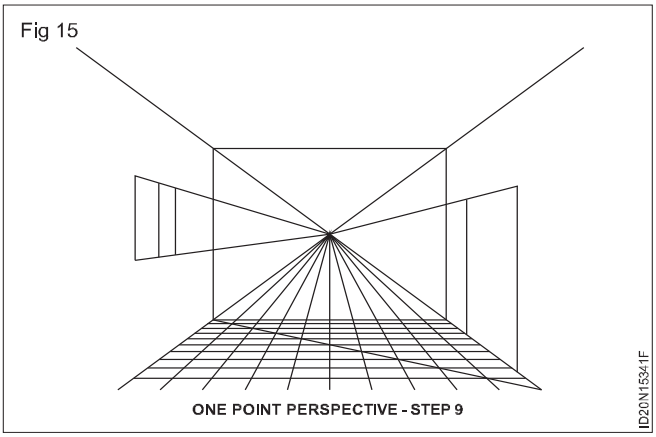
Step 9 (Fig 15): Complete the window and door by adding a vertical line for the back edges. These vertical lines will be parallel with the front edges.

Step 10 (Fig 16): Complete the room by adding a rectangle window in the back of the room and erase all connecting (converging) lines that are no longer necessary. Finish by adding furniture and shading and your own creative touches!

Two - point perspective (Fig 17) : It has one set of lines parallel to the picture plane and two sets oblique to it. Parallel lines oblique to the picture plane converge to a vanishing point, which means that this set - up will require two vanishing points.

Fig 15



ONE POINT PERSPECTIVE - STEP 9

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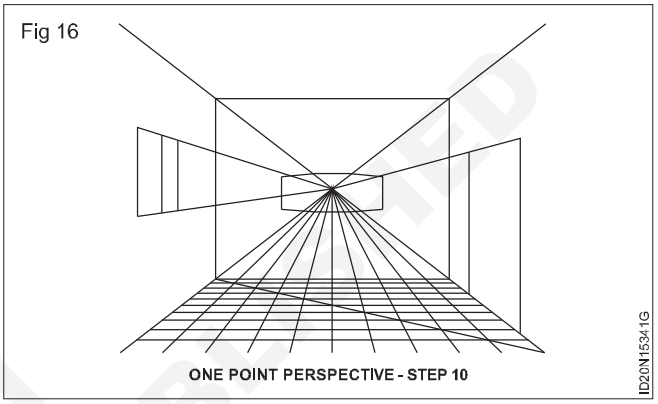
Fig 16



ONE POINT PERSPECTIVE - STEP 10

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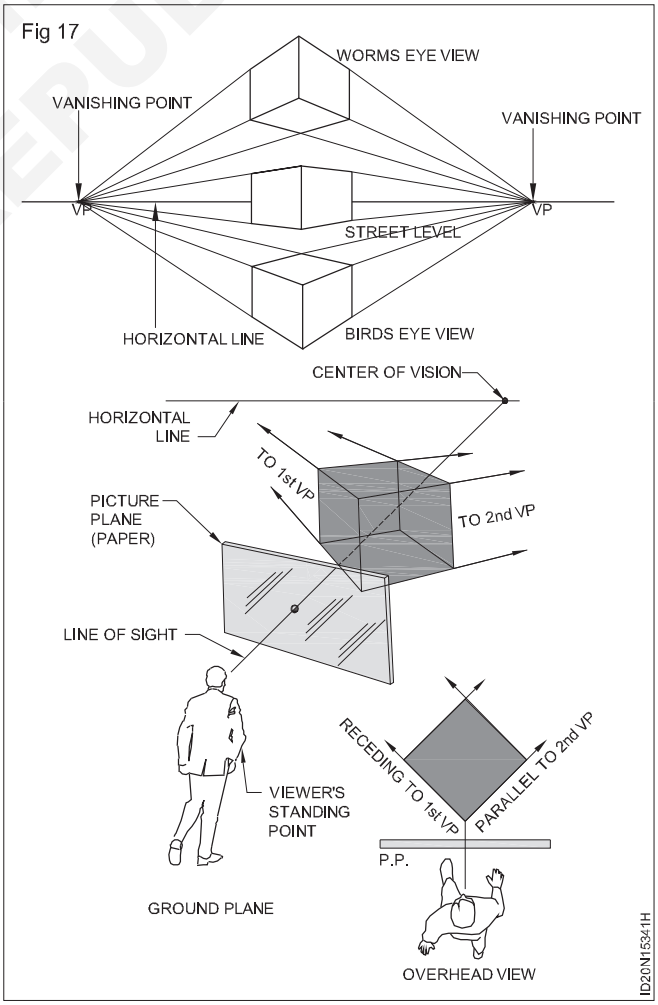
Fig 17



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In 2 point you will have two vanishing points. This will apply when viewing an object in an oblique manner.

In 2 point perspective you will not use the horizontal line.

All vertical lines are perpendicular to horizon (or) will form a 90° angle when intersecting the horizon.

All diagonal lines intersect at both points on the horizon of opposite diagonal lines intersect with one another.

Rules for two point perspective

1 Bigger objects look closer. Smaller objects will appear farther away.

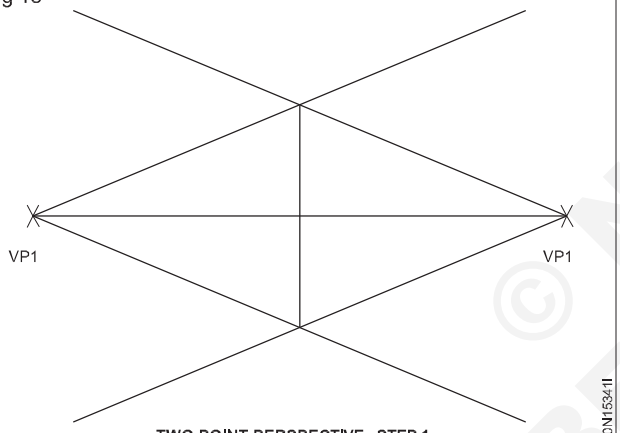
2 All diagonal lines must line up with one of the two vanishing points.

3 Besides diagonal lines, the only other type of line allowed is vertical lines.

How to draw a 2 point perspective of a room

Step 1 (Fig 18): We are facing a corner, and the converging lines "cross" the wall on the left converges on the right to VP2 (vanishing point 2) and the wall on the right converges on the left to VP1. Start out by lightly drawing the horizon, 2 vanishing point a vertical line representing the corner, and 4 diagonal lines as shown in the figure.

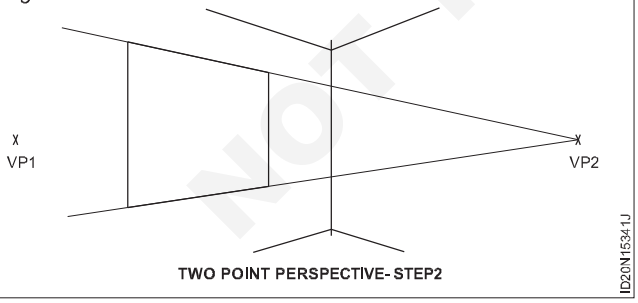
Fig 18



TWO POINT PERSPECTIVE - STEP 1

Step 2 (Fig 19): Add a picture window on the left... the lines converge on VP2

Fig 19



TWO POINT PERSPECTIVE- STEP2

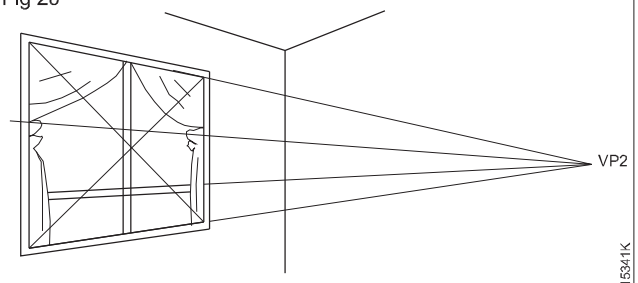
Step 3 (Fig 20): Add some detail to the window

Step 4 (Fig 21): Add a small piece of furniture; start with the base

Step 5 (Fig 22): Establish the basic shape

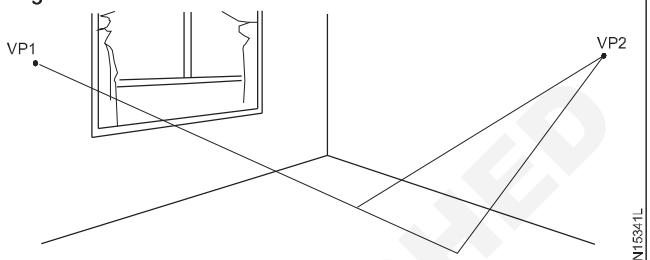
Step 6 (Fig 23): Erase guides and "draw-through" (the parts you don't see):

Fig 20



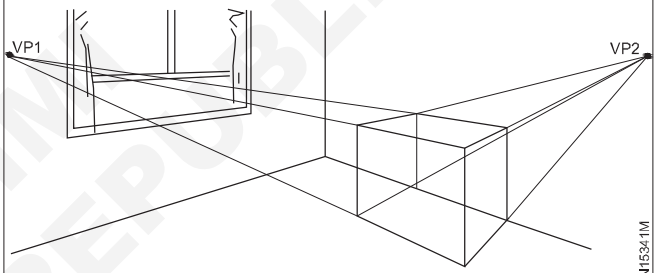
TWO POINT PERSPECTIVE- STEP 3

Fig 21



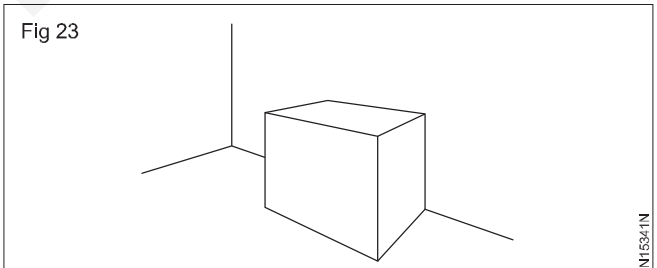
TWO POINT PERSPECTIVE - STEP 4

Fig 22



TWO POINT PERSPECTIVE - STEP 5

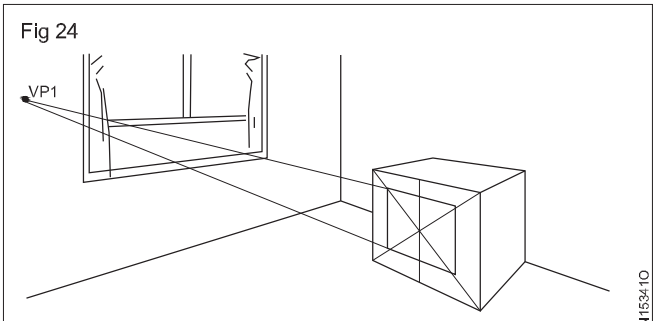
Fig 23



TWO POINT PERSPECTIVE - STEP 6-1

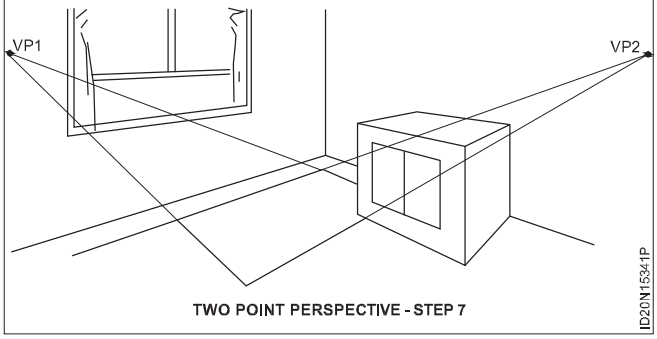
Step 7 (Fig 24 & 25): Add a small rug....

Fig 24



TWO POINT PERSPECTIVE - STEP 6-2

Fig 25

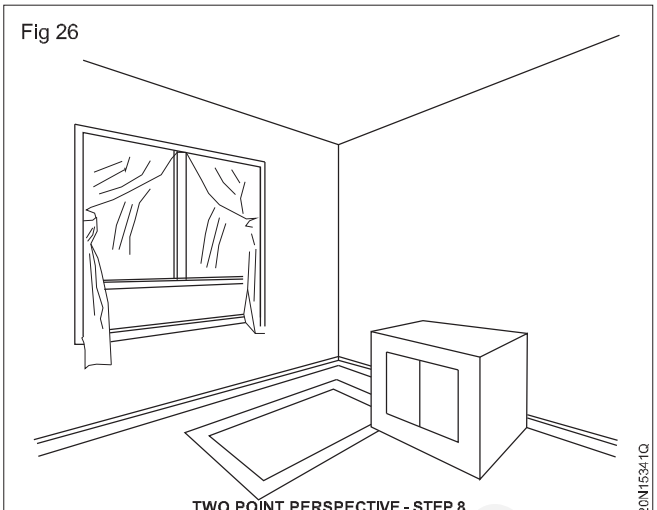


That's it; we established the basic perspective. The details should be added by you according to your test. Add design to the rug, some handles and bevels on the furniture, some simple shading, etc.

Step 8 (Fig 26) : Use your own creative idea in the completion of design. (Step 4 to 7 has emphasis on furniture hence window is not shown fully)

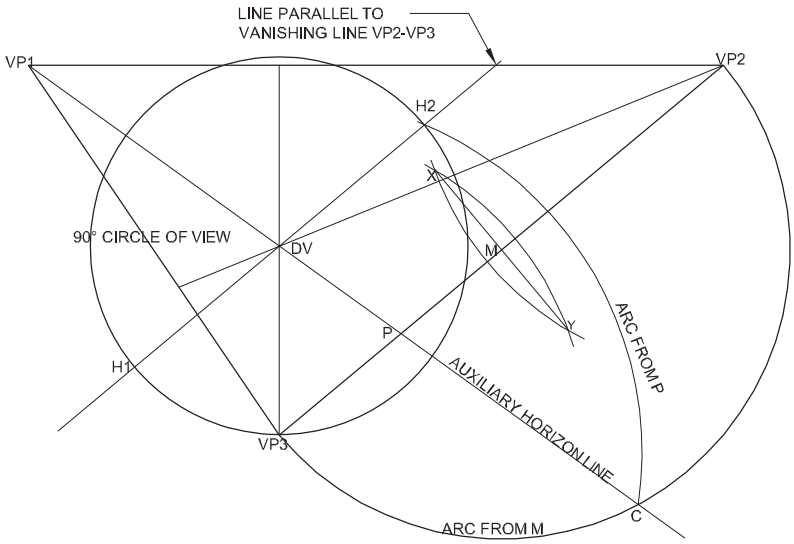
Three - point perspective (Fig 27) : This is useful for very tall buildings where the object would look distorted with only two vanishing points, since vertical lines also

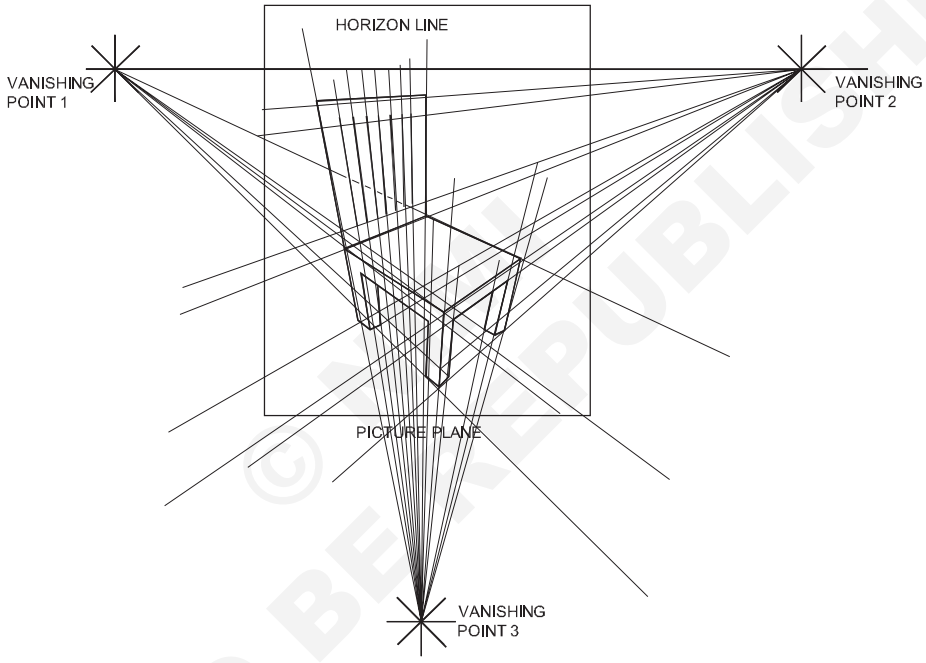
Fig 26



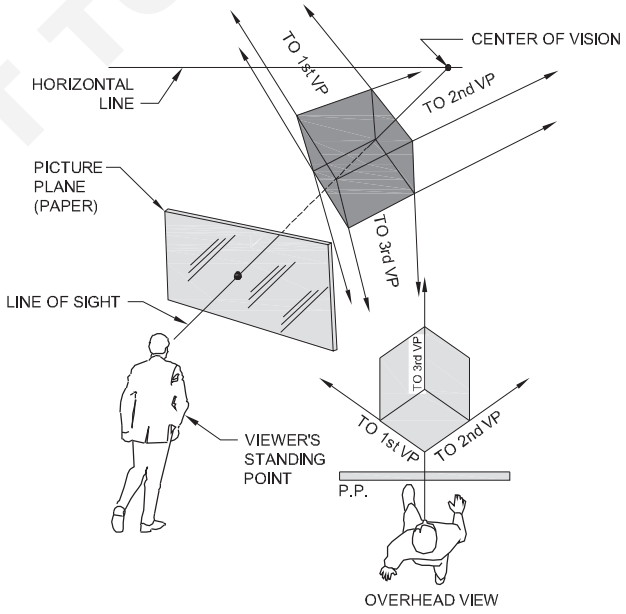
appear to converge towards a separate vanishing point. This perspective requires that all the three principal axes of the object be oblique to the plane of projection. As such, the height line cannot be measured as in a two - point perspective. A sky-scraper can best be drawn by three - point system.

Fig 27





THREE - POINT PERSPECTIVE



OVERHEAD VIEW

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Computer fundamentals

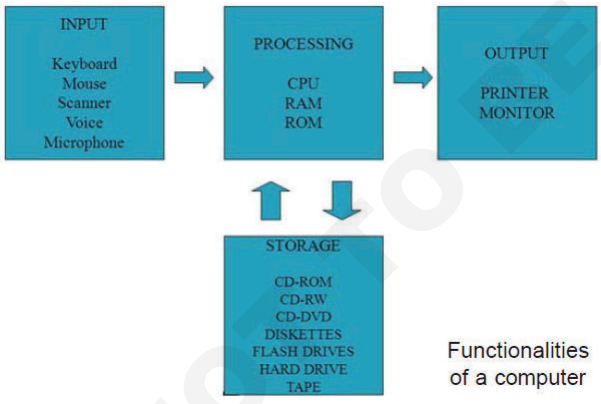
Objectives: At the end of this lesson you shall be able to
- **explain characteristic of computer**
- **identify the basic components of a computer**
- **describe powerpoint presentation -still presentation and animated presentation.**

Definition : A computer is an electronic device, opening under the control of instruction stored in its own memory that can accept data (input) process the data according to specified rules, produce information (output) and store the information for future use. The term computer is derived from the latin word 'Computare', this means to calculate (or) programmable machine. (Fig 1)

Fig 1

Functionalities of a computer (Fig 2)

Fig 2



Any digital computer carries out five-functions in gross terms:

- Takes data as input
- Stores the data/instructions in its memory and use them when required.
- Processes the data and converts it into useful information.
- Generates the output.
- Controls all the above four steps.

Characteristics of a computer

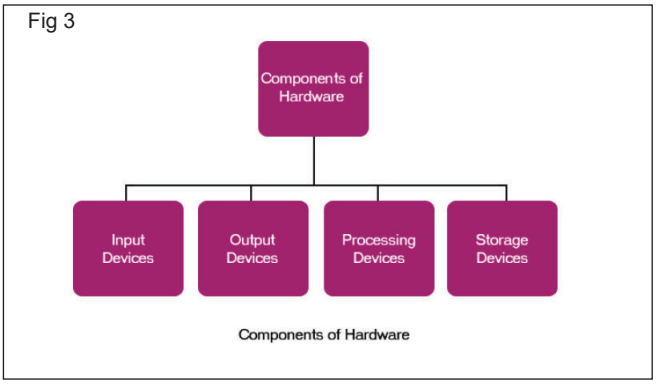
- **Speed** - Typically, a computer can carry out 3-4 million instructions per second.
- **Accuracy** - Computers exhibit a very high degree of accuracy. Errors that many occur are usually due to inaccurate data, wrong instructions bug in chips - all human errors.
- **Reliability** - Computers can carry out same type of work repeatedly without throwing up errors due to tiredness or doredom, which are very common among humans.
- **Versatility** - Computer can carry out a wide range of work from data entry and ticket booking to complex mathematical calculations and continuous astronomical observations. If you can input the necessary data with correct instructions, computer will do the processing.
- **Storage Capacity** - Computers can store a very large amount of data at a fraction of cost of traditional storage of files. Also, data is safe from normal wear and tear associated with paper.

Computer components:

Any kind of computers consists of two components

1 Hardware (Fig 3)

Fig 3



2 Software

1 Hardware: The term hardware refers to mechanical device that makes up computer. Computer hardware consists of interconnected electronic devices that we can use to control computer's operation, input and output. Examples of hardware are keyboard, mouse, hard disk, etc. Which are physical objects that can be touched.

A Input device : Devices that are used to provide data and instruction to the computer are called as Input Devices. Input device translate data from form that humans understand to one that the computer can work with. Most common input devices are keyboard and mouse.

List of Input device

1 Keyboard (Fig 4)

Fig 4

Keyboard

- Keyboard is the most common and very popular input device which helps to input data to the computer.
- It comprises key and each key denotes either an alphabet, number or number commands which can be given to a computer for various actions to be performed.
- It has a modified version of typewriter keys.
- The keyboard is an essential input device and computer and laptops both use keyboards to give commands to the computer.

2 Mouse (Fig 5)

Fig 5

Mouse

- Mouse is also known as a pointing device
- Using mouse, we can directly click on the various icons present on the system and open up various files and programs.
- A mouse comprises 3 buttons on the top and one trackball all the bottom which helps in selecting and moving the mouse around, respectively.
- In case of laptops, the touchpad is given as a replacement of mouse which helps in the movement of the mouse pointer.

3 Scanner (Fig 6)

Fig 6

Scanner

- Scanner is an input device, which works more like a photocopy machine.
- It is used when some information is available on paper and it is to be transferred to hard disk of the computer for further manipulation.
- Scanner captures images from the source which are then converted into a digital form in that can be stored on the disk. These images can be edited before they are printed.

4 Webcam (Fig 7)

Fig 7

Webcam

- Webcam is a short form of web camera which is an input device.
- It is a video camera that feeds or streams an image or video in real time to or through a computer to a computer network such as the internet. Webcams are typically small cameras that sits on a desk, attach to a user's monitor, or are built into the hardware.
- Webcams can be used during a video chat session involving two or more people with conversation, that include live audio and video.

5 Microphone (Fig 8)

- Microphone is an input device used to input sound that is then stored in a digital form.
- It converts sound into electrical signal.
- To record or reproduce a sound created using a microphone, in needs to be connected with an amplifier.

Fig 8

Microphone

6 Joystick (Fig 9)

Fig 9

Joystick

- Joystick is also a pointing device which comprises is stick which is attached at an angle to the base, so that it can moved and controlled.
- Mostly used to control the movement in video games.
- Apart form computer system, a joystick is also used in the cockpit of an aeroplane, wheel chairs, cranes, trucks, etc. to operate them well.

7 Digitizer (Fig 10)

Fig 10

Digitizer

- Digitizer is an input device which converts analog information into digital form. Digitizier can convert a signal from the televison or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.
- Digitizer is also known as Tablet or Graphics as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

8 Light pen (Fig 11)

Fig 11

Light pen

- Light pen is a pointing device similar to a pen.
- It is used to select a displayed menu item or drum pictures on the monitor screen.
- It consists of a photo cell and an optical system placed in a small tube.

9 Barcode reader (Fig 12)

Fig 12

Barcode reader

- It is kind of an optical scanner
- It can read bar codes
- A source of light is passed through a hard code, and its aspects and details are displayed on the screen input devices. Several other such equipments are used in different fields which can be counted as an input device.

B Output devices : Any device that is capable of representing information on a computer is called as output device. Output device receives information from the CPU and present it to the user in the desired form. (Output Device are used to supply processed data).

List of output devices

1 **Monitor (VDU - Visual display units) :** The device which displays all the icons, text, images, etc., over a screen is called the monitor.

When we ask the computer to perform an action, the result of that action is displayed on the monitor.

It displays information in a picture form (or) commonly referred to as pixels more the number of pixels, the better is the picture clarity and sharpness.

There are two main types of monitor screens

a Cathode ray tube monitor (CRT)

b Flat panel screen monitors

a Cathode ray tube monitor (CRT) (Fig 13)

Fig 13

Monitor CRT

- Cathode ray tube monitors use CRT technology similar to television. This technology uses phosphorescent dots to generate pixels that form displayed images
- CRT monitor screens are large and consume more power

b Flat panel screen monitors

- There monitors use a thin panel design instead of CRT technology
- These screens are much lighten and thinner.
- This technology uses liquid crystals as plasma are 3 types of flat panel screen monitor
  - i Liquid Crystal Devices (LCD)
  - ii Light Emitting Diode (LED)
  - iii Plasma monitors

i Liquid Crystal Devices (LCD) monitors (Fig 14)

- It is a flat panel display that uses the light modulating properties of liquid crystals.
- It is more energy efficient as it does not use phosphorous and can be disposed of more safely than the CRT monitors.

ii Light Emitting Diode (LED) monitors (Fig 15)

- It is an improved version of the LCD monitor.

Fig 14

Liquid Crystal Devices (LCD) monitor

Fig 15

Light Emitting Diode (LED) monitor

- The technology used in both the monitors is the same except the back lighting.
- The LED monitors are lighter, thinner, and less expensive.

iii Plasma monitors (Fig 16)

Fig 16

Plasma monitor

- It is a monitor in which each pixel on the screen is illuminated by a tiny bit of charges gas (or) plasma similar to a tiny neon light.
- These monitors are thinner than cathode ray tube monitors and brighter than liquid crystal display monitor (LCD).

2 Printer

- A printer is a hardware device that produces a hard copy version of the processed data from the computer.
- It is a device that accepts texts and graphic output from the computer and transmits the image data to the printer, usually on a paper.

- It is the most common output device to print text or photos.

The printers are classified into two main types.

a Impact printers

b Non impact printer

a Impact printers : This type of printer prints characters by striking on the ribbon, and then they are pressed on the paper.

This type of printers are now a days not in use as they make much of noise.

There are two types of impact printer

i Character printer

ii Line printer

i Character printer (Fig 17)

Fig 17

Character printer

- It can print only text, and a single character at a time.
- The different types of character printers are chain, band, dotmatrix and daisy wheel printers.
- The commonly used printer are dot matrix and daisy wheel.
- This speed is upto 300 lines per minute

ii Line printer (Fig 18)

Fig 18

Line printer

- Line printers can print line by line
- The two types of line printers are drum printer and chain printer.
- Among these, the drum printer has high speed and can print upto 300 to 2000 lines perminutes.

b Non impact printer : These types of printers are those printers that print without striking on the ribbon

The examples of non-impact printers are

i Laser printer

ii Inkject printer

i Laser printers (Fig 19)

Fig 19

Laser printer

- Laser printers use laser lights to produce dots to form the characters for printing.
- They have less smearing problems than a inkject printer, as they don't use inks.

ii Inkjet printers (Fig 20)

Fig 20

Inkjet printer

- Inkjet printers are printers that produce the hard copy by spraying the ink onto the paper.
- It is the most widely used type of printer.

3 Speakers (Fig 21)

Fig 21

Speaker

- A device through which we can listen to a sound as an outcome of what are command a computer to do is called a speaker.
- Speaker are attached with a computer system and also are a hardware device which can be attached separately.
- With the advancement in technology, speakers are now available which are wireless and can be connected using bluetooth or other applications.

4 Projector (Fig 22)

Fig 22

Projector

- An optical device which presents an images or moving images onto a projection screen is called a projector.
- Most commonly these projections are used in classrooms, office, auditoriums, movie theaters etc., for display of the video or lightening.
- If a projector is connecteed in a computer, then the image video displayed on the screen is the same as the one displayed on the computer screen.

5 Headphones (Fig 23)

Fig 23

Headphones

- They perform the same function as a speaker, the only difference is the freqency of sound.
- Using speakers, the sound can be heard over a larger area and using headphones, the sound is only audible to the person using them.
- Also known as earphones headset.
- They are either plugged in a computer can be wireless.

6 Plotter (Fig 24)

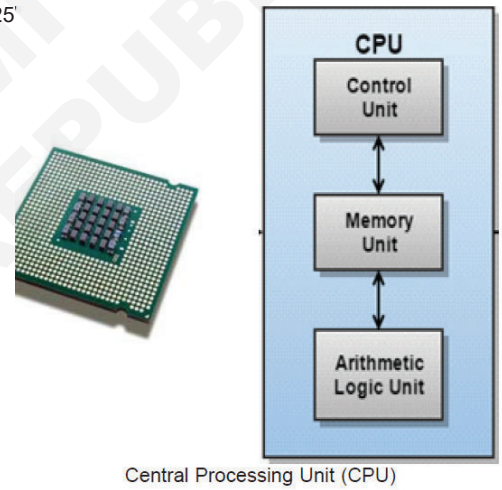
- A plotter is a big size printer that allow users to get big size print that cannot be done by basic printers.
- Most of the plotter has the feature of LTP, LAN and USB printing ports that connectivity to your computer.
- Generally, plotters are used to take prints of line-art application, bit maps, architecture design, drawings etc.

Fig 24

Plotter

C Processing devices [Central processing unit (CPU)] (Fig 25) : The Central Processing Unit is the core of any computer devices. It comprises of three major components of the computer which are:

Fig 25



Central Processing Unit (CPU)

1 Control Unit

2 Memory Unit

3 Arithmetic and Logical Unit

All these three units are elements of CPU and together help in efficient working and processing of data. It is also known as the “Brain of Computer” and the action can be conducted by a device without the execution and permission of the Central Processing Unit.

1 Control Unit : This is the core unit which manages the entire functions of the computers of the computer system.

The Control Unit collects the data entered using the input unit, leads it on for processing and once that is done, receives the output and presents it to the user. It can be said to the centre of all processing actions taking place inside a computer device.

Basically, the instructions taken, interpretation of entered data, issuing signals to execute the data and then finally retrieving the data is all done in the Control Unit.

2 **Memory Unit :** When we enter the data into the computer using an input device, the entered information immediately, gets saved on the memory unit of the Central Processing Unit (CPU). Because of the presence of some existing programming the Memory Unit transmits the data further to the other parts of the CPU.

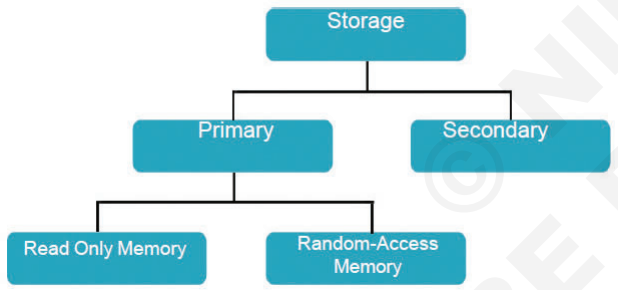
Similarly, when the output of our command is processed by the computer. It is saved in the memory unit before giving the output to the user.

3 **Arithmetic & Logical Unit :** As the name suggests, all the mathematical calculations or arithmetic operations are performed in the Arithmetic and Logical Unit of the CPU.

It can also perform actions like a comparison of data and decision-making actions. The ALU comprises circuits using which addition, subtraction, multiplication, division and other numerical based calculations can be performed.

D Storage Device (Fig 26) : Storage devices are those which store the data in its memory.

Fig 26



1 Primary storage

- Primary storage is a computer memory that is directly accessible to the CPU of a computer without the use of computer's input /output channels.
- Primary storage is used to store data that is likely to be in active use.

Types of primary storage are

a ROM (Read Only Memory)

b RAM (Random Access Memory

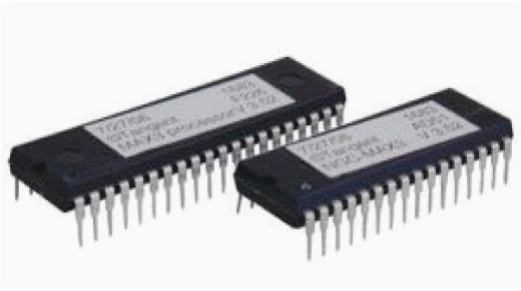
a ROM (Read Only Memory) (Fig 27)

- Read only memory (ROM) is a class of storage media used in computers.
- Data stored in ROM cannot be modified.
- ROM is a non-volatile storage. Data remains unchanged even after switching off the computer.

B RAM - (Random - Access memory) (Fig 28)

- Random access memory (RAM) is a type of data storage used in computers.

Fig 27



ROM

Fig 28

RAM

- It takes the form of integrated circuits that allow the stored data to be accessed in any order (random).
- Data stored in RAM can be modified.
- RAM is a volatile storage. Data will lose after switching off the computer.

2 Secondary storage

- Secondary storage is a computer memory that is not directly accessible to the CPU of a computer, requiring the use of computer's input/output channels.
- It is used to store data that is NOT in active use.
- It is usually slower than primary storage but it always has higher storage capacity.
- It is non-volatile. Data remains unchanged even after switching off the computer.

Types of secondary storage are

i Floppy disk (Disketter)

ii Hard disk

iii CD - Rom disks

iv DVD Driver

v USB flash driver

vi Memory card

i Floppy disk (Fig 29)

- Floppy disk is also referred as " Diskette".
- It is a magnetic storage medium for computer systems.
- It has a small hole on one side called "Right protect notch". Which products accidental writing /deleting the information from the disk.

- The disks are available in two sizes of 5.25 and 3.5 inches and these could be either low density or high-density floppies.
- The storage capacity of floppies are measured in kilobytes (KB) and mega bytes (MB).

Fig 29

Floppy

The details about the storage capacities of the floppies are given below:

Floppy disk	Storage capacity	Size (Diameter)
Low density	360 KB	5.25 inches
High density	1.2 MB	5.25 inches
High density	1.44 MB	3.5 inches
Exdended	2.8MB	3.5 inches

ii Hard disk (Fig 30)

Fig 30

Hard disk drive

- Hard disk is a magnetic disk on which you can store computer data.
- A hard disk is fixed inside the CPU and its capacity ranges from 20 MB onwards.
- It is made up of collection of disc (one below the other) known in as platters on which the data is recorded. There platters are coated with magnetic materials.
- A small hard disk might be as much as 25 times larger than a floppy disk.
- Storage capacity of hard disk varies from 20MB to several giga bytes like 80GB, 160GB etc.

iii CD ROM

- A CD-Rom is a storage device that can be read by a computer with an optical drive.
- It can store software programs to install onto your computer.
- They save fires for backup or to another computer.
- Storate capacity of most CD-Rom is approximately 650MB or 700MB.

CD-ROMs have the following variations:

a CD-R (Compact disk recordable) (Fig 31)

Fig 31

CD - R

- Data can be written onto it just once. The stored data can be read.
- Data once written onto it cannot be erased.

b CD-RW (Compact disc rewritable) (Fig 32)

Fig 32

Fig 33

CD - RW

DVD - ROM

- It is also called as erasable CD. Data once written onto it can be erased to write or record new information many times.
- To use a CD-ROM, a device called CD drive is needed.

iv DVD-ROM (Fig 33)

- DVD ROM is a disc capable of storing a significant amount more data than a standard compact disc (CD).

- It is widely used for storing and viewing DVD storage capacity is 4.7GB, which is over six and a half times be size of a CD> This is enough to store 120 miunutes of high quality video.

v USB Flash drives (Fig 34)

Fig 34

USB Flash Drive

- It is a small portable device that can be use to store, access and transfer data.
- Due to its small size it is commonly called pen drive.
- We can read, write, copy, delete and move data from computer to pendrive (or) pen drive to computer.
- It comes in various storage capacities of 2 GB, 4GB,8GB ect.
- This device is plugged into the USB port after computer and the computer automatically detects this device.

vi Memory Cards (Fig 35)

Fig 35

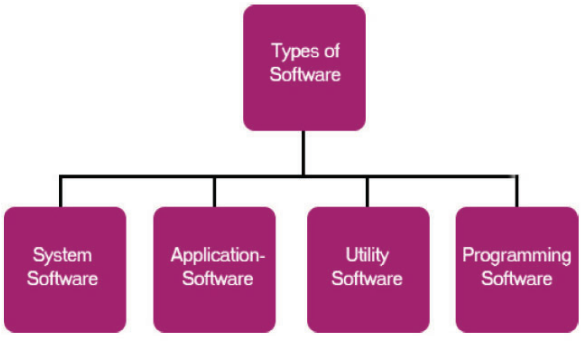
Sand Disk

- Memory card (or) memory cartridge is an electronic data storage device used for storing digital information, typically using flash memory.
- These are commonly used in portable electronic devices, such as digital cameras, mobile phones, computers, tablets etc.

2 Software (Fig 36) : Computer software helps the computer to performs the task using programs. It is generally a language that a computer understands.

It is a set of instructions that helps the user to interact with the computer. Computer software and hardware go hand in hand. Without hardware, the software are cannot work and vice versa.

Fig 36



Types of software

A System software (Fig 37) : System software helps in running the computer hardware and the computer system.

Fig 37

System software

Main system softwares are:

1 Operating systems

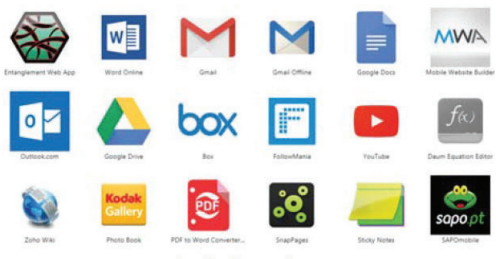
2 Device drivers

1 Operating systems : An operating system is an interface between hardware and user. It is responsible for the management and coordination of activities and the sharing of the limited resources of the computer.

2 Device drivers : A device driver is a computer program allowing higher-level computer programs to interact with a hardware device.

B Application Software (Fig 38) : An application software is meant to establish relation between utility software and system software.

Fig 38



Application software

Types of application software

1 Web browsing software

2 Word processing software

3 Spread sheet software

4 Database software

5 Presentation graphics software

1 Web browsing software : It allows one to surf the Web. Example Internet Explorer. Google chrome etc.

2 Word processing software : Allows users to create, edit a document Example: Ms Word.

3 Spreadsheet software : Allows users to create document and perform calculation. Example: MS Excel etc.

4 Database software : Allows users to store and retrieve vast amount of data.

5 Presentation graphics software : Allows users to create visual presentaion, Example MS Power Point.

C Programming software : This is one of the most commonly known and popularly used forms of computer software. These software come in forms of tools that assist a programmer in writing computer programs.

The tools that help the programmers in instructing a computer system include

- text editors
- compilers
- interpreters

D Utility software (Fig 39) : Utility software helps in the management of computer hardware and application software. It performs a small range of tasks. Some typically examples of utility software are:

Fig 39

Utility software

1 Disk defragmentors 2 Back up

3 Desk partitioner 4 Anti-virus

1 Disk defragmentors : It detect computer files whose contents are stored on the hard disk in disjointed fragments, and move the fragments together to increase efficiency.

2 Backup : This utility make a copy of all information stored on a disk, and restore either the entire disk or selected files.

3 Disk partitioner : It divide an individual drive into multiple logical drivers, each with its own file system which can be mounted by the operating system and treated as an individual drive.

4 Anti-virus : These utilities scan computer for viruses.

Types of computers

Classification of computers : Computers are classified according to the storage capacity, speed and the purpose for which they are developed. These can be classified into three types.

1 Analog computers

2 Digital computer

3 Hybrid computers

Analog computers: They operate by 'measuring instead of 'counting'. The name (derived from greek word analog) denotes that the computer functions by establishing similarities between the two quantities. They are powerful tools for solving differential equations. (Fig 40)

Fig 40

Digital computers: These computers operate by 'counting'. All quantities are expressed as discrete digits or numbers. These are useful for evaluating arithmetic expressions and manipulations of data. (Fig 41)

Hybrid computers: Computers which combine the features of analog and digital computers are known as hybrid computers.

A majority of the computers that are in use are digital. These computers were essentially developed for computations. Later, the developments in the computers led to the use of digital computers in variety of applications. depending on the use of applications, the digital computers are classifies into

a Special purpose computers: These are developed with a specific purpose. Some of the areas where these computers are being used are – soil testing, drip irrigation, medical scanning, traffic signals, spacecraft, rocket technology etc., (Fig 42)

Fig 41

Fig 42

General purpose computers: These are developed to meet the requirements of several areas such are simulation, solving mathematical equation., payroll and personnel database. These computers are available in different size and capabilities and are further classified (based on memory, speed, storage) as follows.

1 Super computers

2 Mainframe computers

- Mini computers
- Micro computers

Super computers: These have extremely large storage capacities and computing speeds which are atleast 10 times faster than other computers. These are used for large scale numerical problems in scientific and engineering disciplines such as electronics, weather forecasting etc. The first super computer was developed in U.S.A. by CRAY computers. In India the indigenous super computer was developed under the name param. (Fig 43)

Fig 43

Mainframe computers: They also have large storage and high computing speed (but relatively lower that the super computers). They are used in applications like weather forecasting, space applications etc., they support a large number of terminals for use by a variety of users simultaneously, but are expensive. (Fig 44)

Fig 44

Mini computers: It is a medium sized computer wit moderate cost, available indigenously and used for large volume applications. It can serve multi-users simultaneously. (Fig 45)

Fig 45

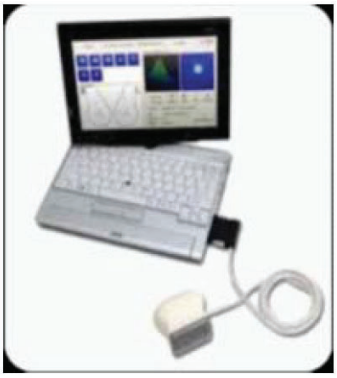
Micro computers: A micro computers is the smallest general purpose processing system. Micro computers are also as 'personal computers' (PC). These are self contained units and usually developed for use by one person at a time but can be linked to very large system. They are cheap, easy to use even at homes and can be read for variety of applications from small to medium range. These are available in three models:

1 PC: Personal computer

2 PC-XT: PC with extended technology

PC-AT: PC with advanced technology (Fig 46)

Fig 46



Microsoft PowerPoint Presentation

Objectives: At the end of this lesson you shall be able to:

- **describe PowerPoint Presentation 2010 version**
- **describe on creating PowerPoint Presentation**
  i still presentation
  ii animation presentation.

Introduction : PowerPoint is a graphical presentation program used to organize and present information. PowerPoint presentations consist of a number of individual pages or "slides". Slides may contain text, graphics, sound, movies and other objects that can be freely arranged.

Presentation can be printed, displayed live on a computer (or) navigated through at the command of the presenter. For larger audiences, the presentation is often projected onto a large screen. Handouts speaker notes, (or) outlines can also be produced from the slides.

Getting started with PowerPoint.

Method one

- Double click the MS PowerPoint icon present in the Computer/Laptop etc (Fig 1).

Fig 1

This will launch the Microsoft PowerPoint 2010 application and you will see the below presentation window (Fig 2).

Method two

If MS PowerPoint is not present on your desktop/ computer then follow the steps below:

Step 1

Click "Start menu" and click "All Programs" options (Fig 3).

Step 2

Search for Microsoft Office from the "Submenu" and click it (Fig 4).

Step 3

Search for Microsoft PowerPoint 2010 from Microsoft Office submenu and click it. (Fig 5)

This will launch the Microsoft PowerPoint 2010 application and you will see the below presentation window. (Fig 6)

Familiarization in Microsoft PowerPoint

Exploring power point windows (Fig 7)

Title Bar (Fig 8)

This is the top section of the PowerPoint window. It shows the name of the file followed by the name of the program which in this case is "Microsoft PowerPoint".

Fig 2

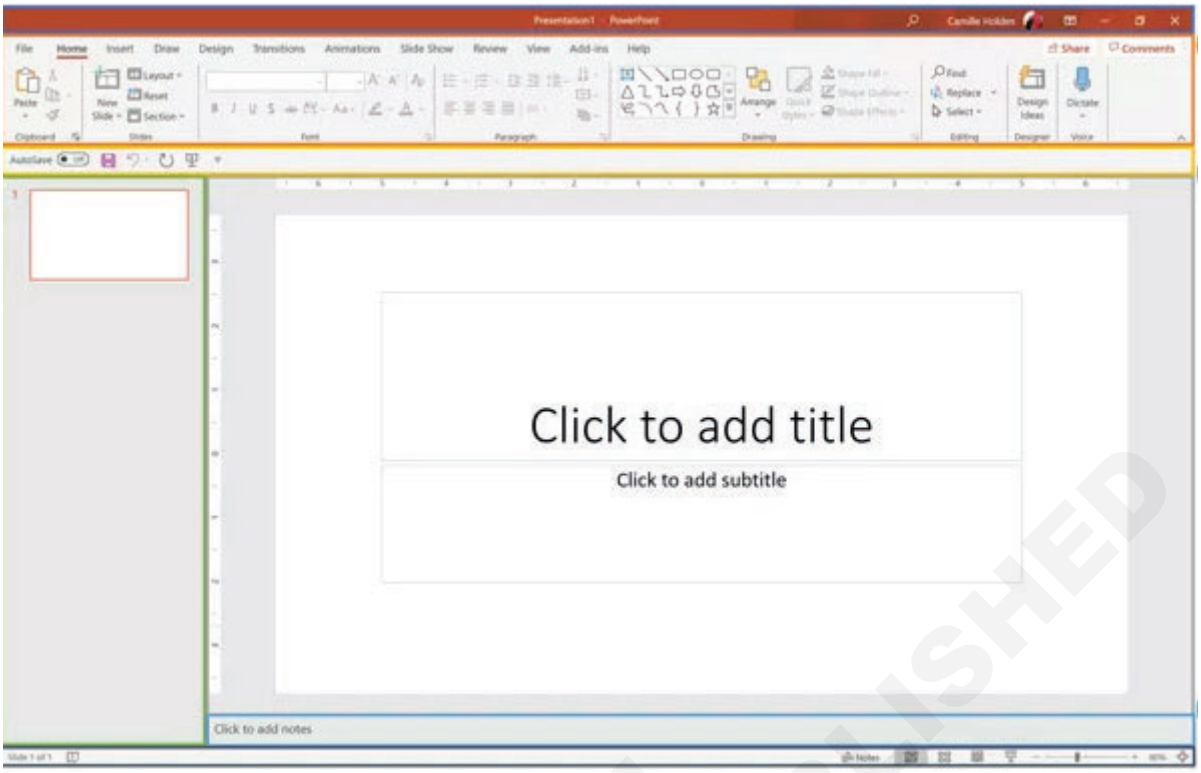


Fig 3

Fig 4

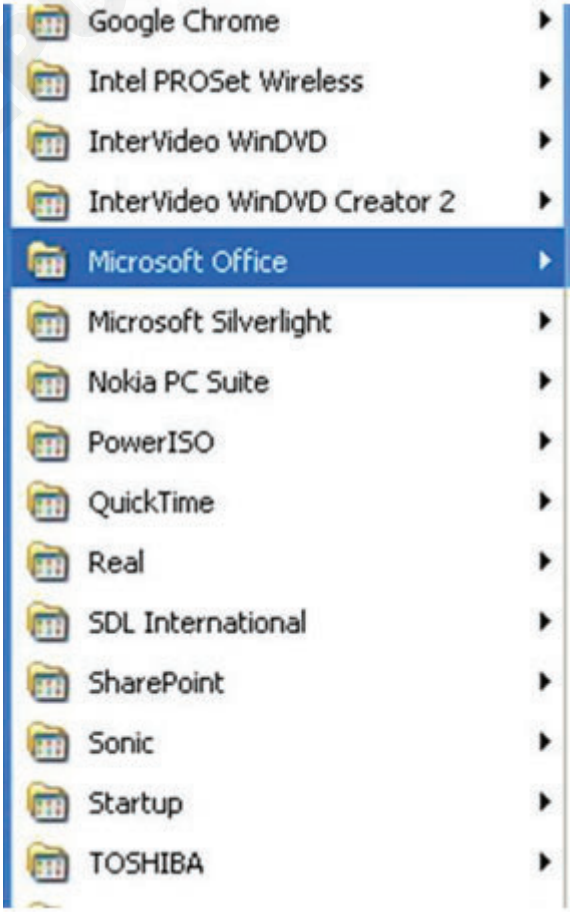


Fig 5

Fig 6

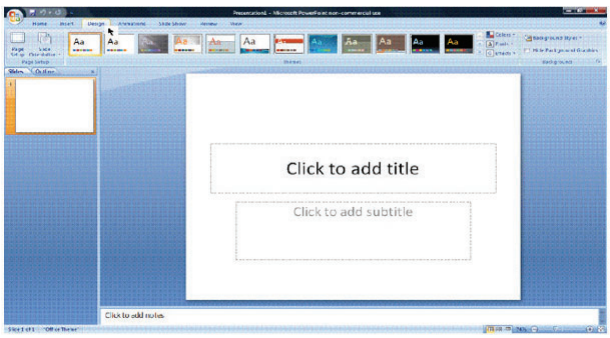


Fig 7

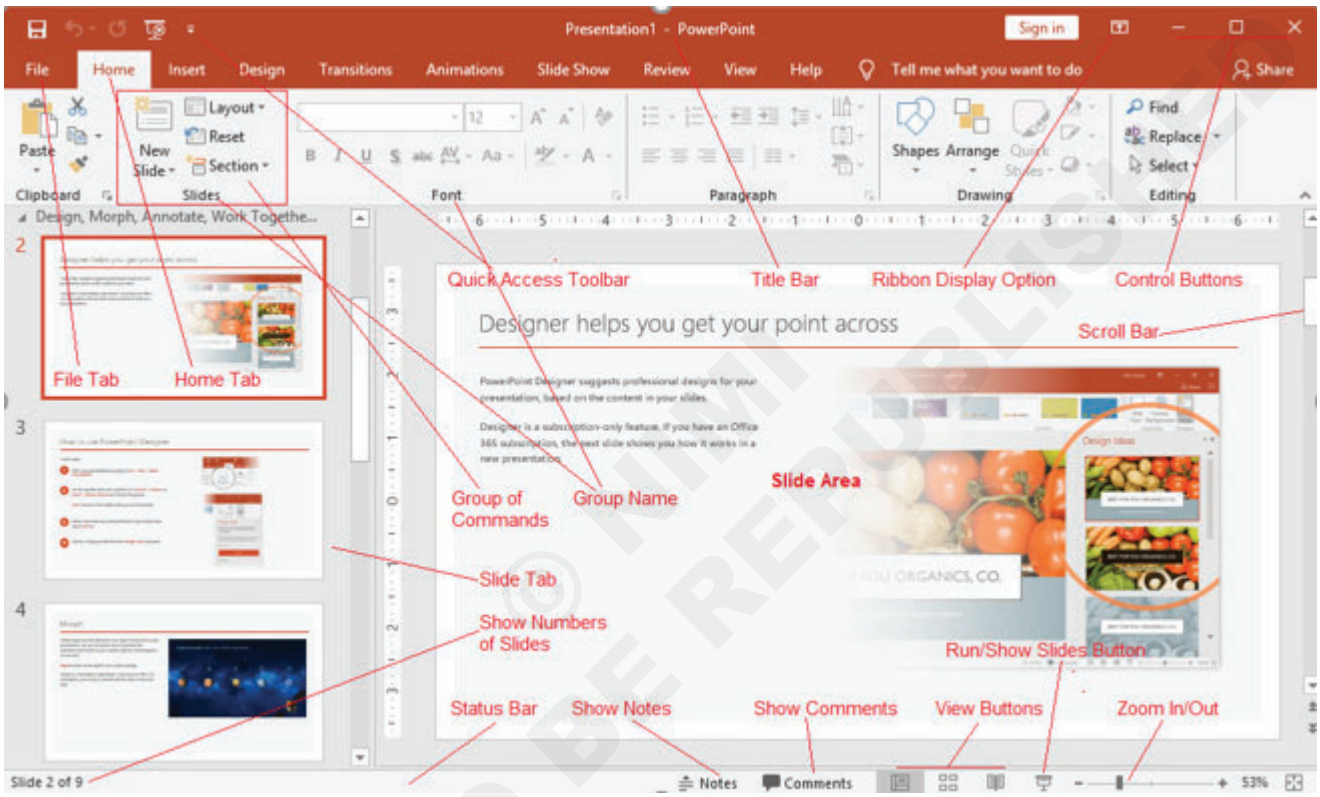
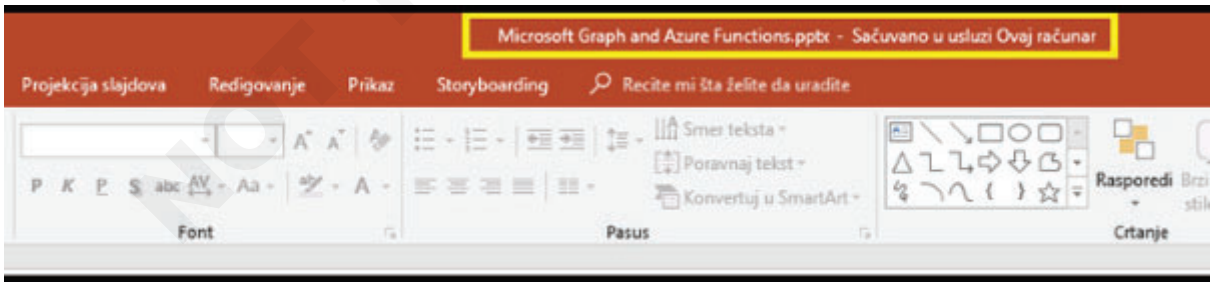


Fig 8



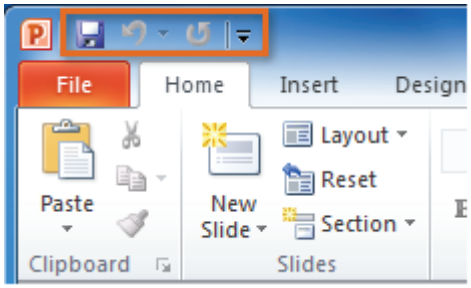
Quick Access Toolbar (Fig 9) : The Quick Access Toolbar is located just above the Ribbon menu. This toolbar offers a convenient place to group the most commonly used commands in PowerPoint.

Ribbon (Fig 10) : Ribbon is located on the top of the PowerPoint window just below the title bar. It contains almost all the commands you need to work with your slides, and is designed in a way that helps you quickly find the commands you need to complete a task.

The ribbon contains three components:

- **Tabs** − They appear across the top of the Ribbon and contain groups of related commands. Home, Insert, Page Layout, etc are some of the examples of Ribbon tabs.

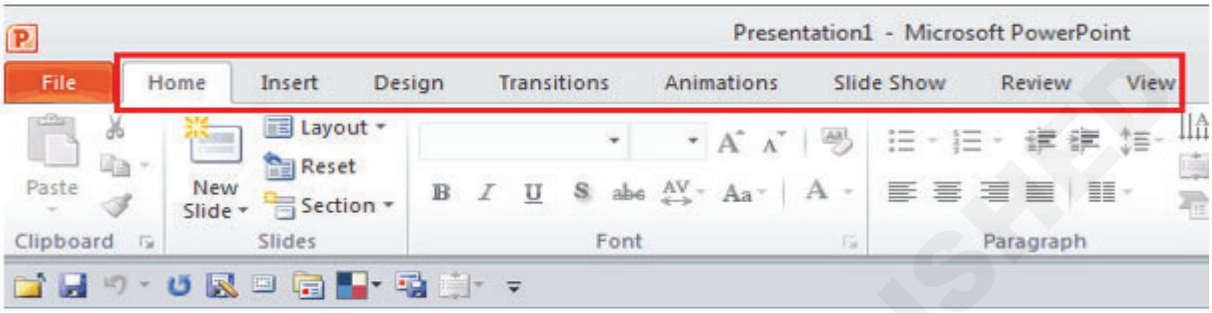
Fig 9



- **Groups** – They organize related commands, each group name appears below the group on the Ribbon. For example, a group of commands related to fonts (or) a group of commands related to alignment, etc.
- **Commands** – Commands appear within each group as mentioned above.

File Tab (Fig 11) : This tab opens the Backstage view which basically allows you to manage the file and settings in PowerPoint. You can save presentations, open existing ones and create new presentations based on blank or predefined templates. The other file related operations can also be executed from this view.

Fig 10

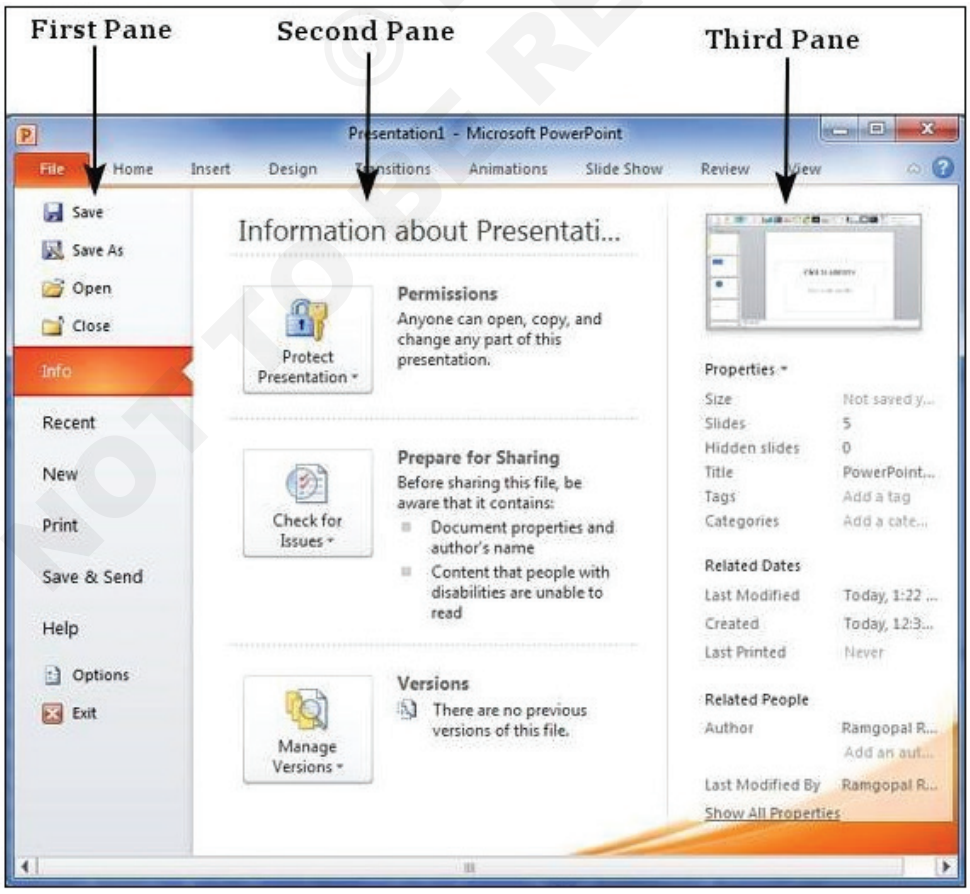


Backstage View (Fig 11) : You can access the Backstage view simply by clicking on the "File tab". You can exit this view by clicking on any tab (including the File tab again). You can also press the 'Esc' button on the keyboard.

The backstage view has three sections or panes.

- **First Pane** – This is the commands pane which consists of all the commands you would typically find in the File menu of older versions. You also have the Options menu which lets you edit the options on the program like customizing the Ribbon.

Fig 11



Various commands under the first pane are described below

1 **Save :** This allows you to save a new file (or) an existing file in standard format. If you are working on a previously saved file this will save the new changes in the same file format. If you are working on a new file, this command would be similar to the "Save As" command.

2 **Save As :** Allows you to specify the file name and the file type before saving the file.

3 **Open :** Allows you to open new PowerPoint files.

4 **Close :** Allows you to close an existing file.

5 **Info :** Displays the information about the current file.

6 **Recent :** Lists series of recently viewed (or) edited PowerPoint files.

7 **New :** Allows you to create a new file using blank or pre-defined templates.

8 **Print :** Allows you to select the printer settings and print the presentation.

9 **Save & Send :** Allows you to share your presentation with larger audience via emails, web, cloud services, etc.

10 **Help :** Provides access to PowerPoint Help.

11 **Options :** Allows you to set various options related to PowerPoint program.

12 **Exit :** Closes the presentation and exits the program.

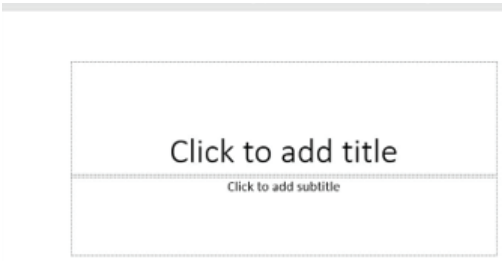
- **Second Pane** − This is the subcommands pane. This will list all the commands related to the main command you choose in the first pane. For example, if you select Print in the first pane, you get to choose the printer and adjust the print settings in the second pane.
- **Third Pane** − This is the preview or file information page. Depending on the command and the subcommand you select, this pane will either display the properties of the file (or) give you a preview of the file.

Slide Tab (Fig 12) : This section is available only in the Normal view. It displays all the slides in sequence. You can add, delete and reorder slides from this section.

Fig 12

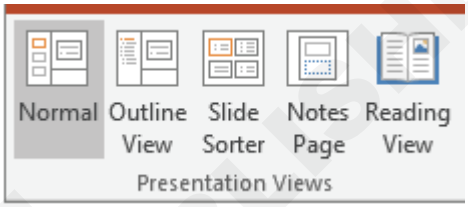
Slide Area (Fig 13) : This is the area where the actual slide is created and edited. You can add, edit and delete text, images, shapes and multimedia in this section.

Fig 13



Slide Views (Fig 14) : It is a group of four buttons located to the left of the Zoom control, near the bottom of the screen, lets you switch between PowerPoint views.

Fig 14

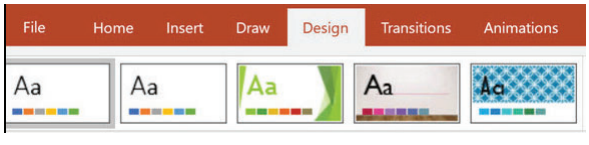


- **Normal Layout view** − This displays page in normal view with the slide on the right and a list of thumbnails to the left. This view allows you to edit individual slides and also rearrange them.
- **Slide Sorter view** − This displays all the slides as a matrix. This view only allows you to rearrange the slides, but you cannot edit the contents of each slide.
- **Reading View** − This view is like a slideshow with access to the Windows task bar in case you need to switch windows. However, like the slideshow you cannot edit anything in this view.

Slide design : On the right-hand side of your screen will appear the "Slide Design" pane. Here you are given three design options to apply to your slides.

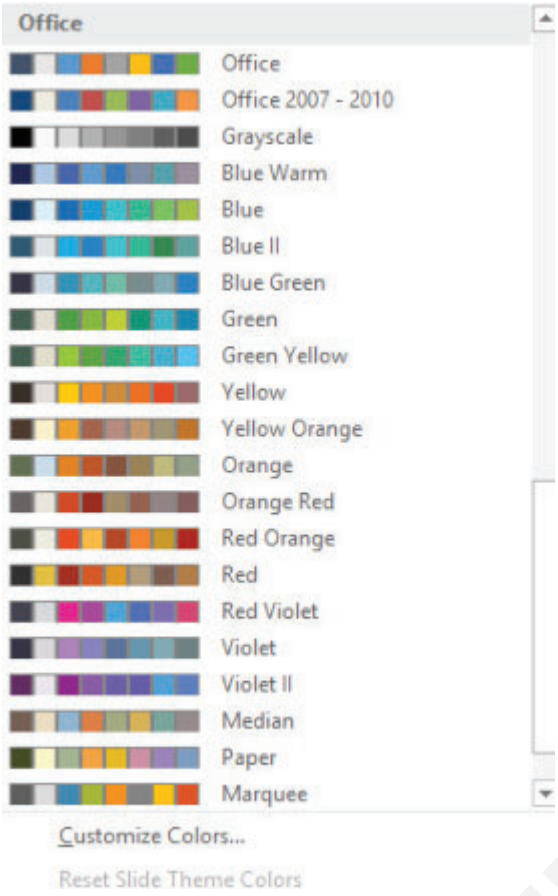
- **Design Templates (Fig 15):** Design templates contain various templates in it that you can choose and apply as background for your slides. For each template, you have the option of applying the design to all slides (or) to only the selected slide. You can view these options by clicking on the arrow on the right side, of the template.

Fig 15



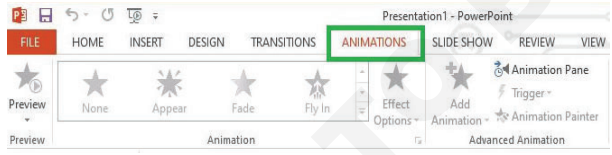
- **Colour Schemes (Fig 16):** This option gives you a variety of color schemes to choose from and to apply to your selected design template.

Fig 16



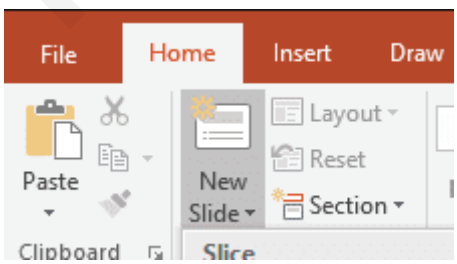
- **Animation Schemes (Fig 17):** This option will allow you to select different types of animation that can be applied to either all the slides (or) only to particular slides. The animation schemes are different ways the slides are "introduced" to your audience, such as Fade, Split, Wipe etc.

Fig 17



PowerPoint Slides (Fig 18) : When you choose to create a blank presentation, PowerPoint will open a presentation with a Title Slide. Once it is open you'll slide with two text boxes for title and subtitle.

Fig 18



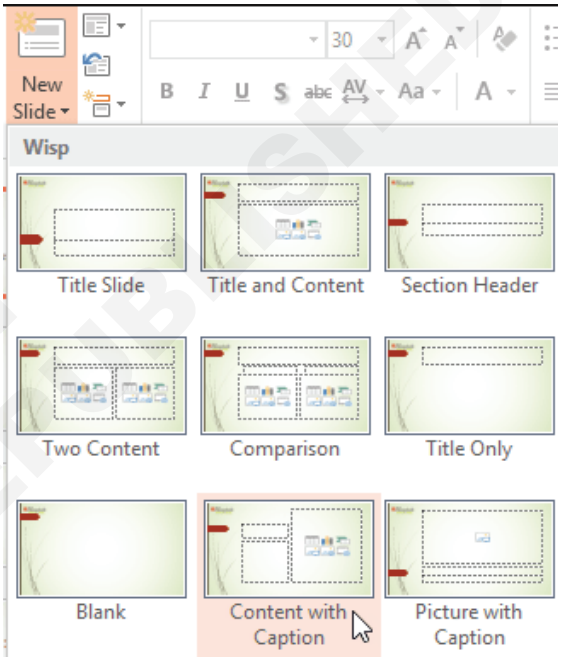
To add a new slide, make sure you're on the Home tab. The new slide button will add slides to your presentation.

The New Slide botton has two parts : Clicking on the top part will automatically insert a new slide. If you have just created a Title slide, the new default layout will be Title and Content slide (for details, see the section on slide layouts).

Clicking on the bottom will give you a choice of layouts. You can choose which layout you want for your next slide. Select layout by clicking on its images in the Office Theme gallery.

Slide Layouts (Fig 19) : There are several standard slide layouts to choose from when adding new slides.

Fig 19



A unique layout can be chosen by clicking on the bottom half of the "New Slide" button in the home tab. When the layout gallery opens, click on the style you want and a new slide with that layout will appear in your presentation. Each layouts caption describes the layout type. Content can be text,tables, charts,graphics, pictures,clip arts, or video. (Fig 20)

The four different types of layout categories

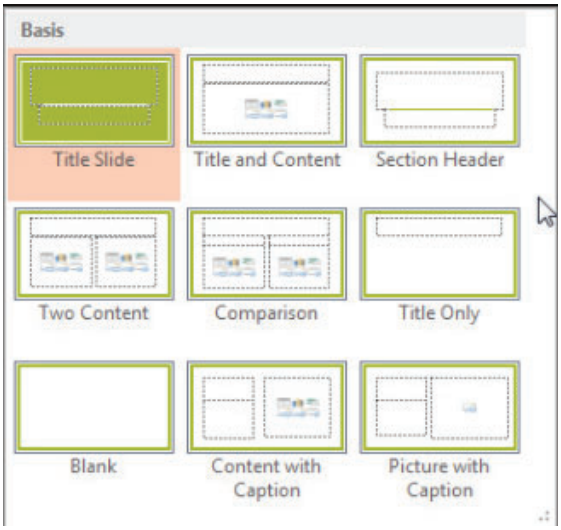
Text Layout: These options are for choosing a layout in which you are only organizing different text boxes. There are no spaces for picture charts or graphs.

Content Layout: These options are for choosing a layout that will only contain pictures, chart, or graphs. There are no spaces for text boxes.

Text and Content Layout: These options have room for both text boxes and pictures, chart, graphs etc.

Other Layouts: These are designed for other media content such as video clips (or) audio tracks.

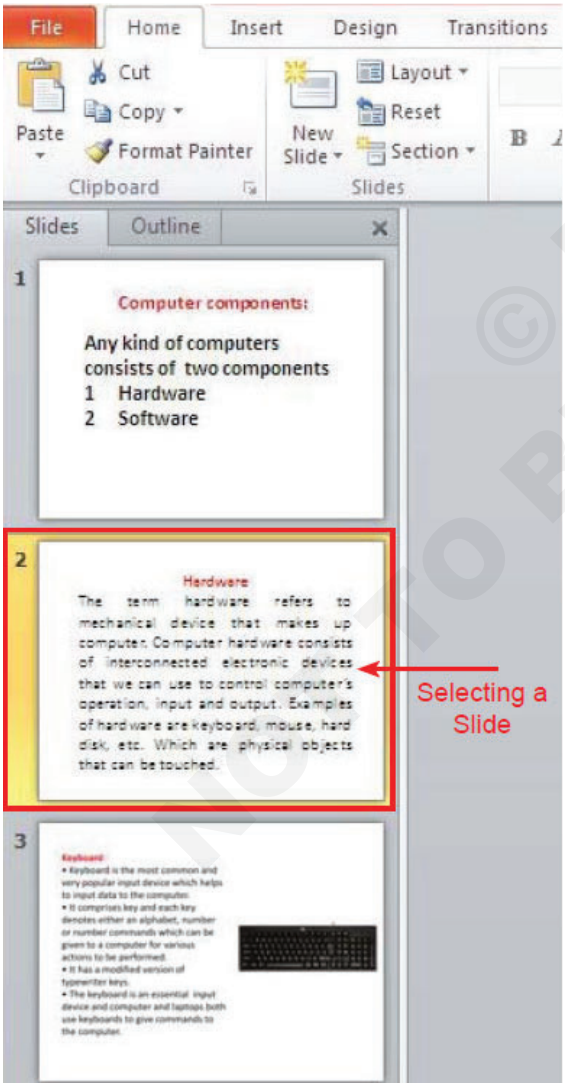
Fig 20



To Change the Layout of an Existing Slide

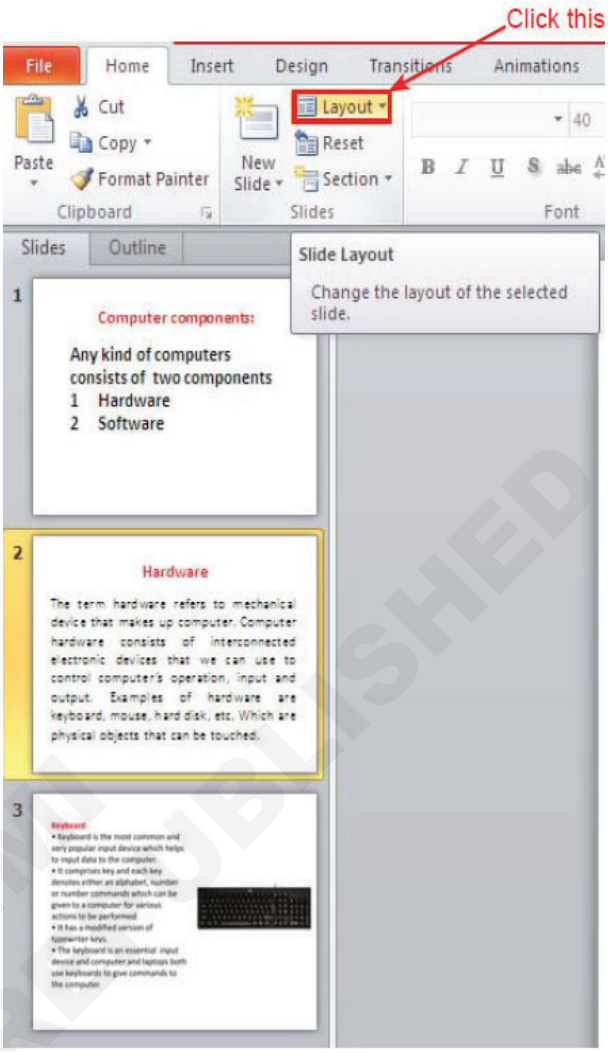
- Select the slide you wish to change. (Fig 21)

Fig 21



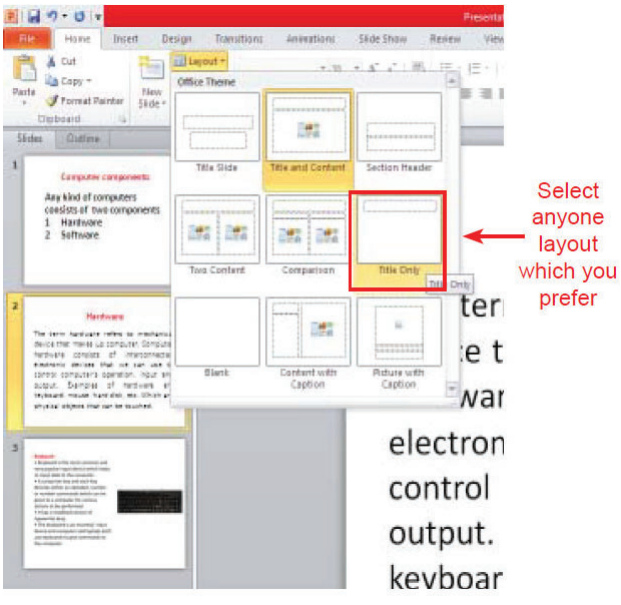
- Click the Layout command in the Slides group on the Home tab. A menu will appear with different options (Fig 22).

Fig 22



- Choose a layout from the menu. The slide will change in the presentation (Fig 23).

Fig 23



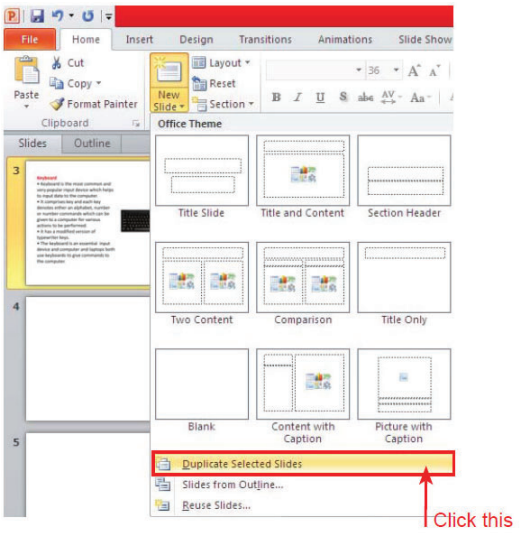
To Duplicate a Slide

1 Select the slide you wish to duplicate

2 Click the New Slide command.

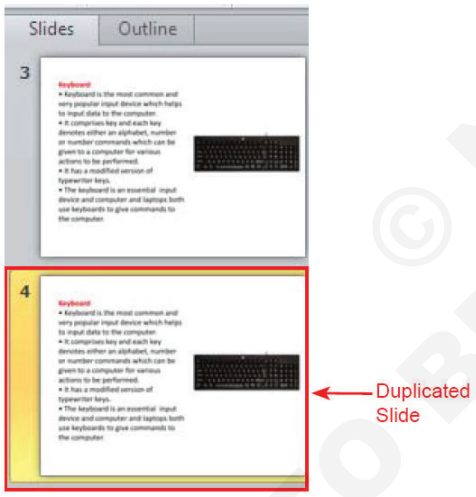
3 Choose “Duplicate Selected Slides” from drop-down menu (Fig 24).

Fig 24



4 A copy of the selected slide appears underneath the original (Fig 25).

Fig 25



To Delete a Slide

1 Select the slide you wish to delete.

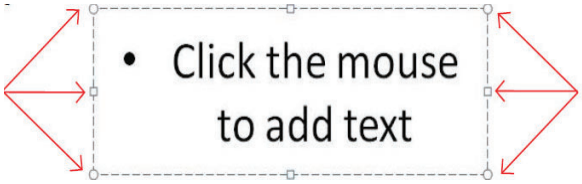
2 Press the Delete or Backspace key on your keyboard.

Text Boxes : Text boxes are “designated” areas that allow you to type words, sentences, and bullet points into the slide. You can adjust the size and placement of the text box within any slide. It is also possible to have multiple text boxes per slide.

When you first open MS PowerPoint there will automatically be two text boxes, on the slide “Click to add title” and “Click to add subtitle”. These text boxes already have a preset format applied to them. The “Title” box has a font size of 44” and the “Subtitle” box has a font size of 32”. You can change the text’s format of any box at anytime by adjusting the format settings on the formatting toolbar.

To adjust the size of the text box, Click on the text box, Once you have clicked on a text box, the border of the box becomes thicker and little circles appear on the corners and at the midpoints of the box (Fig 26).

Fig 26



Move the mouse pointer over any one of the circle. The mouse pointer will change to either ↔ or ↕, Click and hold down the left mouse button. To adjust the height, move the mouse up or down and to adjust the width move the mouse left or right. The corner circles can adjust both height and width, while the mid-point circles can only adjust either height (or) width.

To move the text box to a different location on the slides move your mouse pointer over any part of the thick gray box outline, change in your mouse pointer “plus” sign (+) with arrows. Click and hold down the left button on your mouse. You can now drag the text box to any position on slide by simply moving your mouse.

To write in a text box, simply click inside the box with your mouse. When a cursor is flashing, you are ready to type (Fig 27 & 28).

Fig 27

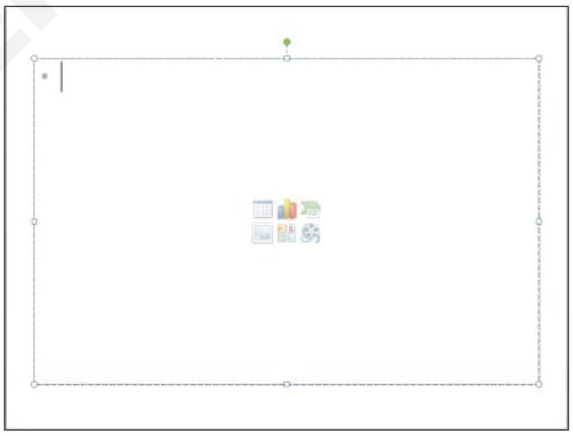
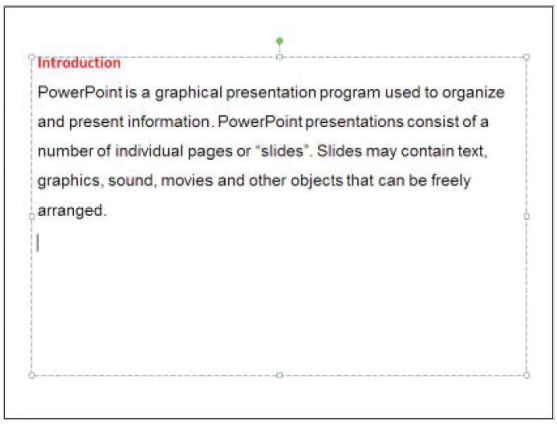


Fig 28



You can also add a text box (or an additional text box) to any slide at any time Use your mouse to click Insert Text box and then “click and drag” your mouse on the slide in the area you want the text box to appear.

To Delete Text

Step 1 Place the insertion point next to the text you wish to delete.

Step 2 Press the Backspace key on your keyboard to delete text to the left of the insertion point.

Step 3 Press the Delete key on your keyboard to delete text to the right of the insertion point.

To Delete a Placeholder

You can easily customize your layout by deleting unwanted (or) “extra” placeholders from any slide.

Step 1 Position your mouse on the dotted border of the placeholder so it changes to a cross with arrows cursor with directional arrows.

Step 2 Click the border to select it. (Fig 29)

Fig 29

Step 3 Press Backspace (or) Delete on your keyboard. The placeholder will be removed from the slide.

Notes Section (Fig 30) : This section allows you to add notes for the presentation. These notes will not be displayed on the screen during the presentation, these are just quick reference for the presenter.

Fig 30

Zoom Options (Fig 31) : The zoom control lets you zoom in for a closer look at your text. The zoom control consists of a slider that you can slide left or right to zoom in (or) out, you can click on the - and + buttons to increase (or) decrease the zoom factor. The maximum zoom supported by PowerPoint is 400% and the minimum zoom supported is 100% and it is indicated by the mark in the middle.

Fig 31

Help (Fig 32) : The Help Icon can be used to get PowerPoint related help anytime you need. Clicking on the “?” opens the PowerPoint Help window where you have a list of common topics to browse from. You can also search for specific topics from the search bar at the top.

MICROSOFT POWERPOINT PRESENTATION

Opening PowerPoint (Fig 33) : To open a PowerPoint presentation, click on the “File tab” in the upper left corner.

Fig 32

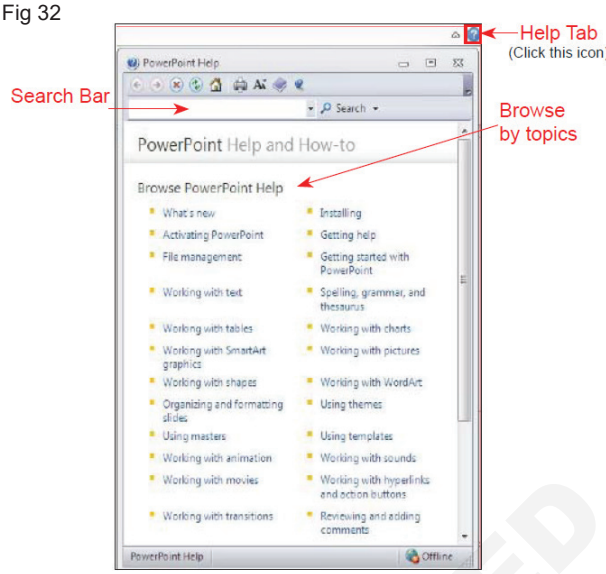
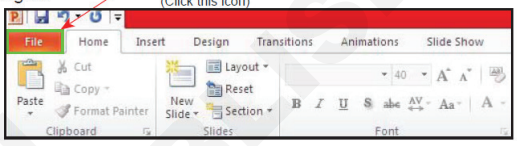


Fig 33



The most common choices for opening a presentation are:

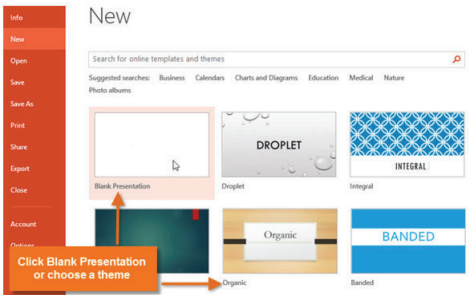
New - allows you to open a Blank presentation (or) you may choose from a selection of Templates and Themes.

Open - lets you navigate to an existing file to view and/ or modify a presentation, that has already been created.

Recent - displays a list of your most recently created presentations and their file locations.

Creating New Presentation (Fig 34)

Fig 34



The New selection gives you several options:

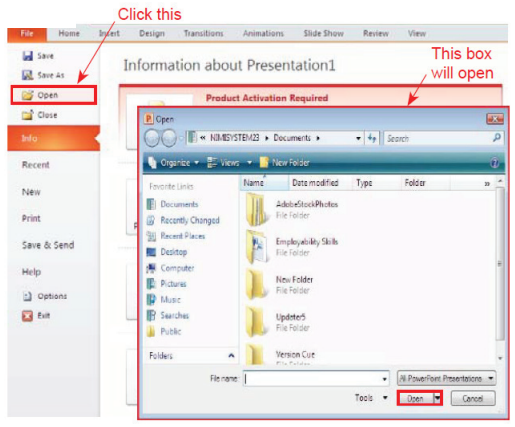
- Blank presentation creates a new presentation using default settings for text and color. These slides will not include content or design elements.
- Templates and Themes are used to create a new presentation based on pre-designed slide styles. These options also do not include content.
- New from existing will use the formatting of a previously created presentaion.

To Open an Existing Presentation

Step 1 Click the File tab. This takes you to Backstage view.

Step 2 Select Open. The Open dialog box appears (Fig 35)

Fig 35

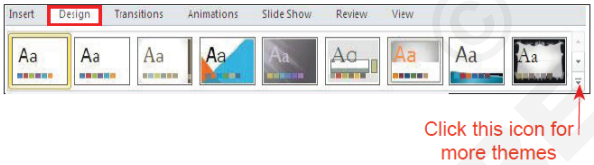


Step 3 Select your desired presentation and then click Open.

Applying a theme

Once a new presentation has been created, a design (or) color scheme can be added. PowerPoint has many pre-set designs and themes. To add a theme to a presentation, go to the Design tab in the Ribbon, and click on any one theme which you prefer. This will add the theme to your presentation (Fig 36).

Fig 36



On the right side of the Theme thumbnails, there's a scroll bar and an Arrow Down button, which will offer more designs, as shown below in the (Fig 37).

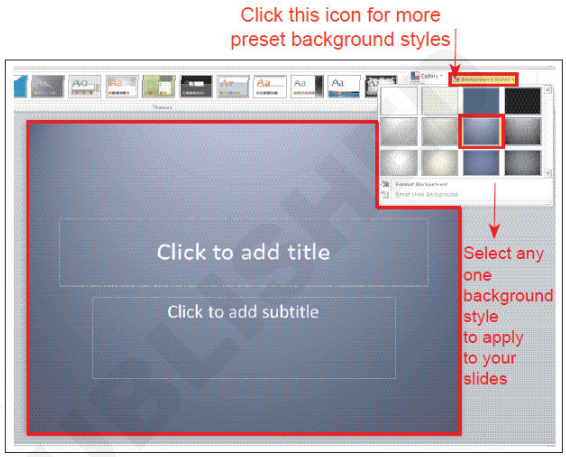
Fig 37

You can also add Background Styles, from this selection. You can add some preset background styles that change according to the colours you have chosen (Fig 38).

Using the Format Background feature, you can choose fill colors, gradients, transparencies, textures (or) pictures for your background.

When you have the desired background fill effect, select Choose to apply it to the selected slide (or) choose "Apply to All" to add the background to all of the slides in the presentation. [Background can be added to selected slide, to do so, click the particular slide from the Thumbnail pane of the navigation bar, then go to "Format Background" and choose any one "Fill" type. Now the background will be applied to that particular slide. (Fig 39). Finally click close ,and do not click "Apply to All" as "Apply to All" will change the background for all the slide at once. If you want to change background for two or more slides click a particular slide and then hold down the control key and click on any other slides you want to apply the design to].

Fig 38



Formatting bulleted lists (Fig 40)

In PowerPoint, you can easily modify a slide's default bulleted list.

- Click inside the text box, and the "Format tab" will automatically be highlighted.
- Click on the Bullets drop down arrow next to the Bullets button.
- A menu of bullet options will appear. (Move over each menu option to display a live preview of the bullet style on the slide) (Fig 41).
- Select the desire bullet option to apply on your presentation.

From the Bullets and Numbering menu you can make various changes to your list:

- The bullet size relative to the text
- The colour of the bullet
- The shape of the built using either a picture or a character.

To Modify the Size and Colour of the bullets

Step 1 Select an existing bulleted list.

Step 2 On the Home tab, click the Bullets drop-down arrow.

Step 3 From the drop-down menu, select Bullets and Numbering. A dialog box will appear. (Fig 42)

Step 4 Set the bullet size using the Size field. (Fig 43)

Fig 39

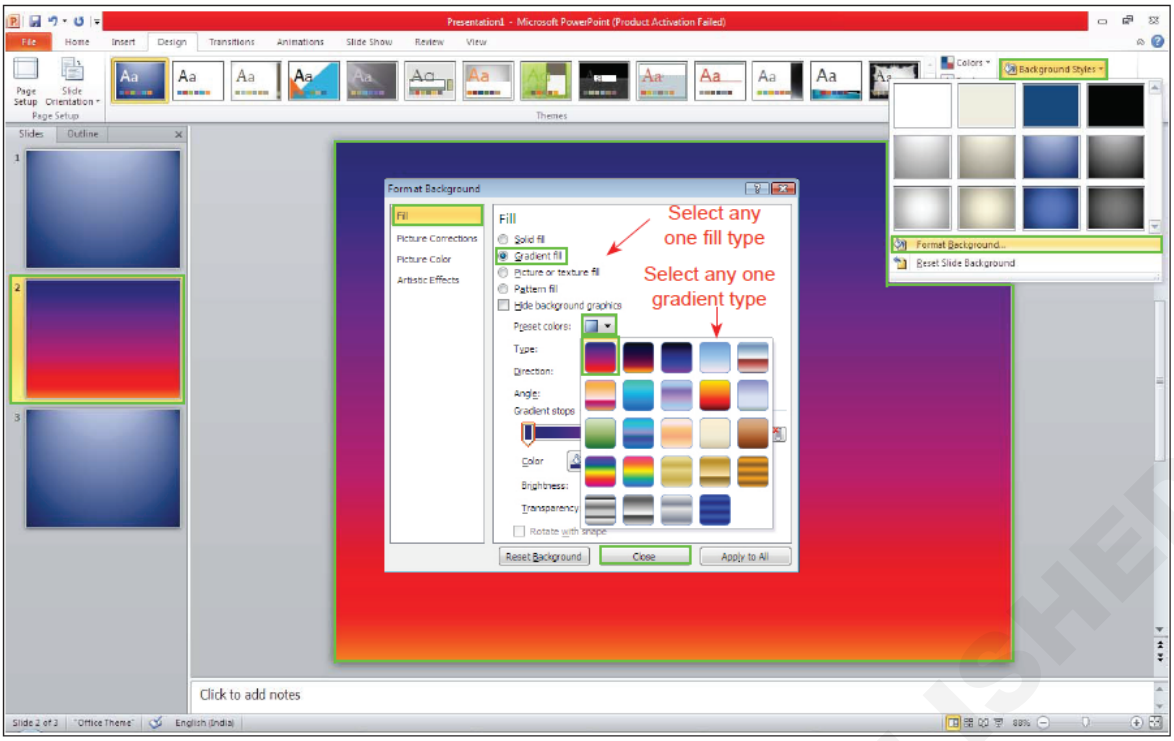
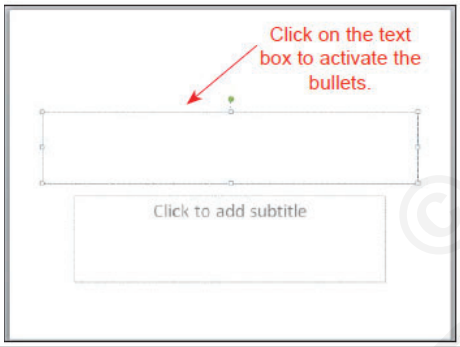


Fig 40



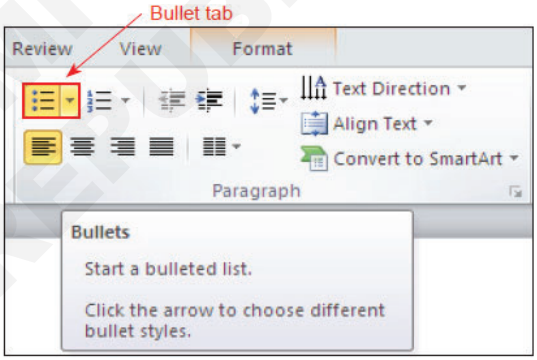
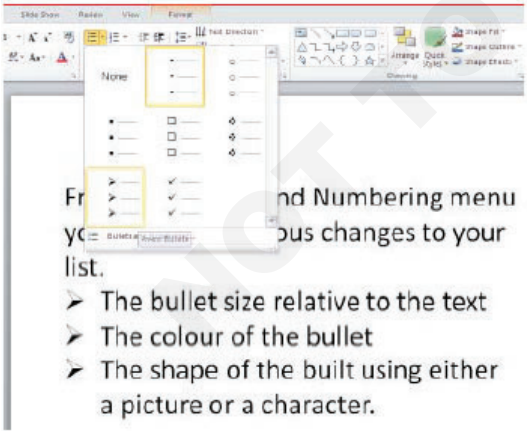


Fig 41

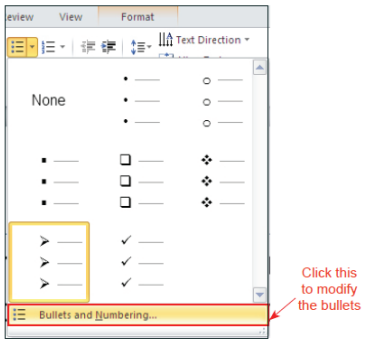


Step 5 Click the Colour drop-down box and select a colour (Fig 44).

Step 6 "Click OK". The list will update to show the new size and colour. (Fig 45)

Follow the same steps for modifying numbers.

Fig 42



To Use a Picture as a Bullet

Step 1 Select an existing bulleted list.

Step 2 On the Home tab, click the Bullets drop-down arrow.

Step 3 From the drop-down menu, select Bullets and Numbering. A dialog box will appear.

Step 4 Click Picture on the Bulleted tab. The Picture Bullet dialog box will appear. (Fig 46)

Fig 43

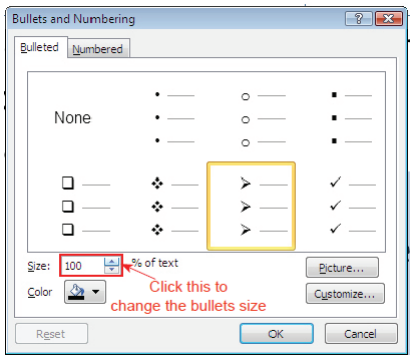


Fig 44

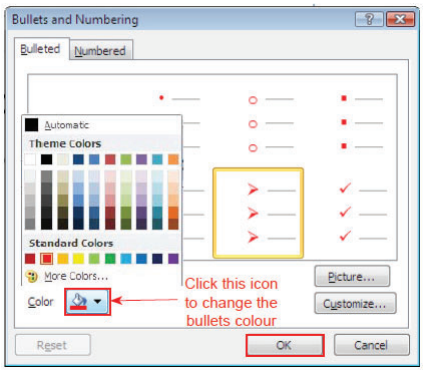


Fig 45

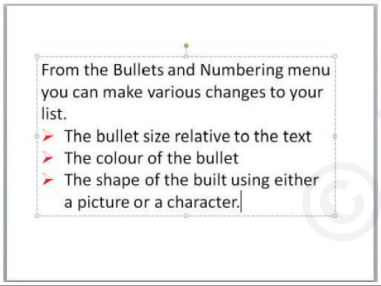
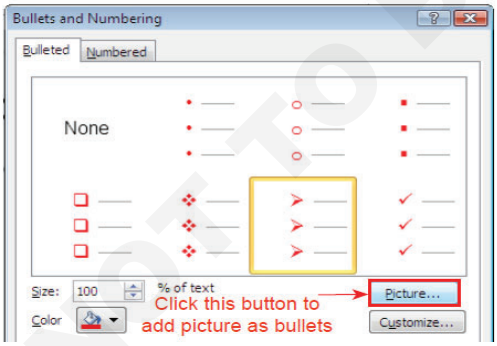


Fig 46



Step 5 Select the desired picture and click "OK" (Fig 47).

Step 6 The list will update to show the new bullets. (Fig 48).

You can also add your own picture as bullets by clicking import option from Picture Bullet dialogue box.

To adjust line spacing between paragraphs or lists. You can do this through the Paragraph group of tools by clicking the Line Spacing button and selection Line Spacing Options. (Fig 49)

Fig 47

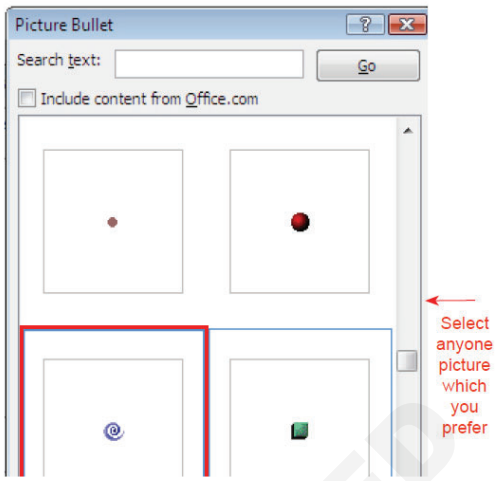


Fig 48

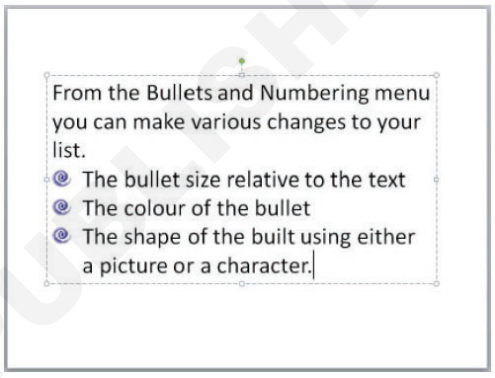
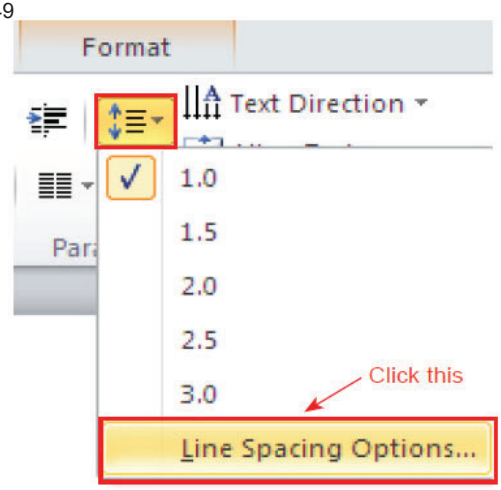


Fig 49

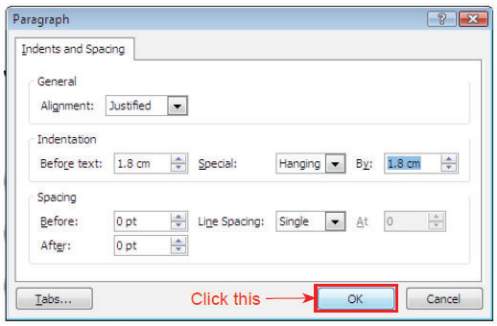


Indents and Spacing controls will open in a separate dialog box,do all the modification and click "OK" (Fig 50).

Adding content

Text is the default content of a slide below. The format for the default is a bulleted list. To add text, click and begin typing, to add other content, click on the icon within the content group on the new slide. Each icon will open the appropriate dialog box or task pane in the drawing tool. (Fig 51)

Fig 50



- The icons on Fig 52 represent the six standard graphical elements that you might want to insert.

Fig 52

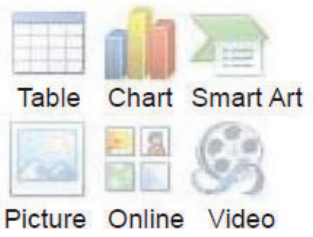
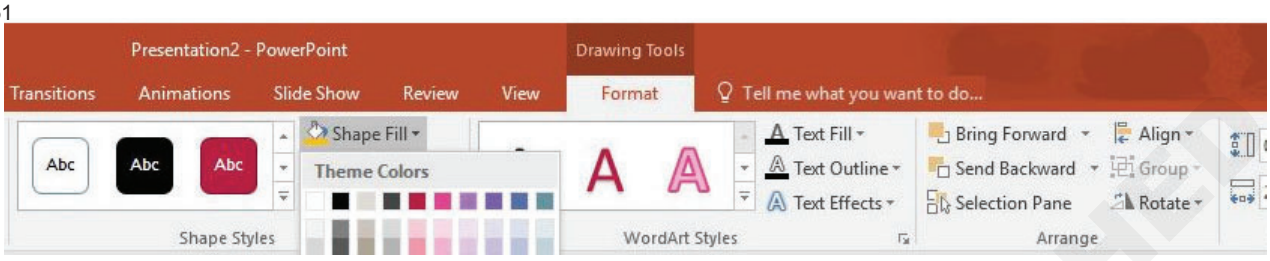


Fig 51



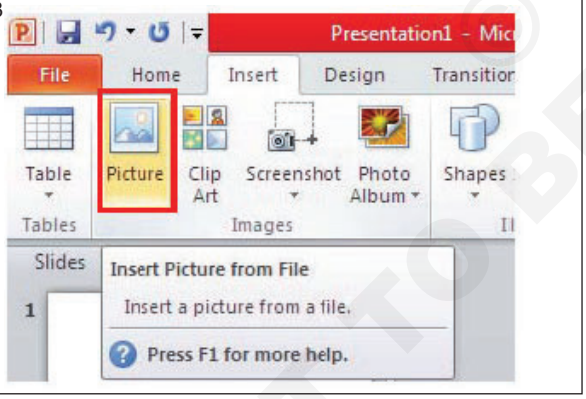
- Clicking on an icon will open the associated dialog box. Note that these icons, as well as several other insertion options, are also displayed in the Insert tab on the Ribbon.

To Insert an Image from a File:

Step 1 Select the Insert tab.

Step 2 Click the Picture command in the Images group. The Insert Picture dialog box appears (Fig 53).

Fig 53



Step 3 Select the desired image file and click Insert (Fig 54).

Step 4 The picture will appear in your slide (Fig 55).

Rotating a picture

It is possible to rotate pictures in MS PowerPoint. Once a picture has been inserted onto a slide and you have clicked on the picture, you can notice a green circle above the center of the picture (Fig 56).

Move the mouse pointer over the green circle, and left-click and hold the button down. Now move the mouse either clockwise or counter-clockwise and the picture will rotate in the same direction. When it is in the position, you need to release the mouse button.

Fig 54

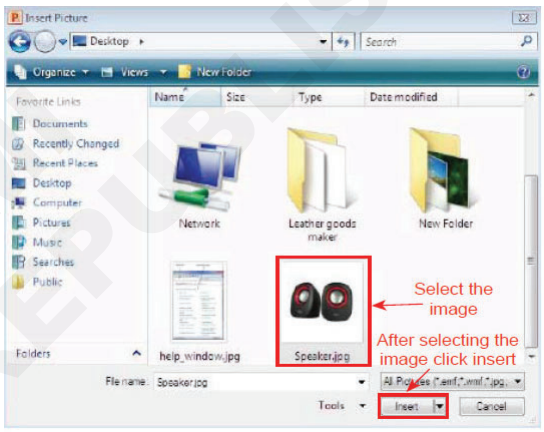


Fig 55

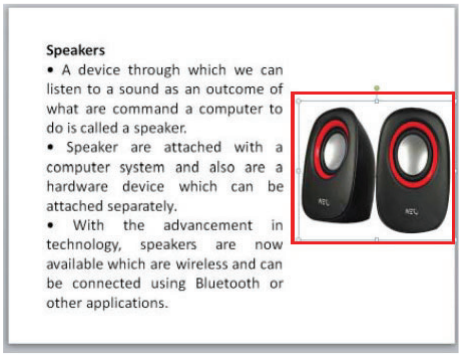


Fig 56

To Crop an image:

Step 1 Select an image. The Format tab will appear.

Step 2 Select the Format tab.

Step 3 Click the Crop command. The black cropping handles appear (Fig 57).

Fig 57

Step 4 Click and drag a handle to crop an image.

Step 5 Click the Crop command to deselect the crop tool.

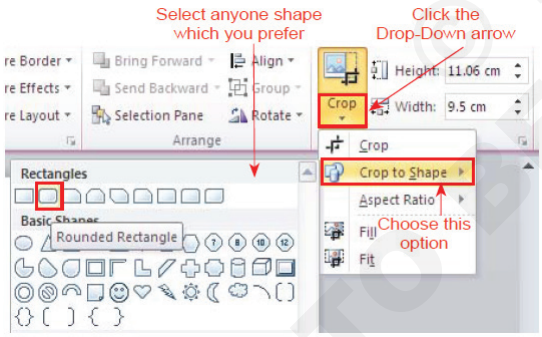
To Crop an Image to a Shape

Step 1 Select the image. The Format tab will appear.

Step 2 Select the Format tab.

Step 3 Click the Crop drop-down arrow (below the Crop command). A drop-down menu will appear (Fig 58).

Fig 58



Step 4 Select a shape from the drop-down menu.

Step 5 The image will take the shape that you have selected. (The image with white background and without any border, when placed on a white background slide does not show any shape when applied to it. So make sure you have a colourful background) (Fig 59 & 60).

To Add a Border to a Picture

Step 1 Select the picture.

Step 2 Select the Format tab.

Step 3 Click the Picture Border command. A drop-down menu will appear (Fig 61).

Step 4: From the drop-down menu, you can select a color, weight (thickness) etc (Fig 61).

Step 5: After the selection, border will be apply to the image (Fig 62).

Fig 59

Fig 60

Fig 61

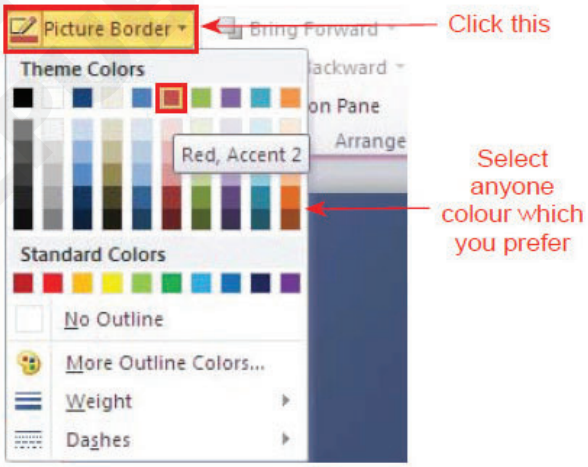
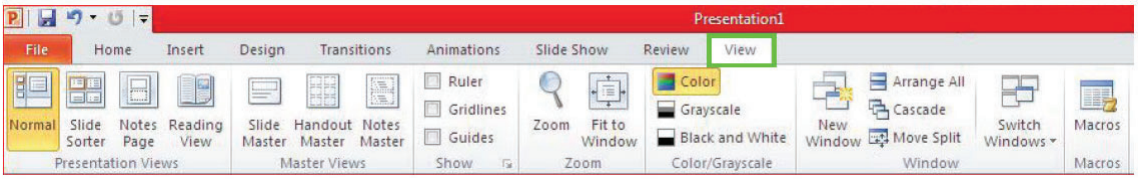


Fig 62

Viewing presentations : There are four different ways to view your presentation in PowerPoint. The views can be accessed using the buttons in the status bar, (or) by using the View tab on the Ribbon (Fig 63).

Fig 63



Different views in PowerPoint Presentation

1 **Normal view:** Normal view displays a single slide as it appears in the presentation, as well as thumbnails and an outline tab, where you can organize the structure. Speaker notes can be added in the botton section of this windows. This view is used to create and edit slides (Fig 64).

2 **Slide sorter view:** From this view you can recorder slides by dragging and dropping them, (or) you can set the timing for the slide show. You can also hide slides in this view. Hiding a slide will keep it in the file, but it will not show when you view the presentation (Fig 65).

Fig 64

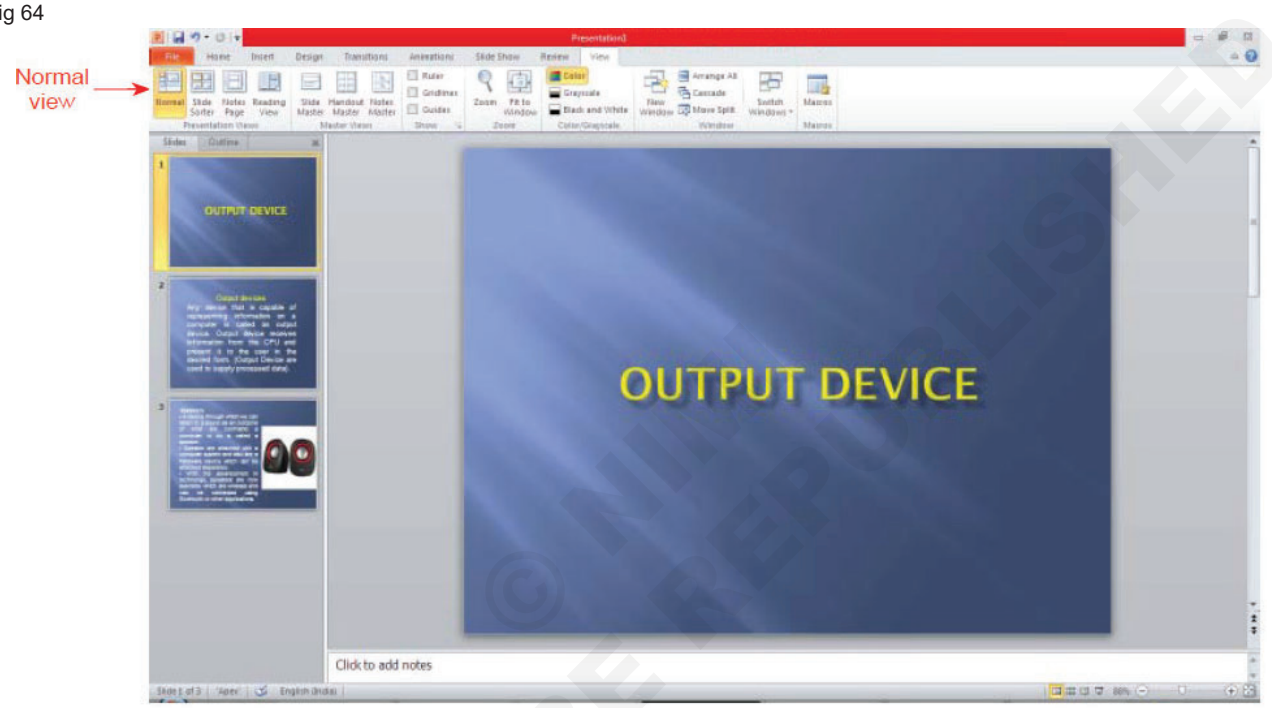


Fig 65

3 **Notes page view:** Note page view allows the speaker to create notes to use during a presentation. Each page corresponds to one slide. These can be printed to assist the presenter during the presentation. Use this view when you're composing speaking topics (Fig 66).

4 **Reading view / Slide view** displays the slides as audience will see them. Use the arrows and icons on the lower right side of the Status Bar to advance slides (or) switch views (Fig 67 & 68).

Use the Esc key to return to normal view.

Slide show tab : The slide show tab allows you to review the slide show from the beginning to end (or) from the current active slide. You can also control how the show will be presented and rehearse timings in this Set Up Slide Show drop down box (Fig 69).

Changing the Order of slides in a presentation : In the slide sorter view, click and hold down the left mouse button and drag the slide to a new location. "You'll see a

line where the slide will be placed when you release the mouse button (Fig 70 & 71).

Fig 67

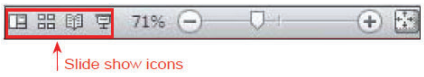


Fig 66

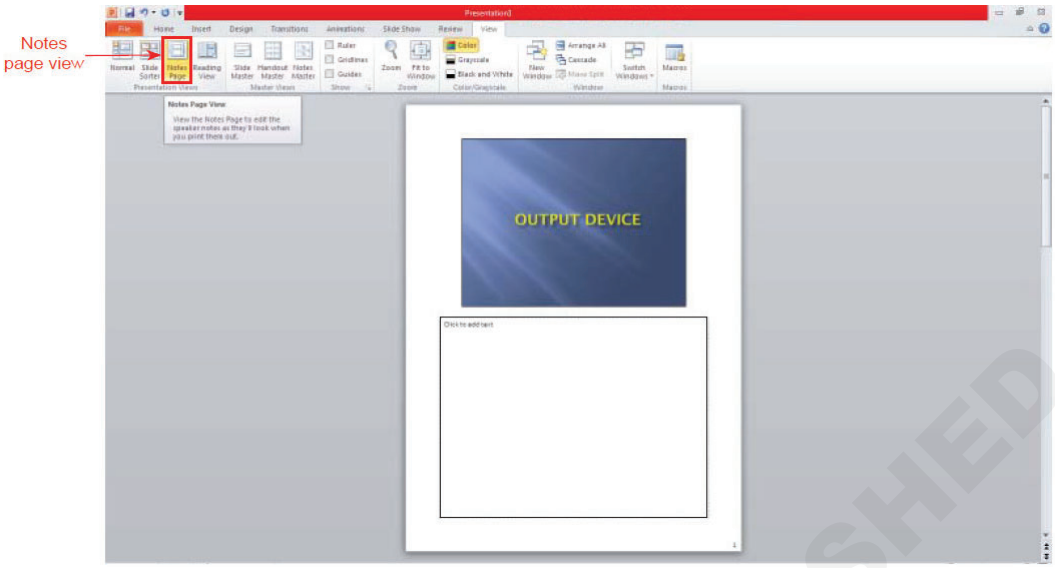


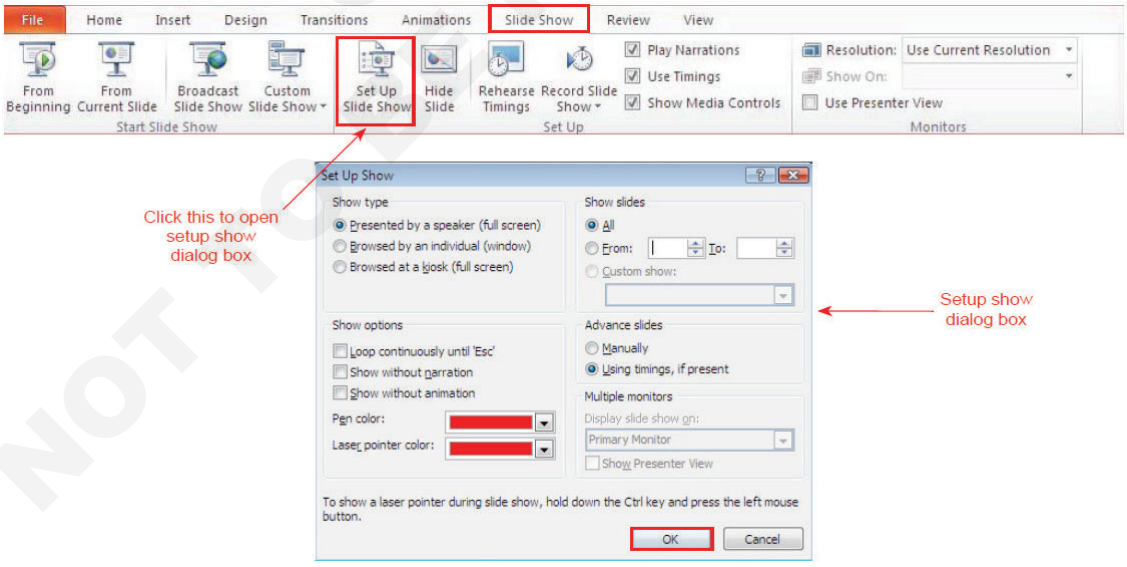
Fig 68

Saving slide shows : When you have completed your presentation (or) When you come to a stopping point and want to leave the computer (or) close the program, it is important to save your work (even if you are printing a hard copy - saving should be done).

Click➝ File➝Save from the Menu Bar to get started.

You can change the filename that PowerPoint has chosen just by typing a new one in the file name box at the bottom of the window that appears (Fig 72).

Fig 69



MS PowerPoint will automatically save your document with the suffix "ppt" this is simply a tag that lets PowerPoint known that your work is specific to this program. You do not have to type it - just highlight what is there (default is "Presentation I") and write a new file name. (If you are using the newest version of PowerPoint it will have the suffix - pptx-).

To bring a saved document back up on the screen from MS powerpoint (Fig 73)

Step 1 Click ➝File ➝Open from the menu bar.

Step 2 Find where the file is located (which folder, that is) and click on the filename of the document you want.

Fig 70

Fig 71

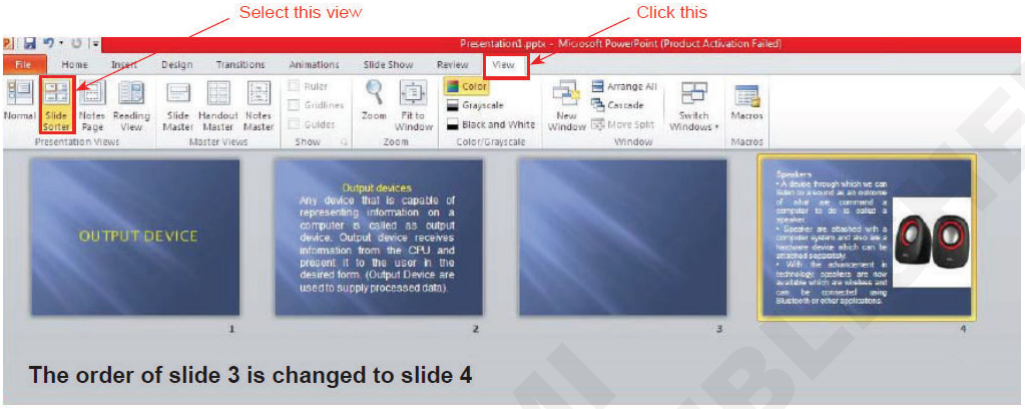


Fig 72

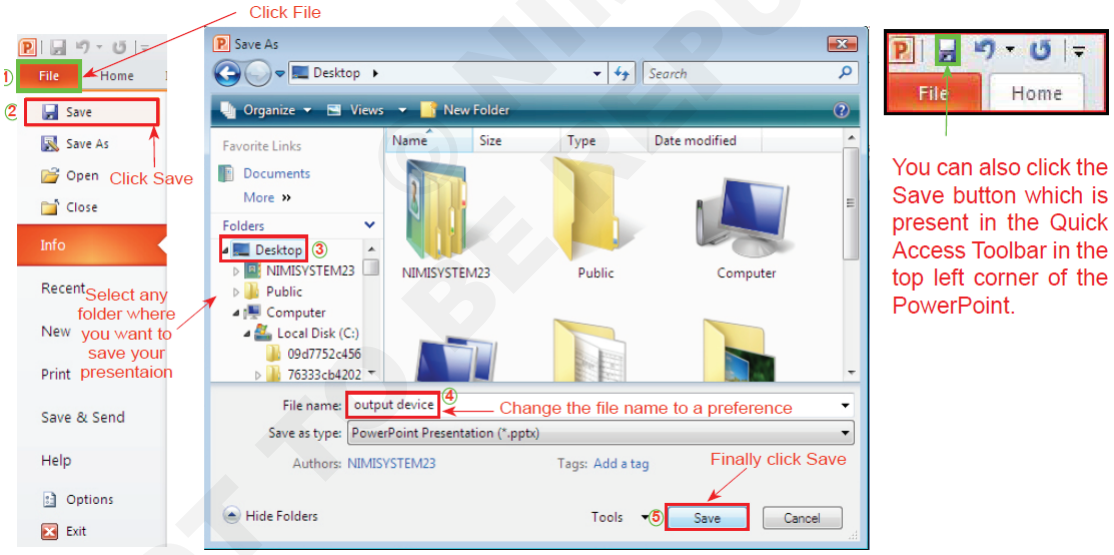
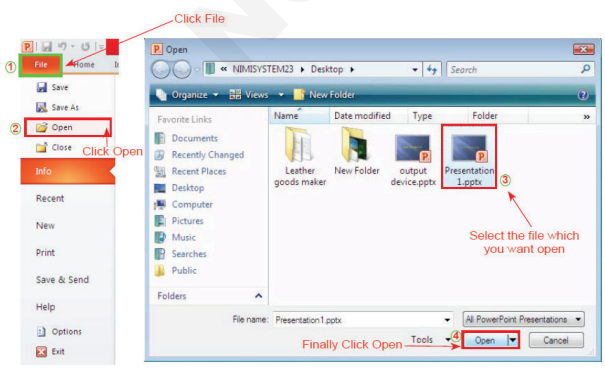


Fig 73



Step 3 Click ➝Open.

Printing slide shows

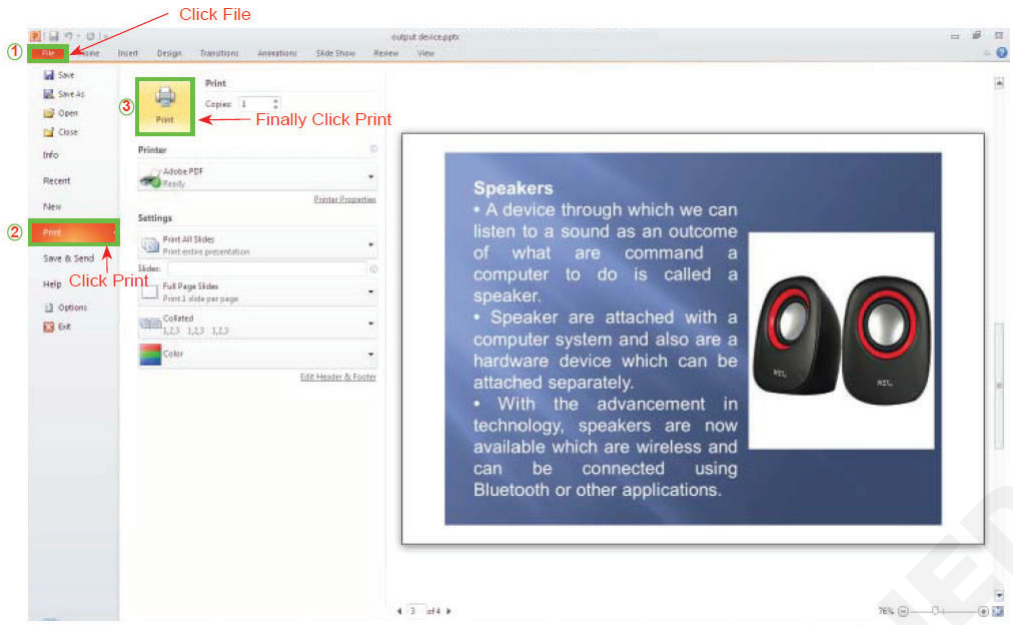
To print your MS PowerPoint slides (Fig 74).

Step 1 Click➝File➝Print from the menu bar and a print window will pop up on the screen.

Step 2 Click "Ok" for your document to start printing.

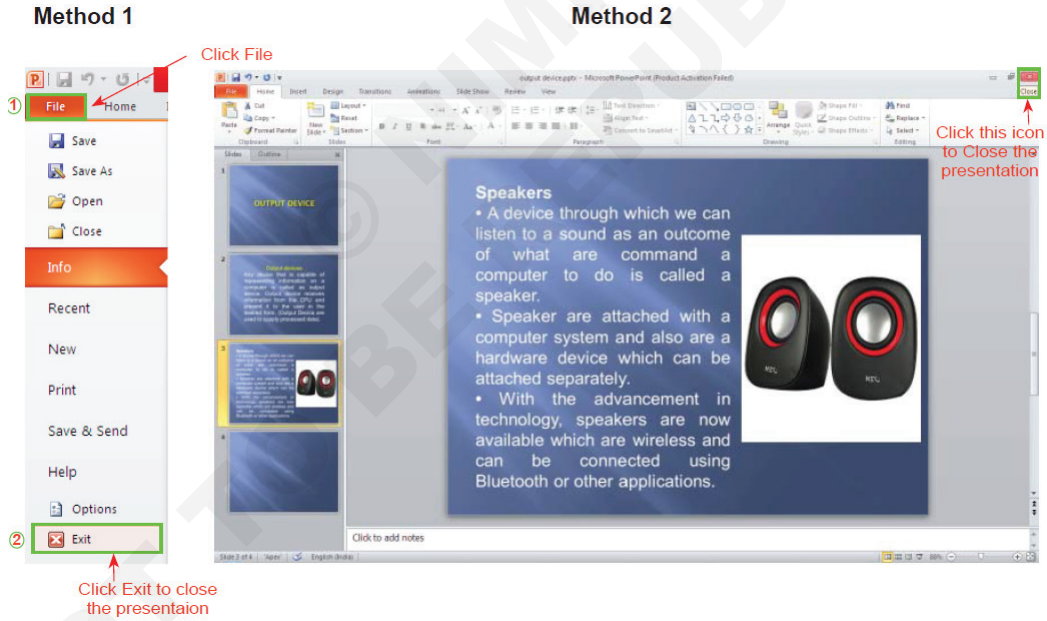
As with all commands in MS PowerPoint, you can make changes along the way. From the print menu, you can alter how many copies will be made, in what order the pages will be and much more. You can choose to print a certain number of slides per page, (or) the outline, (or) even notes.

Fig 74



Existing PowerPoint (Fig 75) : There are several ways to close your file and exit PowerPowint. From the File Button, click "close", if you have not saved your presentation, PowerPoint will prompt you to save. Click "Yes" to save your presentation and your changes, click "No" to discard your changes and close the file (or) Choose Exit (or) use "X" in the upper right corner of the PowerPoint window.

Fig 75



Powerpoint presentation animation

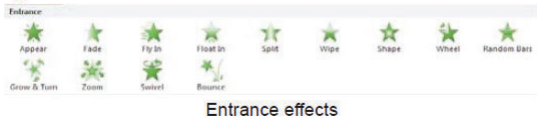
Introduction : In PowerPoint you can animate text and objects such as clip art, shapes, and pictures. Animation, (or) movement, on the slide can be used to draw the audience's attention to specific content (or) to make the slide easier to read. (Fig 76)

The Four Types of Animations

There are many different animation effects that you can choose from, and they are organized into four types:

Entrance: These control how the object enters the slide. For example, with the Bounce animation, the object will fall onto the slide and then bounce several times (Fig 77).

Fig 77

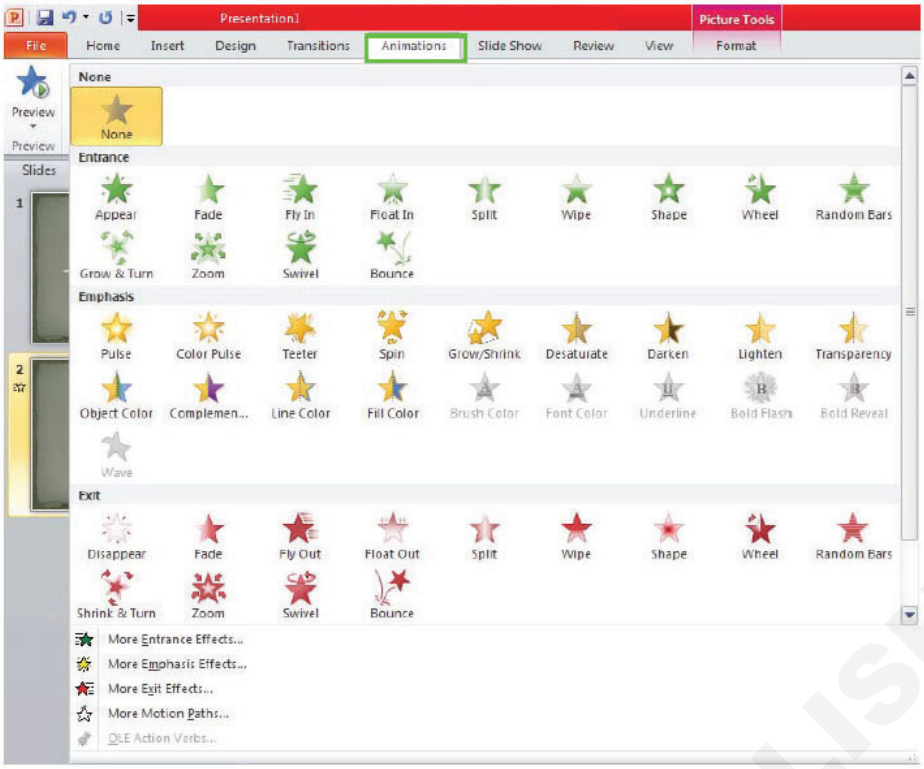


Entrance effects

Emphasis: These animations occur while the object is on the slide, often triggered by a mouse click. For example, you can set an object to Spin when you click the mouse (Fig 78).

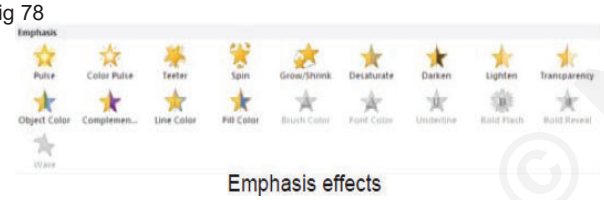
Exit: These control how the object exits the slide. For example, with the fade animation, the object will simply fade away (Fig 79)

Fig 76



Animation effects

Fig 78



Emphasis effects

Fig 79

Exit effects

Motion Paths: These are similar to Emphasis effects, except the object moves within the slide along a pre-determined path, for example a circle (Fig 80).

Fig 80

To Apply an Animation to an Object:

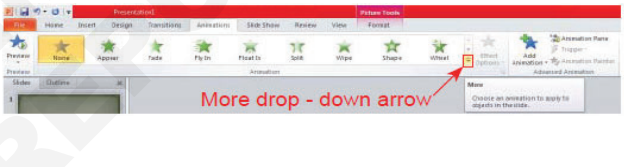
Step 1 Select an object

Step 2 Click the Animations tab.

Step 3 In the Animation group, click the More drop-down arrow to view the available animations (Fig 81).

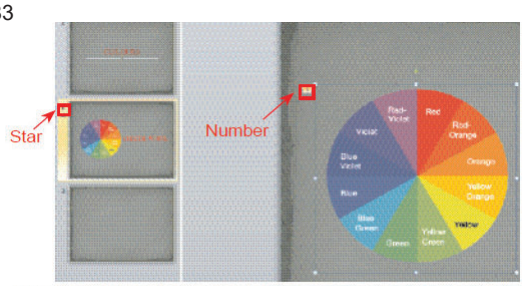
Step 4 Select the desired animation effect (Fig 82).

Fig 81



Step 5 The object will now have a small number next to it to show that it has an animation. Also, in the Slide pane, the slide will now have a star symbol next to it (Fig 83).

Fig 83



The star and the number indicate that an effect has been added

At the bottom of the menu, you can access even more effects (Fig 84).

Effect Options : Some effects will have options that you can change. For example, with the Wheel In effect, you can control which direction the object comes from. These options can be accessed from the Effect Options command in the Animation group (Fig 85)

Fig 82

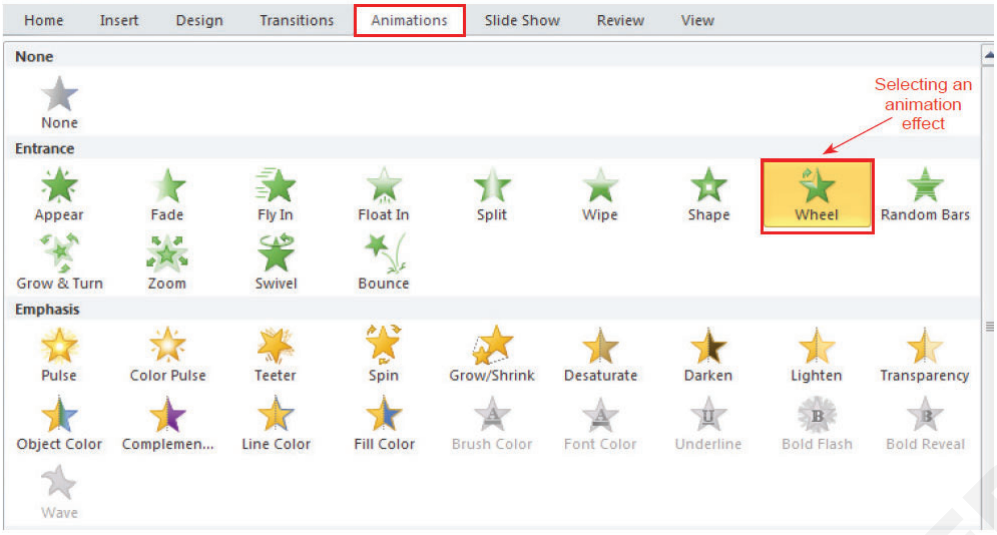


Fig 84

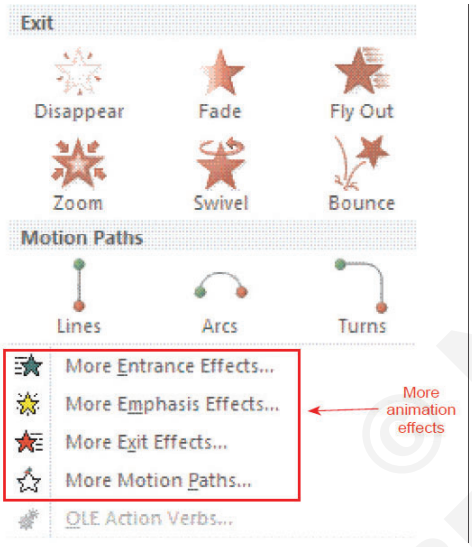
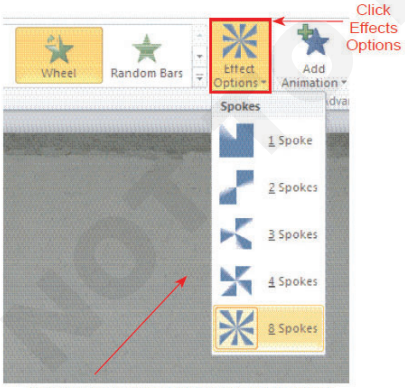


Fig 85



Working with Animations

To Add Multiple Animations to an Object: If you select a new animation from the the menu in the Animation group, it will replace the object's current animation. However, you'll sometimes want to place more than one animation on an object, for example an Entrance and an Exit effect. To do this, you'll need to use the "Add Animation command", which will allow you to keep your current animations while adding new ones.

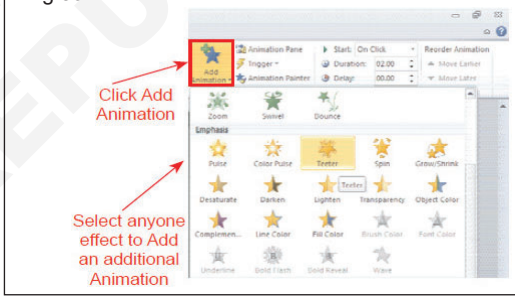
Step 1 Select the object.

Step 2 Click the Animations tab.

Step 3: In the Advanced Animation group, click the Add Animation command to view the available animations.

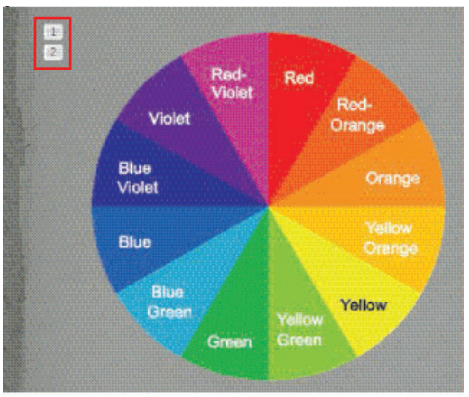
Step 4 Select the desired animation effect (Fig 86).

Fig 86



Step 5: If the object has more than one effect, it will have a different number for each effect. The numbers indicate the order in which the effects will occur (Fig 87).

Fig 87



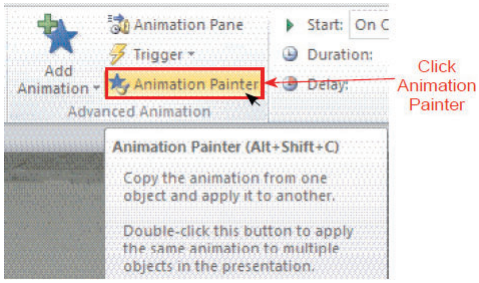
An object with two animations

To Copy Animations with the Animation Painter : In some cases, you may want to apply the same effects to more than one object. You can do that by copying the effects from one object to another using the Animation Painter.

Step 1 Click on the object that has the effects that you want to copy.

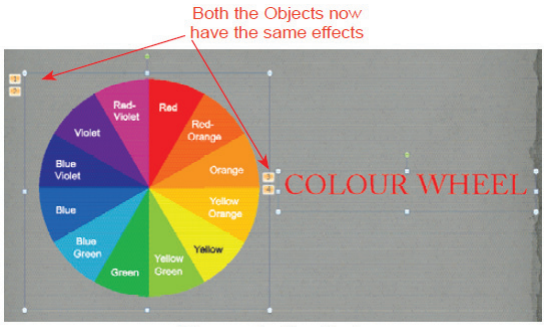
Step 2 From the Animations tab, click the "Animation Painter" command (Fig 88).

Fig 88



Step 3 Click on the object that you want to copy the effects to. The effects will be applied to the object (Fig 89).

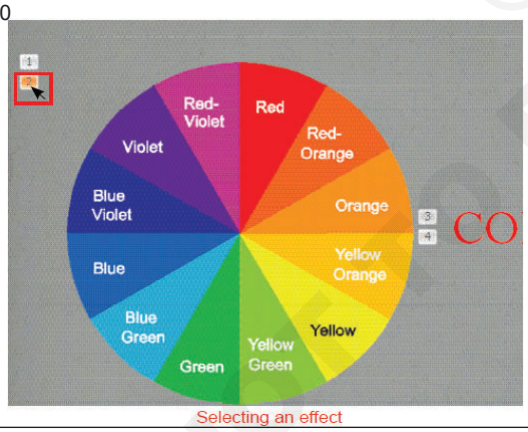
Fig 89



To Reorder the Animations

Step 1 Select the number of effect that you want to change. (Fig 90)

Fig 90



Step 2 From the Animations tab, click the Move Earlier (or) Move Later commands to change the order (Fig 91).

To Preview Animations: Any animation effects that you have applied will show up when you play the slide show. However, you can also quickly preview the animations for the current slide without viewing the slide show.

Step 1 Navigate to the slide that you want to preview.

Step 2 From the Animations tab, click the Preview command. The animations for the current slide will play (Fig 92).

Fig 91

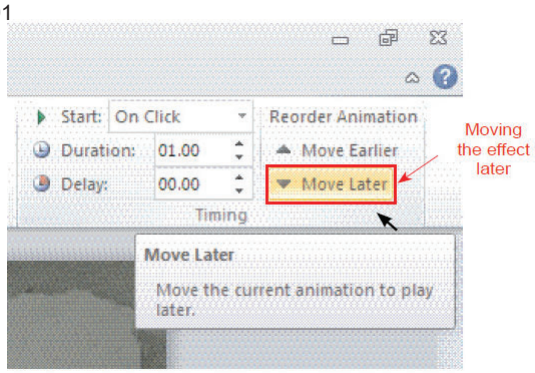
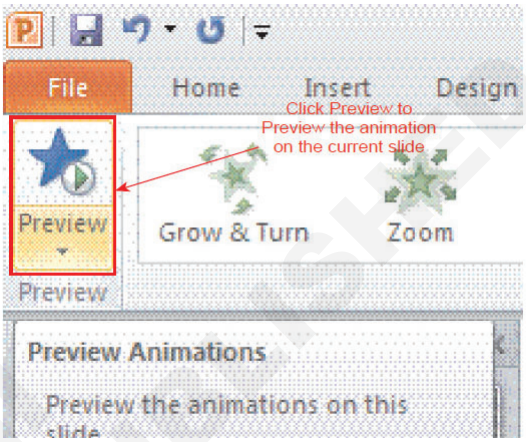


Fig 92



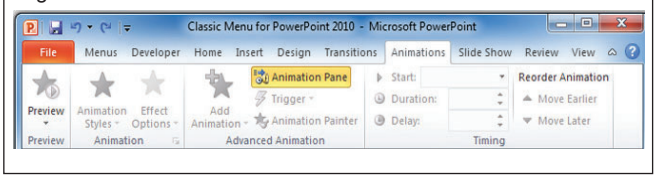
The Animation Pane

The Animation Pane allows you to view and manage all of the effects that are on the current slide. You can modify and reorder effects directly from the Animation Pane, which is especially useful when you have a large number of effects.

To Open the Animation Pane

Step 1 From the Animations tab, click the Animation Pane command (Fig 93).

Fig 93



Step 2 The Animation Pane will open on the right side of the window. It will show all of the effects for the current slide in the order that they will appear (Fig 94).

To Reorder Effects from the Animation Pane

Step 1 On the Animation Pane, click and drag an effect up or down (Fig 95).

Step 2 The effects will reorder themselves.

To Preview Effects from the Animation Pane

Step 1 From the Animation Pane, click the Play button (Fig 96).

Step 2 The effects for the current slide will play. On the right side of the Animation Pane, you will be able to see

a timeline that shows the progress through each effect (Fig 97).

Fig 94

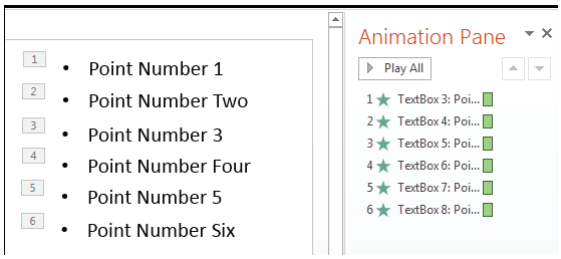


Fig 95

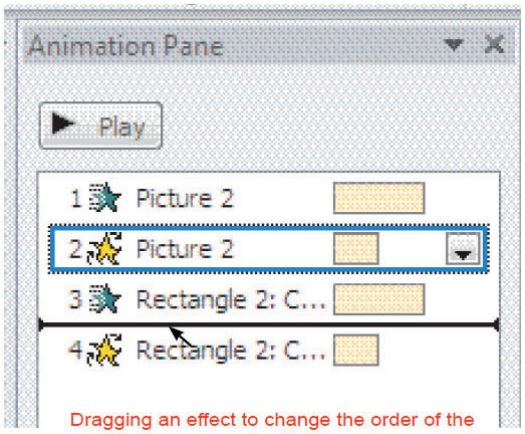


Fig 96

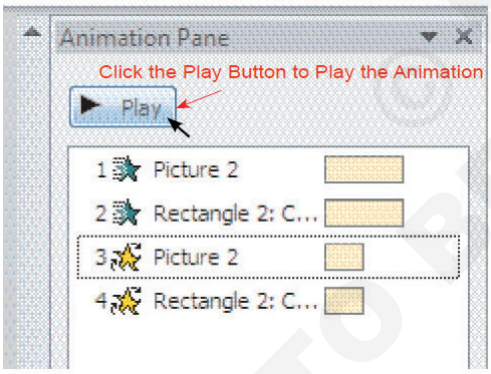
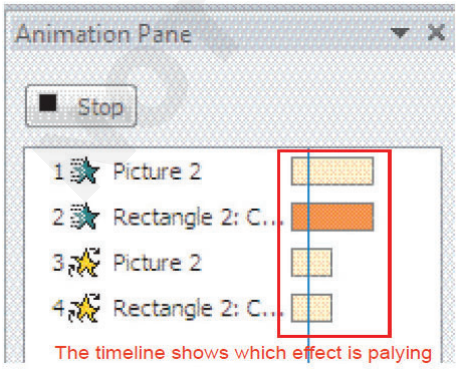


Fig 97



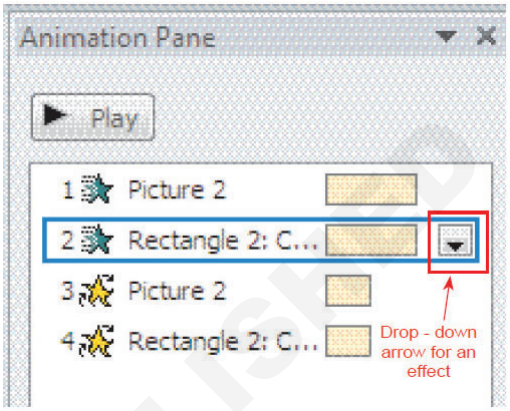
If the timeline is not visible, click the drop-down arrow for an effect and select Show Advanced Timeline.

To Change an Effect's Start Option

By default, an effect starts playing when you click the mouse during a slide show. If you have multiple effects, you will need to click multiple times to start each effect individually. However, by changing the start option for each effect, you can have effects that automatically play at the same time (or) one after the other.

Step 1 From the Animation Pane, select an effect. A drop-down arrow will appear next to the effect (Fig 98).

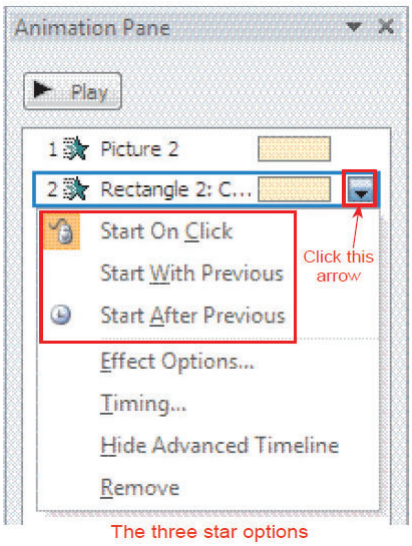
Fig 98



Step 2 Click the drop-down arrow. You will see three start options:

- **Start on Click -** This will start the effect when the mouse is clicked.
- **Start With Previous -** This will start the effect at the same time as the previous effect.
- **Start After Previous -** This will start the effect when the previous effect ends (Fig 99).

Fig 99



Step 3 Select the desired start option.

When you preview the animations, all of the effects will play through automatically. To test effects that are set to Start on Click, you will need to play the slide show.

The Effect Options Dialog Box

From the Animation Pane, you can access the Effect Options dialog box, which contains more advanced options that you can use to fine-tune your animations.

To Open the Effect Options Dialog Box

Step 1 From the Animation Pane, select an effect. A drop-down arrow will appear next to the effect.

Step 2 Click the drop-down arrow and select Effect Options. The Effect Options dialog box will appear.

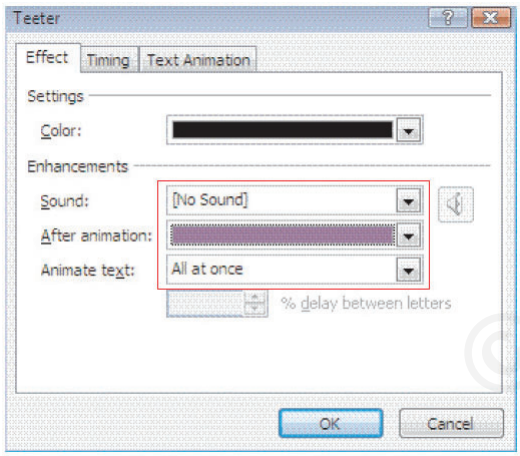
Step 3 From here, you can add various enhancements to the effect.

Sound - Adds a sound effect to the animation.

After animation - Changes the color or hides the object after the animation is over.

Animate text - If you are animating text, you can choose to animate it all at once, one word at a time, (or) one letter at a time (Fig 100).

Fig 100



Effect Options dialog box

Some effects have additional options that you can change. These will vary depending on which effect you have selected.

To Change the Effect Timing

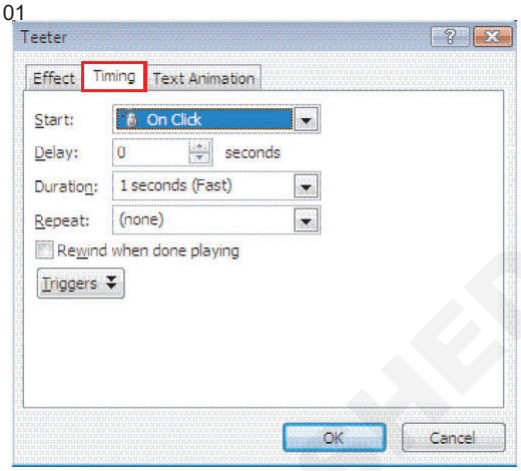
Step 1 From the Effect Options dialog box, select the Timing tab (Fig 101).

Step 2 From here, you can add a delay before the effect starts, change the duration of the effect, and control whether or not the effect repeats. After the changes click "OK' to close. (Fig 102).

Introduction to and history of Autodesk 3ds Max

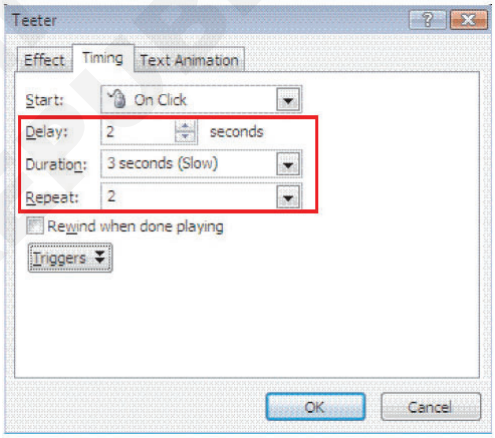
Developed and produced by Autodesk Media and Entertainment, Autodesk 3ds Max is software for rendering 3D animation, models and imagery. It was originally called 3D Studio and was created by the Yost Group of Atari for work on the DOS platform, and development started in 1988. It later was adopted for Windows NT with 3D Studio DOS release 4 and was subsequently renamed 3D Studio MAX. 3D studio MAX, also developed by the Yost group was produced by Kinetix, which was then the media and entertainment division of Autodesk. It was the release 8 of the original 3D Studio, which was renamed Autodesk 3ds Max which was made available to the public in 2009. 3ds Max offers much functionality targeted towards ease of use and faster image and animation rendition.

Fig 101



Selecting the Timing tab

Fig 102



Changing the Timing options

Major Applications of Autodesk 3ds Max

The software is used in developing CGI as well as applications ranging from academia to game development. Each use of the software requires the use of a different set of tools available in the software and as plug-ins. 3ds Max is available free of cost for students. However profession packs are available for sale.

Major Features of Autodesk 3ds Max

Autodesk 3ds Max is primarily, although not completely, based on polygon modeling. Polygon modeling is used more extensively in game design than in other animation application as it offers a highly specific control over individual polygons that make up the model. This feature of polygon modeling also allow for greater optimization of the model.

Usually, the design process begins at the selection of a primitive model bundled with 3ds, which is then

further refined as per need. The current versions have a simplified mesh editing interface and using the 'edit poly' modifier which moves the tools available in the primitive model, higher in the modifier stack, allowing them to be used on top of other modifications.

In the 3ds Max software various unique primitive shapes such as teapots, cones, pyramids and cubes are available which can be used as a base for model development.

Although polygons are the method of choice for model building, surfaces are easier to define using other methods. 3ds Max's subdivision surface support allows for smoothened surfaces and with the use of tools like Soft Selection, which allows manipulation of vertex clouds into the desired shape without distortions from unwanted shapes and displaying smooth surfaces. The sculpting brush feature allows smooth surfaces to be drawn by hand, if polygons give a distorted image, although functionality is limited.

The NURBs feature of Autodesk 3ds allows smooth surface rendition by use of mathematical formulae and is of greatest use to in accurate simulation of mechanical parts. This is of greatest use in applications such as automobile design and instrument design.

3ds Max allows the use of custom lighting and shadows and highlights can also be 'burned' into the image rendered. These settings are mostly used for game imagery, since pre-fit values of shadows and highlights allows the game engine to process less data thereby improving game speed and performance as the model is already painted with the required modifications.

This also means that for constant lighting conditions during play, especially if motion is involved, the images do not falter and give a constant, regular image, free of improper shadows and bad graphics.

For life like character models, 3ds Max includes simulation for hair, skin, cloth and fur, all requirements for simulation of living beings. These inbuilt add-ons reduce the time required for model development and improve the detail for each frame.

It also includes rigid body dynamics which means that simulation of hard bodies such as wood or bricks, is easy to perform. This software is also equipped with features like shatter effect to recreate the dynamics of shattering rigid objects. However, soft body dynamics, which allows for the motion simulation of deformable objects, is not supported by 3ds Max, which makes simulation of such objects difficult.

A very useful feature of this software is the support for Inverse Kinematics and Forward Kinematics. Inverse Kinematics or skeleton modeling allows the user to create a model and fit it with a skeleton, which can then be animated as per the requirements of the animator. This skeleton can then be placed inside the model, making the animating the model easier.

Tools available in Autodesk 3ds Max

- **MAXScript:** It is a scripting language which is built into the software and can automate repetitive tasks, give varying combinations of present features and developing tools and user interfaces. MAXScript can also be used to build plug-ins for 3ds Max.
- **Scene Explorer:** Scene Explorer provides an orderly, hierarchical view of scene data. It allows categorical editing of data, to achieve simplicity in editing complex sets and can also manage code in .NET.
- **Character Studio:** Initially a plug-in character studio is a tool for help in animating virtual characters, the Character Studio allows using stock skeleton animation to quickly and easily modify characters for a project which work on the 'biped' skeletal system.
- **General keyframing:** There are two keying modes; auto key and set key which provide support for separate workflows. The keyframing controls given help in easing the animation by providing simple, but important features like cut, copy and paste.
- **Constrained animation:** It allows animation of objects placed inside the constraints of their shape. This tool allows the animation of objects along curves with controls provided for smoothness, velocity, alignment, banking etc. and along surfaces.
- **Skinning:** Using with the Physique or Skin, a fine control of movement can be achieved and can be used in the most tricky of places.
- **Integration with Autodesk Vault plug-in:** The Autodesk Vault is a plug-in which is shipped along with 3ds Max and is used to integrate user data and assets on to one location, thus tracking progress on projects. Also, managing work in progress is an easier task. The plug-in enables users to safely and easily design, find, reuse and share 3ds Max models for a team production effort.

Introduction to 3ds Max

Formerly known as a 3D studio and 3D studio Max, 3ds Max is a 3D professional modeling, animation, and rendering application build for making 3D animations, models, interactive games, visual effects for the entertainment industry. It plays a huge role in designing 2D cross-section shapes of 3D models. It can bring characters to life by using a special character called the inverse kinematics, which links different components of a character together.

Main Toolbar: It is present at the top of the interface. It includes tools and options that appear like buttons and dropdown menus.

Command Panel: It is situated on the right side of the interface. It includes all other commands that the user needs.

Maxscript Editor: It is used to code scripts, utilities, and plugins.

Viewports: This is the view boxes that display the scene from four different angles- Top, left, front, and perspective. The viewport is very helpful and makes work easy and quick.

Material Editor: It is used for texturing objects and preparing materials and maps that can be applied to the objects.

Render Frame Window: It allows the user to view the final output of their scene with materials and lighting. This output can also be saved for future references.

How Does 3ds Max Make Working so Easy?

It has an amazing set of tools and commands and supports unique features that make it a user-friendly software. It has various unique built-in Primitive shapes such as teapots, cones, cubes, pyramids that are used as a foundation for model development.

Working with this becomes more easy and more fun when most of the tools and commands are right in front of the user, and it doesn't confuse them. This program is also used in the simulation of mechanical parts as it supports the NURBS feature that allows smooth modeling by using mathematical formulas.

Character modeling is also made simpler as 3ds Max includes simulations for hair, skin, fur, and cloth. These inbuilt tools reduce the time taken for modeling and enhance the detailing.

What Can You Do With 3ds Max?

With this, the user can create animated individual characters and develop scenes with multiple people in them. The program has multiple animation controllers that can be created, modified, and even shared.

Moreover, it supports 3D rendering characteristics. One of the main abilities of the program is that the users can view the rendering results without actually rendering the scene. This is achieved by starting the Active Shade Mode in the Program itself.

The interface of the program is clear and user-friendly. The plugins can be used with great ease and without any lagging with render programs like V-ray and others.

Working with 3ds Max

Working with 3ds Max will not be a simple task for a beginner. Users who have previous knowledge of working with 3D software will have an advantage. However, beginners will not require much time to study the program. The Workspaces, tools, commands, and interface are quite effortless. The modeling, texturing, and rendering of models are aided with a robust set of tools and functions that makes working simpler.

Advantages

Some of the major pros are-

It supports a huge number of tools that are easily available for modeling.

It is user-friendly in modeling and complex animation

It supports powerful and multiple tools for animation

It supports the Material Editor that allows the user to create and edit materials and maps in their scenes.

Required Skills

Before starting to learn 3ds Max, the users should have good knowledge about the 3D environment and its tools and presets. Also, prior knowledge about working on software like AutoCAD will give a good boost to the users.

Why Should We Use 3ds Max?

There are some uses are-

It is a favorite software with architectural and visualization animators.

It works and blends greatly with other Autodesk products.

It has strong rendering abilities, improvised usage with industry-standard products.

It is a time saver software with additional animation tools and mapping workflow.

3ds Max Scope

It has a lot of scope in almost every industry, based on building design, infrastructure, construction, product development, and the gaming world since it has a better User Interface than Maya.

It offers some tools and modifiers that are very simple and makes the task easier. While Maya is used more for filming and animation, Max is used for games and better modeling.

Who is the right audience for learning these technologies?

It is a gigantic application and can be learned by anyone interested in 3d modeling and infrastructure. Moreover, users aiming to learn gaming skills, product designing, producing detailed characters, and many more can be the right audience for learning this application.

How will this technology help you in career growth?

By making the users learn various skills and techniques required to develop various models and massive games. This technology will help the users in the long run and provide a path to grow careers.

Conclusion

All in all, Autodesk 3ds Max is a practical software for learning and practicing animation, and it helps in developing skills required for 3D modeling and animation purposes. One of the best features is the plugin functionality which boosts its features and makes it a globally used application.

2D commands and use of different menus

Objectives: At the end of this lesson you shall be able to
- **introduction of auto cad.**
- **explain different types of 2 D commonds used in 2D drawing.**

Introduction

AutoCAD allows you to have across to a large number of commands, a general rule is that you use 20% of the commands 80% of the time. I will start by introducing you to the most common drawing commands. When you combine these with the basic modify commands, you will be able to make elaborate drawings quite quickly. In other words, most of the commands you will use while using Auto cad are taught in level1.

The important thing to remember is that AutoCAD will expect you give it information in a very particular order. The most frustrating thing when you begin using this program is that you will try to do something, but auto cad will not work. In most cases, it means that you are trying to input information at the wrong time. This is why it is very important to be in the habit of looking at the command line.

Basic commands - I

Objectives : At the end of this lesson you shall be able to
- **explain circle arch**
- **explain cllipse polygon**

Circles

Circle command (Fig 1,2, & 3)

1	Choose	Draw, circle.
		(or)
2	Click	The Circle icon.
		(or)
3	Type	Circle at the command prompt.
4	Type	One of the following options: 3P/2P/TTR/<<center point>>:
		(or)
5	Pick	A center point
6	Type	A radius or diameter.
		(or)
7	Pick	A radius or diameter Diameter/<<radius>>:

TIPS

- To create circles that are the same size, press ENTER when asked for the circle radius.
- When selecting a circle with a pick box, be sure to select the circumference of the circle.

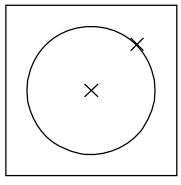
The command line tells you what information AutoCAD requires to continue.

Your first drawing alignment will be to use the drawing commands in conjunction with the co-ordinate system it is very important to understand how to give the program accurate information. You will use the following commands.

Drawing arcs and circles.

CADD provides many ways to draw arcs and circles. There are a number of advanced techniques available for drawing arcs and circles, which can simplify many geometrical drawing problems. You can draw an arc by specifying circumference and radius, radius and rotation angle, chord length and radius, etc.

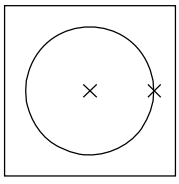
Fig 1



CIRCLE COMMAND

ID20N163811

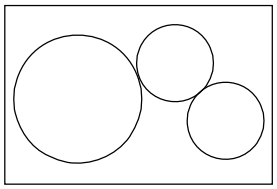
Fig 2



CIRCLE COMMAND

ID20N163812

Fig 3



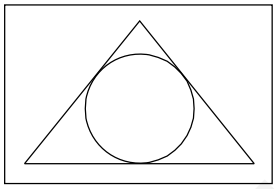
CIRCLE COMMAND

ID20N163813

Arc command (Fig 4)

1	Choose	Draw, arc.
		(or)
2	Click	The Arc icon.
		(or)
3	Type	Arc at the command prompt command: ARC
4	Draw	One of the arcs.

Fig 4



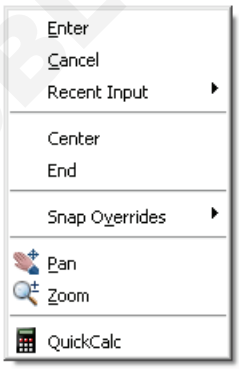
CIRCLE COMMAND

ID20N163814

TIPS

- Except for 3 point arcs, arcs are drawn in a counter clock wise direction.
- While in the arc command, press the right mouse button to select the following options for arcs: (Fig 5)

Fig 5



Arc examples (Fig 6)

3 point arc

Start, centre, chord length

Start, centre, end

Start, end, radius

Start, centre, included angle

Start, end direction

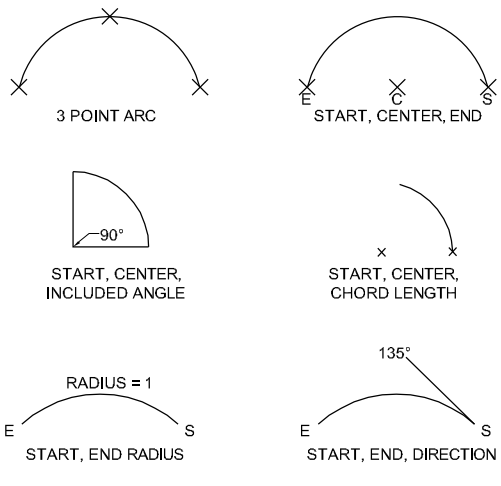
Drawing ellipses and elliptical arcs

Ellipses are much easier to draw with CADD than on a drawing board. On a drawing board, you need to find the right size template or draw a series of arcs individually to draw an ellipse. With CADD, all you need to do is specify the size of the ellipse.

The following are two basic methods for drawing ellipses:

- Length and width.
- Axis and rotation angle.

Fig 6



ARC COMMAND

ID20N163816

Ellipse.

Creates an ellipse or an elliptical arc:

1 **Choose** Draw, Ellipse.

(or)

2 **Choose** The ellipse or partial ellipse icon

(or) 

3 **Type** Ellipse at the command prompt
Command: ellipse

4 **Type** One of the following options:

Arc/Center/Isocircle/<Axis endpoint1>:

Ellipse options

Axis endpoint 1: Defines the first axis by two specified endpoints. The angle of the first axis determines the angle of the ellipse. The first axis can define either the major or the minor axis of the ellipse.

Ellipses options

Axis end point 2: <Other axis distance>/Rotation: Specify a point or enter a distance

Arc: Creates an elliptical arc. The angle of the first axis determines the angle of the elliptical arc. The first axis can define either the major or the minor axis of the elliptical arc.

Center : Creates the ellipse by a specified center point.

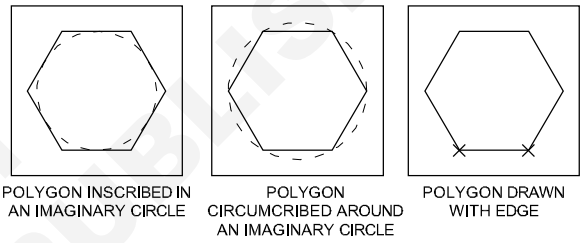
Isocircle : Creates an isometric circle in the current isometric drawing plane.

Rotation : The major axis is now treated as the diameter of a circle that will be rotated a specified amount around the axis. You enter an angle between 0 and 89.4 degrees.

Polygon (Fig 7)

1	Choose	Draw, ploygon.
		(or)
2	Click	The polygonicon.
		(or)
3	Type	Polygon at the command prompt.
4	Type	The number of sides for the polygon (3-1024).
5	Pick	The center of the polygon. Edge/ <Center of polygon>: pick.
		(or)
6	Type	E to define the polygon by two edges.
		(or)
7	Type	I or C to place the polygon in side or outside of an imaginary circle. Inscribed in circle/ circum scribed about circle (I/C)

Fig 7



Basic commands - II

Objective: At the end of this lesson you shall be able to
- **express move, copy, offset, rotate, trim,on,fillet, array, stretching, lengthen.**

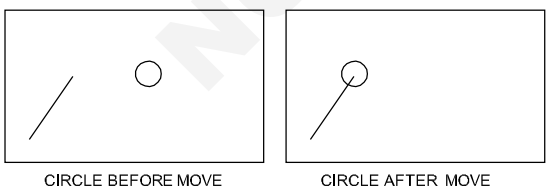
The previous lesson dealt with drawing commands. This lesson will introduce some common modifying commands. In AutoCAD, you may actually use modifying commands more often than drawing commands. Now that you know the basics, here's some more commands to add to your collection. Three commands, Trim, Extend and Offset are used often in 2D AutoCAD work.

Command	Keystroke	Location	Result
Rectangle	RECTANGLE/REC	Home>Draw>Rectangle	Draws a rectangle after you enter one coner and then the second.
Trim	TRIM/TR	Home>Modify>Trim	Trims objects to a selected cutting edge.
Exlend	EXTEND/EX	Home>Modify>Extend	Extends objects to a selected boundary edge.
Offset	OFFSET/O	Home>Modify>Offset	Offsets an object (parallel) by a set dis tance.
Object snaps	OSNAP/OS/F3	Tools>Object Snap Settings	Brings up the OSNAP dialog box.
Move	Move/M	Home>Modify>Move	Moves an object or objects.
Copy	Copy/CP	Home>Modify>Copy	Copies object(s) once or multiple times.
Stretch	Stretch/S	Home>Modify>Stretch	Stretches an object after you have selected a portion of it.
Mirror	Mirror/MI	Home>Modify>Mirror	Creates a mirror image of an object or se lection set.
Rotate	Rotate/RO	Home>Modify>Rotate	Rotates objects to a certain angle.
Fillet	Fillet/F	Home>Modify>Fillet	Creates a round corner between two lines.
Chamfer	Chamfer/CHA	Home>Modify>Chamfer	Creates an angled corner between two lines.
Array	Array/AR	Home>Modify>Array	Creates a repeating pattern of the selected objects.

Move command (Fig 1 & 2)

1	Choose	Modify, Move. Or
2	Clik	The Move icon or 
3	Type	Move at the command prompt command: MOVE or M
4	Pick	Objects to move select objects (select)
5	Pick	A point to move from base point of displacement: (Pick point)
6	Pick	A point to move to second point of displanement: (pick point)

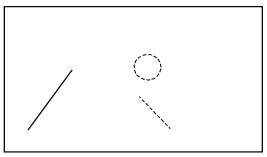
Fig 1



MOVE COMMAND

TIP : To move an object a specified distance, type a distance at the second point of displacement prompt:@1<0

Fig 2



MOVE COMMAND

Moving drawing objects : CADD allows you to move drawing objects within a drawing in a convenient manner. Unlike on a drawing board, you don't need to first erase and then redraw in a new place. You can simply rearrange the existing drawing objects, as you like. This is a very useful tool for analyzing design alternatives and making quick adjustments to drawings.

Previous selection

Places selected objects in the previous selection set

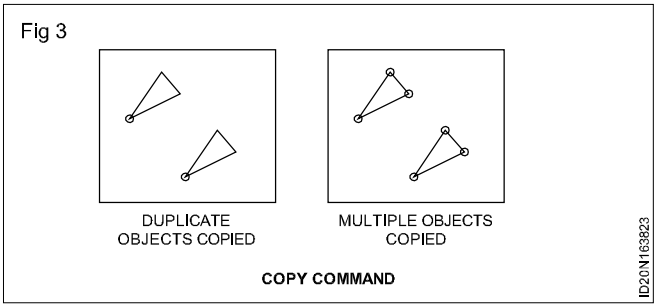
1	Choose	Modify, move.
		(or)
2	Click	The move icon.
		(or
3	Type	Move at the command prompt. Command: Move or M
4	Pick	Objects to move. Select objects : (P)

Previous selection set highlighted

TIP

AutoCAD requires that objects be selected in order to be processed. The Select Objects prompt occurs after many commands, including the SELECT command itself.

Copying drawing objects (Fig 3)



CADD allows you to make quick and easy copies of existing drawing objects. You can copy individual drawing objects or the entire drawing all at once. You can even make multiple copies of drawing objects within seconds.

Using the copy function is quite similar to the way the move function is used. First, you need to select objects using any of the methods described earlier. Then you need to indicate a base point and a relocation (or destination) point. The copied objects are placed according to the relocation point.

Making multiple copies in a rectangular fashion

There are separate functions available in CADD that allow you to make multiple copies in a linear or rectangular fashion (commonly known as a rectangular array). You can make hundreds of copies within seconds. You don't need to enter a base point and a destination point. You just need to select the objects, specify how many rows and columns you need and the distance between them.

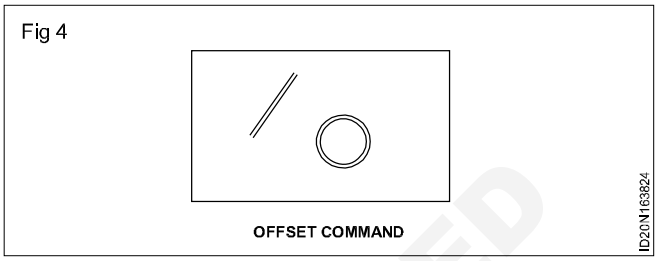
Copy command

1	Choose	Modify, copy.
		(or)
2	Click	The copy icon
		(or)
3	Type	Copy at the command prompt.
4	Pick	Objects to copy.
		Select objects: (select)
5	Pick	A point to move from.
		Base point or displacement /multiple: (pick point).
6	Pick	A point to copy to.
		Second point of displacement: (Pick point)
		(or)
7	Type	A point to copy to.
		Second point of displacement: @1<0

TIP

To copy many objects in the same copy command, type M for Multiple at the "Base point or displacement/Multiple" option.

Offset command (Fig 4)



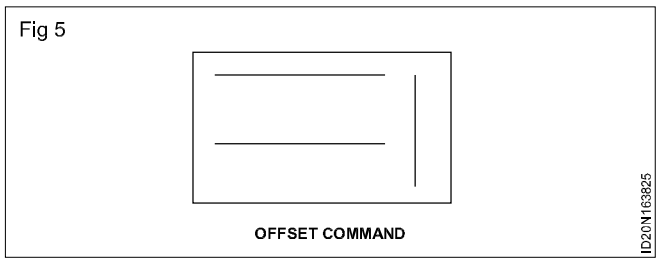
Offset distance

To offset a specified distance:

1	Choose	Modify, Offset. 
		(or)
2	Choose	The offset icon.
		(or)
3	Type	OFFSET at the command prompt. Command: OFFSET or O
4	Type	The distance to offset. Offset distance or <Through point>: (number)
5	Pick	The object to offset. Select object to offset: (select object)
6	Pick	A side to offset object to. Side to off set: (pick side)
7	Pick	Another object to offset
		Select object to offset: (Pick side)
		(or)
8	Press	Enter to end the command.

Offsetting objects by specifying a distance

Offset through point (Fig 5)



To offset through point

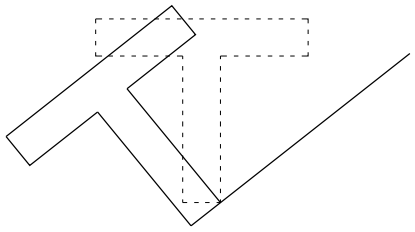
1	Type	Offset at the command prompt
		Command: Offset
2	Type	T to specify a through point

		Offset distance or <Through point>: (T)
3	Pick	A point to offset through (HINT: use ob ject snaps) Select object to offset: (pick) through point: (select object)

Offset through a point

Rotate (Fig 6)

Fig 6



ROTATE COMMAND

ID20N163826

1	Choose	Modify, rotate 
		(or)
2	Click	The modify icon.
		(or)
3	Type	Rotate at the command prompt Command: Rotate
4	Pick	Objects to rotate: Select objects: (select)
5	Pick	A pivot point to rotate around Base point: (point)
6	Type	A rotation angle<Rotation angle>/Refer ence: (number)
		(or)
7	Pick	A rotation angle<Rotation angle>/Refer ence: (point)

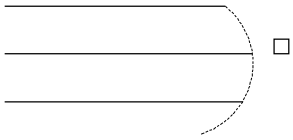
Rotating the drawings : CADD drawing allows you to rotate selected drawing objects to a specified angle. To rotate, you need to select the drawing objects, enter a reference point (or base point) and the rotation angle. The base point acts as a pivot point around which the objects are rotated. The rotation angle determines by how much the objects will be rotated and in which direction.

Reference angle rotation : A positive angle causes counterclockwise rotation, and a negative angle produces clockwise rotation. If you respond to the last prompt with r, you can specify the current rotation and the new rotation you want. AutoCAD prompts

1	Type	R for a rotation angle<Rotation angle>/ Reference: (R)
2	Choose	An existing rotation angle Rotation angle: (number or points)
3	Choose	A new rotation angle New angle:
		(number or points)

TIP (Fig 7)

Fig 7



TRIM COMMAND

ID20N163827

You can show AutoCAD the reference angle (by pointing to the two endpoints of a line to be rotated), and then specify the new angle. You can specify the new angle by pointing or by dragging the object.

Trim

The trim command allows you to trim objects in a drawing so they end precisely at a cutting edge defined by one or more other objects in the drawing.

1	Choose	Modify, trim 
		(or)
2	Click	The trim icon.
		(or)
3	Type	Trim at the command prompt
		Command: trim
		Select cutting edge(s)
4	Pick	The cutting edge to extend to
		Select objects: (select)
5	Press	Enter to accept the cutting edge
		Select objects: (press enter)
6	Pick	Objects to trim
		<Select object to trim>/Project/Edge/ Undo:
		Select an object, enter an option, press enter
7	Press	ENTER when youare done choosing objects
		Select object to trim/Undo: (press en ter)

TIP: Hold the shift key to interactively extend instead of trim.

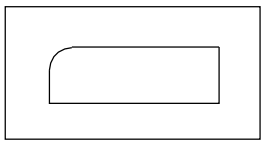
Cutting drawing objects along an edge : CADD allows you to erase drawing objects along a selected edge (this technique is often called trimming).When you use this function, you are prompted to select the drawing object that is to be used as the cutting edge and then select the objectgs that are to be erased along that edge.

Making sharp and rounded corners : CADD allows you to make fine corners of any two lines or arcs. This technique, often called filleting, is the quickest way to join the missing corners of lines and arcs. With this function active, to make a corner all you need to do is select

the lines or arcs that have missing corners. CAD automatically extends or shortens the selected objects to form a corner. You can also specify whether you want a sharp corner or a rounded corner.

Fillet (Fig 8)

Fig 8



FILLET COMMAND

ID20N163828

1	Choose	Modify, fillet.
		(or)
2	Click	The fillet icon.
		(or)
3	Type	FILLET at the command prompt. Command: FILLET
4	Pick	First object to fillet. Polyline/radius/ trim<Select two objects>: Select first object.
5	Pick	Second object to fillet.
		Select second object: select second object.
		(or)
6	Type	One of the following options:
	P	Fillets a nentire Polyline
	R	Sets the filletradius.
	T	Sets the trimmode (trim cuts the fil let corner and no trim keeps the fillet corner).

TIP

You can also fillet PARALLEL lines as well as PLINES with LINES

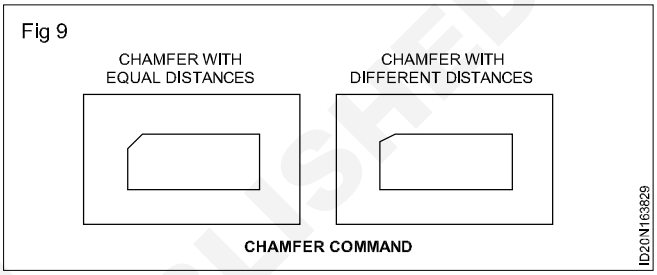
Type a radius of Zero (0) to create a clean 90 degree corner.

Chamfer

1	Choose	Modify,chamfer.
		(or)
2	Click	The chamfer icon.
		(or)
3	Type	CHAMFER at the command prompt.
		Command: Chamfer
4	Pick	First object to chamfer. Polyline/ distance/angle/trim/ method<Select first line>: select first object.
5	Pick	Second object to chamfer.
		Select second object: select second object.
		(or)
6	Type	One of the following options:
	P	Chamfers entire Polyline.
	D	Sets chamfer distances.
	A	Uses a distance and angle method in stead of two distances.
	T	Sets the trim mode
	M	Sets the method to distance or angle.

Chamfer with equal distances (Fig 9)

Fig 9



CHAMFER COMMAND

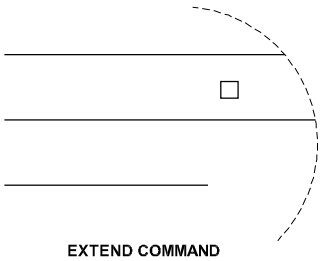
ID20N163829

Chamfer with different distances

Making chamfered corners : CADD allows you to make a chamfered corner between two lines. It works quite like the fillet command. When you enter the chamfer command, you are prompted to select the lines that are to be chamfered and enter a chamfer distance. The chamfer distance determines the size of the chamfer.

EXTEND (Fig 10)

Fig 10



EXTEND COMMAND

ID20N16382A

1	Choose	Modify, extend,
		(or)
2	Click	The extend icon.
		(or)
3	Type	EXTEND at the command prompt command: EXTEND Select boundary edge (s)...
4	Pick	The BOUNDARY edge to extend to select objects: (select)
5	Press	ENTR to accept the boundary edge select objects: (press enter)
6	Pick	The object to extend

		<Select object to extend> / Project/ edge/ undo: Select an object, enter an option, or press enter: (select)
7	Press	ENTER when you are done choos ing objects.

Lines extended to an arc (Arc is boundary edge)

TIP

- Use the object selection option FENCE to choose mul tiple objects.

Extending drawing objects to an edge

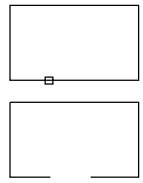
CADD allows you to extend lines to a selected drawing object. Often you need to extend lines to construct a drawing and to fix any graphical errors. To extend lines, you need to select an edge to which the lines should extend and then select the lines to be extended.

Dividing an object into equal parts

CADD allows you place dividing marks on a drawing object such as a line, arc, ellipse or spline. To use this command, you need to select an object and specify how many divisions are required. This function places markers at equal distances on the drawing object.

Break (Fig 11 & 12)

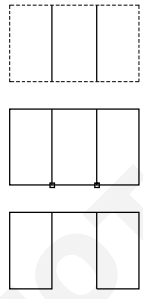
Fig 11



BREAK COMMAND

ID20N16382B

Fig 12



BREAK COMMAND

ID20N16382C

1	Choose	Modify, break.
		(or)
2	Click	The break icon.
		(or)
3	Type	BREAK at the command prompt. Command: BREAK
4	Pick	Object to break. Select object: (select one object)
5	Pick	A second break point. Enter second point: (point)
6	Type	F to choose a different break point Enter second point (or F for first point): (F)
7	Pick	The first break point on the object
		Enter first point: (point)
8	Pick	A second break point

TIP

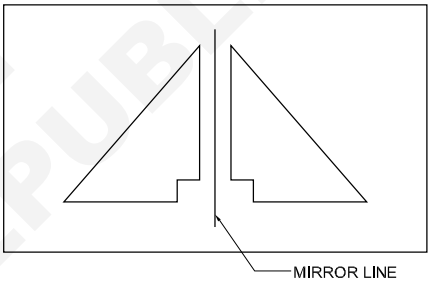
You can also type coordinates instead of picking a break point. Enter second point (or F for first point): @3'<0

If you break a circle, it changes to an arc by deleting the portion from the first point to the second, going counterclockwise.

Breaking a polyline with nonzero width will cause the ends to be cut square.

Mirror command (Fig 13)

Fig 13



MIRROR COMMAND

ID20N16382D

1	Choose	Modify, mirror.
		(or)
2	Click	The mirror icon
		(or)
3	Type	MIRROR at the command prompt. Command: MIRROR
4	Pick	Objects to mirror. Select objects: (Se lect)
5	Pick	First point of mirror line: (point)
6	Pick	Second point: (Point)
7	Type	Yes to delete the original objects and No to keep them.
		Delete old objects? Y or N

Mirroring drawings : CADD allows you to create mirror images of drawings. This capability is very useful when you want to draw something that is symmetrical on both sides. You need to draw only one half of the drawing; the rest of the drawing can be completed using the mirror function. To make a mirror image, you need to select the objects to be mirrored and indicate a mirror axis. The

mirror axis is an imaginary line along which the diagram is mirrored.

Array

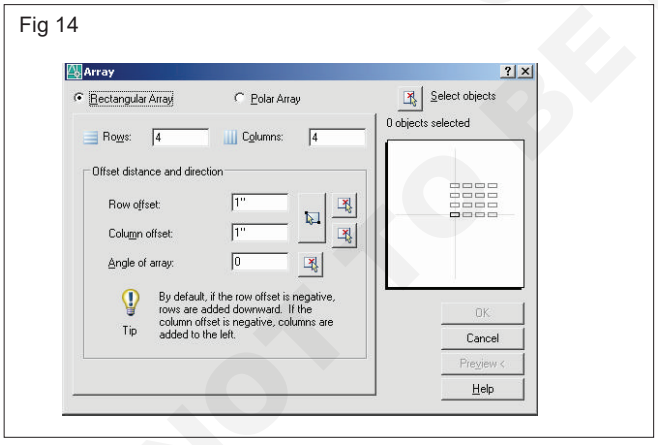
Rectangular array

To draw rectangular array

1	Choose	Modify, array.
		(or)
2	Click	The array icon.
		Or
3	Type	ARRAY at the command prompt. Command: ARRAY objects to array. Select
4	Pick	Objects to array. Select Objects: (select)
5	Type	The number of rows top to bottom. Number of rows (----) <1>: (number)
6	Type	The number of columns left to right. Number of columns (III) <1>: (num ber)
7	Type	The unit cell distance between items in each row. Distance between rows: (+number=up, number = down)
8	Type	The unit cell distance between items in each column.
		Distance between columns: (+ num ber = right, - number = left)

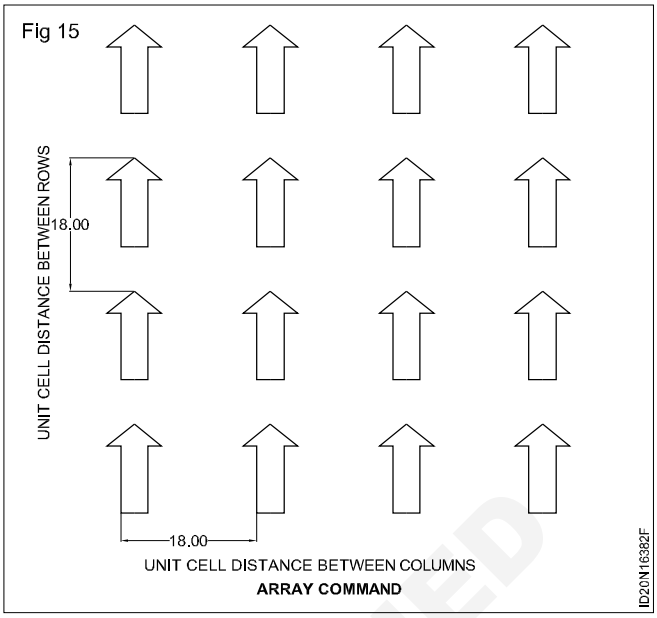
Creating an array of objects (Fig 14 & 15)

Fig 14



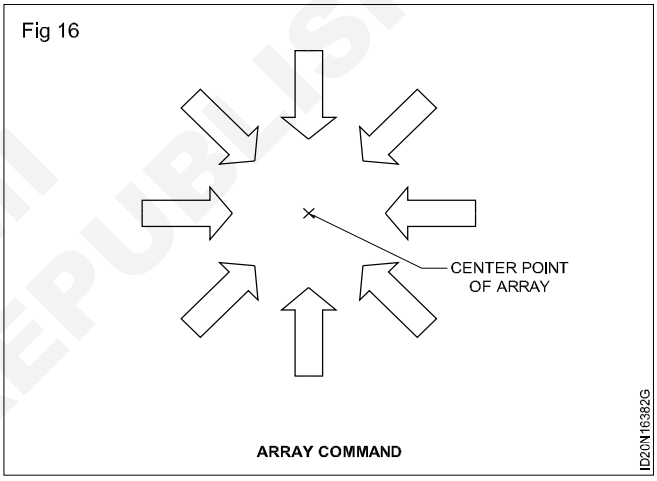
The array command in AutoCAD is used to make multiple copies of objects. Although you can use the copy command to duplicate objects, the array command is more flexible and precise. One advantage of using the array command is that it allows you to copy objects in a defined angle and exact number of copies. Therefore, you can create array in various pattern. For example, you can show multiple objects in a row, column, or irregular pattern such as a spiral. Let's look at a few examples below:

Fig 15



Polar array (Fig 16 & 17)

Fig 16

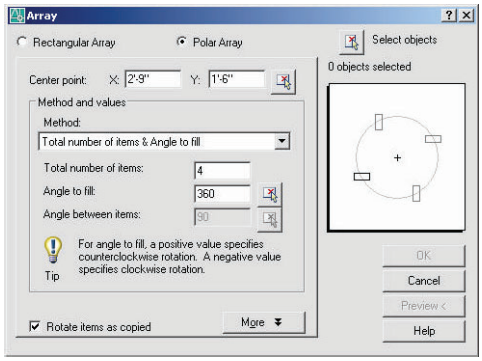


To draw a polar array:

1	Choose	Modify, array.
		(or)
2	Click	The array icon.
		(or)
3	Type	Array at the command prompt. Com mand: Array
4	Pick	Objects to array. Select Objects: (select)
5	Type	P to draw a polar array. Rectangular or Polar array (R/P):P
6	Pick	A center point for the array. Center point of array. Pick point
7	Type	The total number of items in the ar ray. Number of items: number
8	Type	The number of degrees to rotate the objects. Degrees to fill (+=CCW, -+CW) <360>: Number

9 Type Yes No to rotate objects. Rotate objects as they are copied? <y> Y or N

Fig 17



Stretch

1 Choose Modify, stretch

(or)

2 Click The stretch icon.

3 Type STRETCH at the command prompt.
Command: STRETCH select objects to stretch by window.

4 Type C to choose CROSSING window Select objects: C

5 Pick A first corner to stretch. First corner: (point)

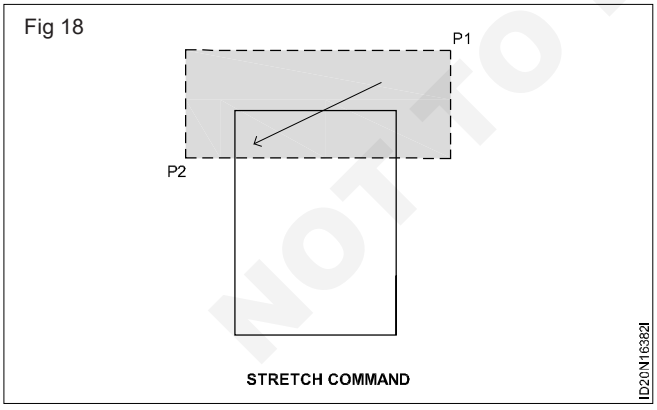
6 Pick The opposite corner to window the ob jects to stretch.
Other corner: (point)

7 Press ENTER to accept objects to stretch

8 Pick A base point to stretch from Base point: (point)

Stretching diagrams (Fig 18)

Fig 18



CADD allows you to quickly change the size of diagrams by stretching lines, arcs, splines, etc. This function is very helpful to make quick alterations to drawings. To use the stretch function, you need to select the drawing objects to be stretched and specify the distance and direction of stretching.

9 Pick A point to stretch to New point: (point)

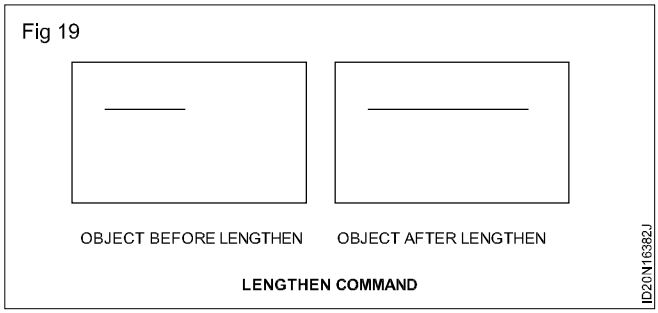
10 Type A distance to stretch. New point: @ 1<0

TIP

The Stretch command must use a CROSSING window or a CROSSING POLYGON window.

Lengthen (Fig 19)

Fig 19



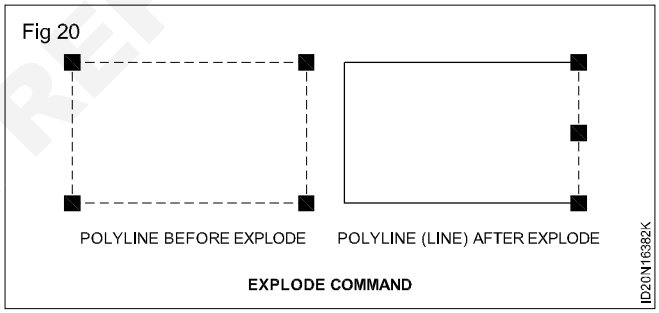
1 Choose Modify, lengthen.

(or)

2 Type Lengthen at the command prompt.
Command:_ lengthen (Fig 17)
Select an object or [DElta/Percent/Total/
Enter delta length or [Angle]<0.0000>:2
Select an object to change or [Undo]: pick object
Object before lengthen
Object after lengthen

Explode command (Fig 20)

Fig 20



1 Choose Modify, explode.

(or)

2 Pick The explode icon.

3 Type EXPLODE at the command prompt.
Command: EXPLODE (Fig 18)

(or)

4 Pick The object to explode. Select objects: (pick)

4.3 OOPS commands

Reinserts the last erased set of objects or block even if it was not the last command issued. Otherwise oops acts like UNDO.

1 Type OOPS at the command prompt to rein sert erased objects
Command: OOPS

Other CAD commands

Objectives : At the end of this lesson you shall be able to
- **explain points, rectangle, poliline, spline, multllines, construction line**
- **adding patterns to drawings.**

Introduction

Drawing multiple parallel lines : CADD allows you draw parallel lines simultaneously just by indicating a starting point and an end point. These lines can be used to draw something with heavy lines or double lines. For example, they can be used to draw the walls of a building plan, roads of a site map, or for any other presentation that requires parallel lines.

Most programs allow you to define a style for multiple parallel lines. You can specify how many parallel lines you need, at what distance and if they are to be filled with a pattern or solid fill.

A number of add-on programs use multiple lines to represent specific drawing features. For example, an architectural program has a special function called "wall". When you use this option, it automatically draws parallel lines representing walls or specified style and thickness.

Drawing flexible curves : CADD allows you to draw flexible curves (often called splines) that can be used to draw almost any shape. They can be used to create the smooth curves of a sculpture, contours of a landscape plan or roads and boundaries of a map.

To draw a flexible curve, you need to indicate the points through which the curve will pass. A uniform curve is drawn passing through the indicated points. The sharpness of the curves, the roughness of the lines and the thickness can be controlled through the use of related commands.

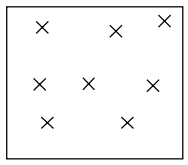
Adding hatch patterns to drawings : The look of CAD drawings can be enhanced with the hatch patterns available in CAD. The patterns can be used to emphasize portions of the drawing and to represent various materials, finishes, and spaces. Several ready-made patterns are available in CAD that can be instantly added to drawings.

Hatch patterns are quite easy to draw. You don't need to draw each element of a pattern one by one. You just need to specify an area where the pattern is to be drawn by selecting all the drawing objects that surround the area. The selected objects must enclose the area completely, like a closed polygon. When the area is enclosed, a list of available patterns is displayed. Select a pattern, and the specified area is filled.

Point command (Fig 1)

1 Choose Draw, point, single or multiple point
(or)
2 Click The point icon
(or)
3 Type Point at the command prompt
Command: Point
4 Pick A point on the drawing

Fig 1



POINT COMMAND

ID20N163831

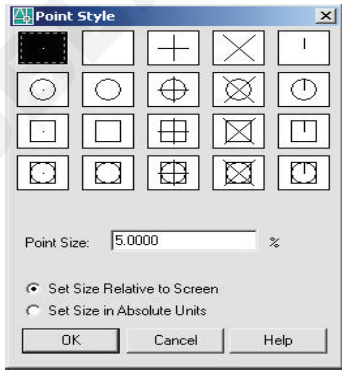
Point (point)

Point styles 21.1

Changes the appearance of points and point sizes.

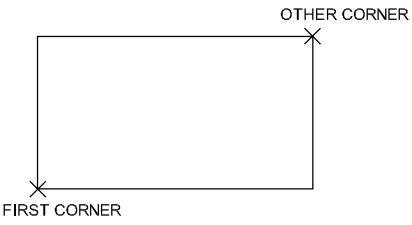
1 Choose Format, Point Style...
(or)
2 Type DDP type at the command prompt.
Command: DDP type (Fig 2)

Fig 2



Rectangle (Fig 3)

Fig 3



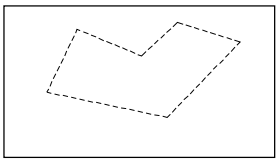
RECTANGLE COMMAND

ID20N163833

1 Choose Draw, rectangle.
(or)
2 Click The rectangle icon
(or)
3 Type Rectangle at the command prompt Com mand: RECTANG chamfer/Elevation/ Fillet/Thickness/Width/<First corner>
4 Pick first corner
5 Pick other corner or type coordinates (i.e. @ 4,2)

Pline command (Fig 4)

Fig 4



PLINE

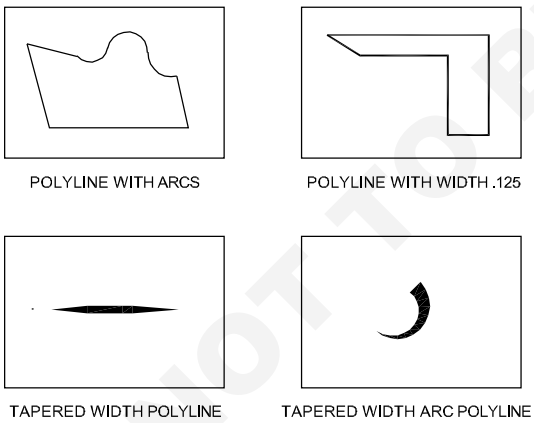
ID20N163834

A polyline is a connected sequence of line segments created as a single object. You can create straight line segments, arc segments, or a combination of the two.

1	Choose	Draw, polyline.
		(or)
2	Pick	The pline icon.
3	Type	PLINE at the command prompt Com mand: PLINE or PL
4	Pick	A point on the drawing to start the polyline
		Form point: (select)
5	Type	One of the following options Arc/Close/ Halfwidth/Length/Undo/Width/<endpoint of line>:
		(or)
6	Pick	A point to continue drawing Arc/Close/ Halfwidth/Length/Undo/Width/<endpoint of line>: (pick point)

PLINE options (Fig 5)

Fig 5



PLINE

ID20N163835

Arc : Toggles to arc mode and you receive the following: Angle/CEnter/CLose/Direction/Halfwidth/Line/Radius/ Second Pt/Undo/Width/<enter of arc>:

Close : Closes a polyline as it does in the line command.

Halfwidth : Specifies the halfwidth of the next polyline segments. Can be tapered.

Length : Specifies the length to be added to the polyline in the current direction.

Undo : Undoes the previous pline segment as with the line command.

Width : Specifies the width of the next polyline segments. Can be tapered.

Polyline with arcs

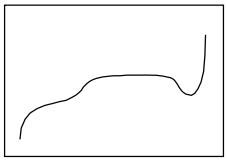
Polyline with width 125

Tapered width polyling

Tapered width arc polyline

Convert pline to spline (Fig 6)

Fig 6



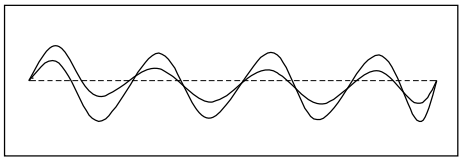
PLINE TO SPLINE

ID20N163836

1	Draw	A Pline
2	Type	PEDIT to edit the polyline as a spline.
3	Choose	Draw, Spline
4	Type	Object at the command prompt.
5	Click	Once on the polyline to turn it into a spline.

Spline (Fig 7)

Fig 7



SPLINE

ID20N163837

The spline command creates a particular type of spline known as a non uniform rational B-spline (NURBS) curve. A NURBS curve produces a smooth curve between control points.

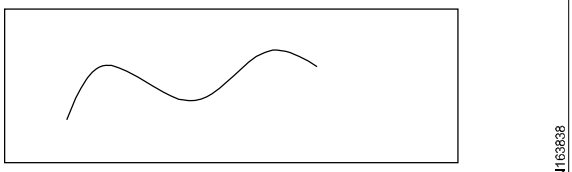
1	Choose	Draws, spline.
		(or)
2	Click	The spline icon
		(or)
3	Type	Spline at the command prompt Com mand: Spline
4	Pick	A start point for the spline Object /<En ter first point> (pick point)
5	Pick	Points until you are done drawing splines Enter point: (pick points)
6	Press	Enter or close to complete the spline

7 Pick Starting tangent point for the spline En ter start tangent (pick point)

8 Pick Ending tangent point for the spline Enter end tangent (pick point)

Spline options (Fig 8)

Fig 8



Object: Convers 2D or 3D spline-fit polylines to equiva lent splines

Points: Points that defines the spline

Close: Closes a spline

Fit Tolerance: Allows you to set a tolerance value that creates a smooth spline.

TIP: Refer to AutoCAD online help topic for more information on spline options.

Editing splines

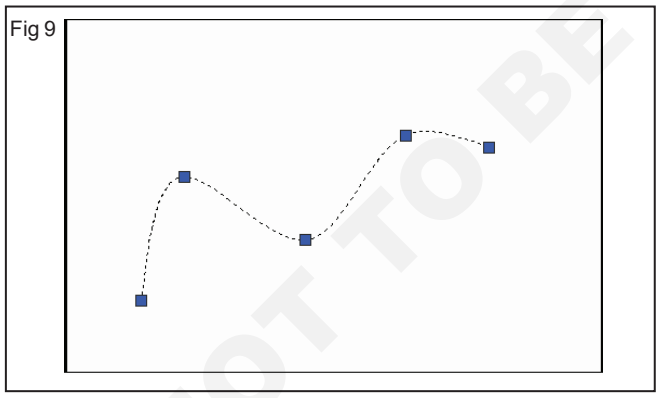
1. Choose Modify, Object, Spline.

TIP

Drawings containing splines use less memory and disk space than those containing spline-fit polylines of similar shape.

Multilines (Fig 9)

Fig 9



MLINE Command

1 Choode Draw, multiline.

(or)

2 Type MLINE at the command prompt Com mand: MLINE

3 Pick A point to start the multiline.

Justification/Scale/Style/<From point>: pick point

4 Pick A second point to continue the multiline. <To point>: Pick point

5 Pick The next point to continue drawing Multilines. Undo/<To point>: pick point

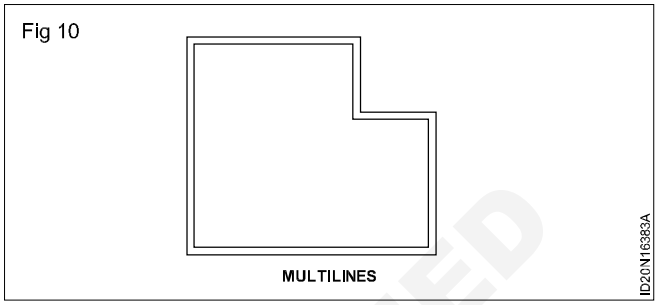
6 Press ENTER to end the multiline

Close/Undo/<To point>: press enter

(or)

7 Type C to close the multiline back to the first point. Close/Undo/<To point:C (Fig 10)

Fig 10



Multiline styles

1 Choose Format, multiline style.

2 Type Mlstyle at the command prompt.

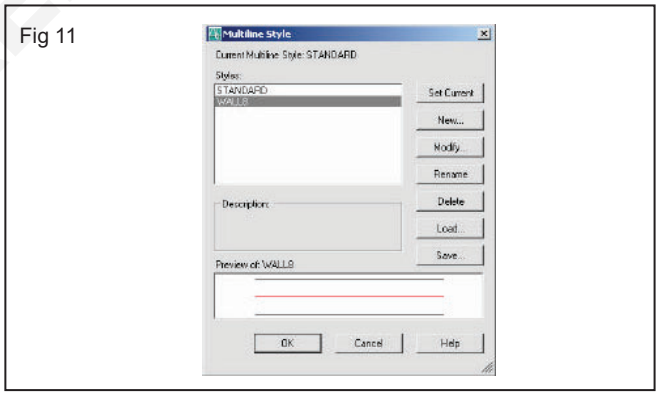
Command: Mlstyle

3 Rename The existing style called STANDARD to your new style.

4 Choose Element properties to change the ap pearance of the Multilines.

5 Choose ADD to create the new multiline.(Fig 11)

Fig 11



Editing multilines (Fig 12, 13 & 14)

1 Choose Modify, Multiline

(or)

2 Type MLEDIT at the command prompt

Command: MLEDIT

3 Choose from one of the mledit options

Construction line

Creates an infinite line.

1 Choose Draw, Construction Line

(or)

Fig 12

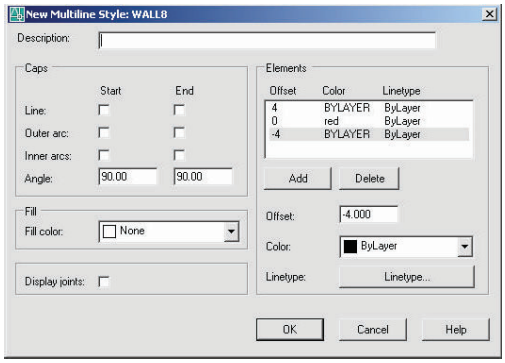


Fig 13

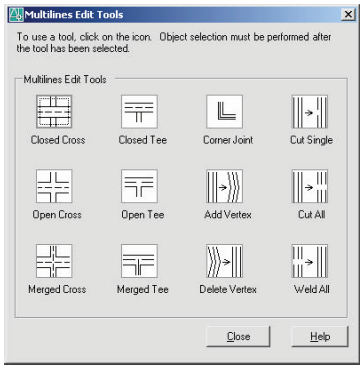
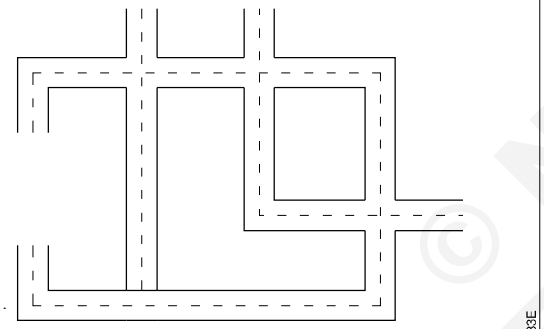


Fig 14



2 Choose — the XLINE icon.

(or)

3 Type — XLINE at the command prompt. Com mand: XLINE

Specify a point or [Hor/Ver/Ang/Bisect/ Offset]

XLINE options (Fig 15 & 16)

HOR: Creates a horizontal xline passing through a specified point

VER: Creates a vertical xline passing through a specified point

ANG: Creates an xline at a specified angle.

BISECT: Creates an xline that passes through the selected angle vertex and bisects the angle between the first and second line

OFFSET: Creates an xline parallel to another object.

Fig 15

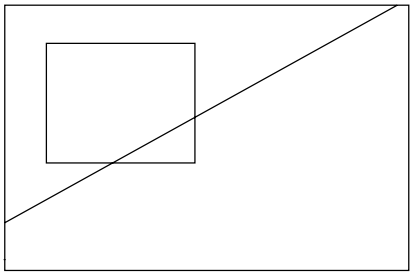
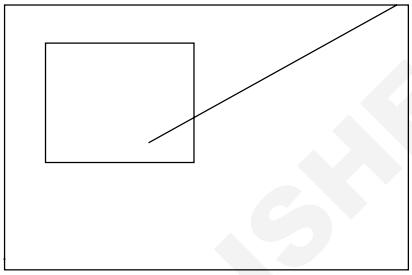


Fig 16



Ray command

Creates an infinite line in one direction

1 Choose — Draw, ray

(or)

2 Type — Ray at the command prompt. Command: Ray specify a point: (pick through point)

Batch command

1 Choose — Draw, hatch...

(or)

2 Click — The hatch icon.

(or)

3 Type — BHATCH at the command prompt

Command: BHATCH

Batch options

Pattern type: Sets the current pattern type by using AutoCAD's Predefined patterns or user defined patterns.

Pattern properties: Sets the current pattern, scale, angle, and spacing, Controls if hatch is double spaced or exploded.

Pick points: Constructs a boundary from existing objects that form an enclosed area.

Select objects: Selects specific objects for hatching. The boundary hatch dialog box disappears and AutoCAD prompts for object selection.

Inherit properties: Applies the properties of an existing associative hatch to the current pattern type and pattern properties options.

Preview hatch: Displays the hatching before applying it. AutoCAD removes the dialog box and hatches the selected areas.

Associative: Controls associative hatching.

Apply: Crates the crosshatching in the boundary.

Annotative hatch

Hatching from the design center 20.3

1 Choose: A cross hatch pattern from the following AutoCAD directly\AutoCADxxxx\Support\acad.pat or \AutoCADxxxx\Backup

2 Drag: and drop a pattern into a drawing.

TIP

Be sure the HPSCALE is set before dropping a hatch pattern into a drawing.

Fig 17

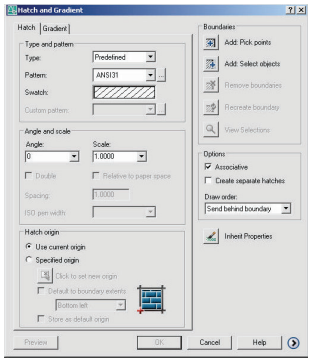


Fig 18

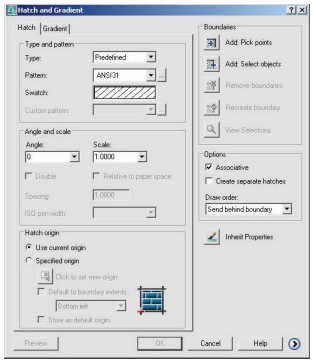
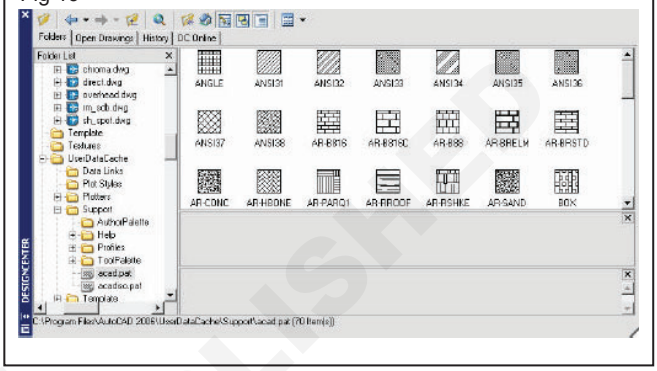


Fig 19



Concept of 2D drawing

Objective: At the end of this lesson you shall be able to
- **define 2D drawing concepts.**

Concept of 2D drawing

2 Dimensional drawing 2D drawing view is a representation of a 3D cad part or assembly that is placed on a drawing sheet. Drawing view represents the shape of the object when viewed from various standard directions such as front,top, side and so on most designers and engineers already know that what you may not know is how much more you can do with your drawings with just a little but of guidance.

2D engineering drawings provide an easy reference of the tolerances that need to be net on critical dimensions. They also communicate how individual parts come together to make up assemblies and provide important inspection points. Your drawings are an important reference document for quality control.

Designers today use CAD software instead of creating physical drawings on a drafting table. Since the last few years 2D drawings. Work as communication tools for engineers. It helps optimize the overall engineering project, from conceptual design the product layouts with the technical advertisement and increasing user demands, more sophisticated tools like 3D CAD software gained immense popularity. It offer benefits in terms of reduced design cycle time and project efficiency. However professionals stiee prefer to use 2D drafting when it comes of finishing the job quickly in expensively and effectively.

Lets look at the benefits of using 2D drawing in todays fast paced digital world.

- **Flexible design:** One of the potential advantage of using 2D CAD is that the designs are easy to amend unlike with traditional paper based models. It takes few clicks to change the layout on a digital platform that means you can experiment with various options until you are satisfied with the design. In this a professional can create a realistic reproduction of the finished product, and show how all the elements would fit together in the defined space.
- **Easy to use:** 3D CAD tools offer numerous functions for the designer how ever many of them are not required to create drawing for assembly, piping components plan and more. O the other hard 2D CAD tools contain only the essential junctions, which are easy to understand and operate. It includes a layer, live types, line weights and more.
- **Error free:** With the reduced number of manual calculations 2D CAD has minimum room for errors. Design engineers can digitally create various mechanical components along with precise dimensions and alter them based on the requirements. The CAD tool can calculate the changes made in different factors automatically. Further it incorporates the inputs with the previously built design. As a result you can get accurate, quicker alternations of current designs with minimum manual inputs.
- **Time saving:** The 2D CAD software calculates many of the added/updated calculations with less manual input. It allows the designer to focus of the areas that require more attention. Also digital drawings can be shared across involved teams quickly. It helps keep everyone on the same page, and It errors or changes found by any team member, It can be dressed immediately. Thus the process of creating designs becomes quicker.
- **Cost-effective:** 2D CAD solutions are for more cost effective than advanced 3D CAD. More over you get the project output in less time.

  The cost of wiring on expert reduced significantly. Besides the designs are easy to understand and meet the expectations at first in most cases will make you worry free from paying professionals for expensive alternation.

Where 2D Drawings are preferable than 3D models

– Tight deadlines to complete the project.

– Designs are required for single component

– When drawing require less space

– When the models do not need any 3D functionality.

Use of 2D drawing:

2D drawing and drafting is the process of creating and editing technical drawings as well as annotating designs. Drafters use computer aided design CAD software to develop floor plan, building permit drawing, building Inspection plans and landscaping layouts.

Concept of rendering

Objective: At the end of this lesson you shall be able to
- **explain rendering.**

Rendering basics: The process of creating a computerized rendering involves four steps:

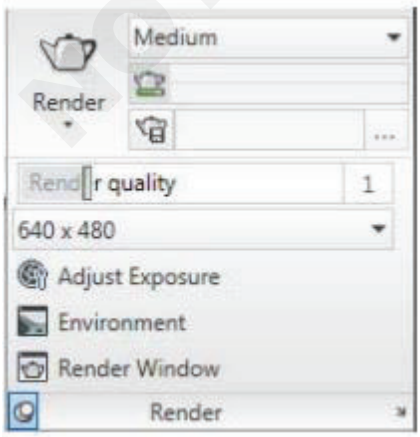
- Create the actual model
- Place lights
- Attach materials to objects in the model
- Render the image

Other than creating the model, these procedures are conceptual rather than discrete sequential steps, and often are performed in an iterative process. For example, you may place some lights and create a test rendering. Then, after viewing the results of your test, you may change some of the lights and render and the image again.

There is one last change to be addressed before we proceed. AutoCAD now uses a ribbon bar, collecting tools into task-based panels, eliminating multiple toolbars and reducing screen clutter.

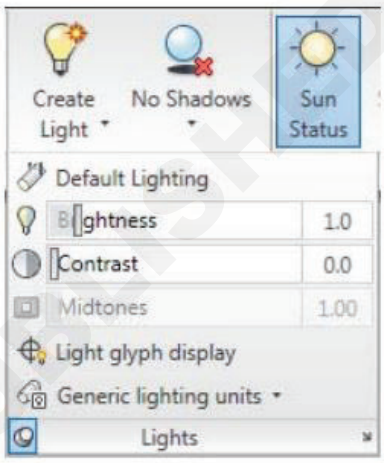
Render panel (Fig 1): The render panel appears on the render ribbon bar and initially displays in its collapsed state. In this state, you can render an entire view, render a cropped portion of a view, select a render present, and render to a file. A rendering progress meter, also found in the render window, displays how far rendering has progressed. You can also open the render presets manager where you create or alter custom render presets and displays the advanced render settings palette to adjust more advanced settings. By expanding the render panel, you gain access to tools to adjust the render quality, control the resolution of the rendering, adjust the exposure, displays the render environment dialog box where you can set fog and depth of field effects, and displays the render

Fig 1



Working with lights (Fig 2): Placing lights in your model quickly add a new level of realism. The combination of carefully placed lights and realistic materials turns a flat, shaded image into close approximation of reality.

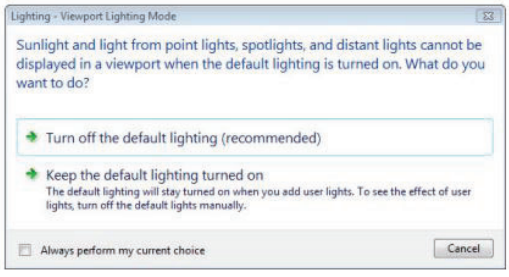
Fig 2



When you work in a viewport with a 3D shaded view, the default lighting comes from two distant sources that follow the viewpoint as you move around the model. All faces in the model are illuminated so that they can be seen. You can control the brightness and contrast. The default lighting must be turned off in order to display lighting from user-created lights or the sun. You place lights using the tools in the lights panel, found on the render ribbon bar.

User-Created lights (Fig 3): For more control over lighting, you can create point lights, spotlights, web lights, and distant lights to achieve the effects you want. Note that when you place your first light into a drawing, AutoCAD displays a warning dialog to let you know that the effects of lights cannot be displayed in a viewport until you toggle

Fig 3

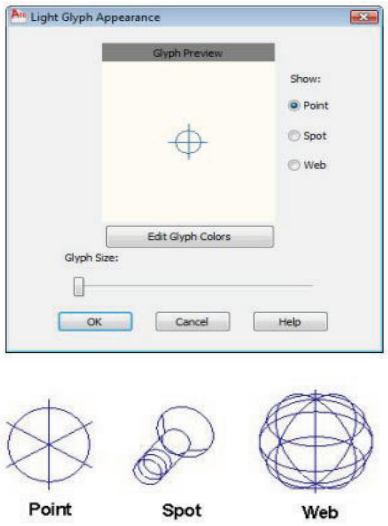


After placing lights, you can move or rotate them with grip tools, turn them on and off, and change properties such as colour. The effects of the changes you make are immediately visible in the viewport.

Spotlights, point lights, and web lights are each represented by a different light glyph. Distant lights and the sun are not represented by glyphs in the drawing because they do not have a discrete position and affect the entire scene. You can turn the display of light glyphs on and off while you work. By default, light glyphs are not plotted.

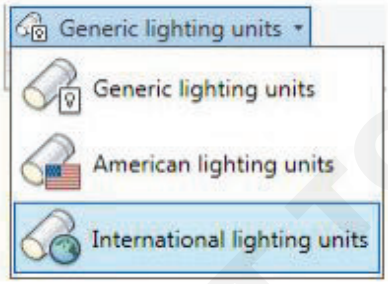
The appearance of light glyphs is controlled from the light glyph appearance dialog box, accessed by clicking the light glyph settings button on the drafting tab the options dialog box. (Fig 4)

Fig 4



For more precise control over lighting, you can use photometric lights to illuminate your model. Photometric lights use photometric (light energy) values that enable you to more accurately define lights as they would be in the real world. (Fig 5)

Fig 5



Point Light (Fig 6): A point light radiates light in all directions from its location and does not target an object. Use point lights for general lighting effects. You can create point lights using the POINTLIGHT command or by selecting a point light from the lights panel. You can also create a target point light, either by using the TARGETPOINT command or by changing the targeted property of the point light from no to yes. The difference between the target point light and a point light is the additional target properties that are available.

Spot Light (Fig 7): A spot light emits a directional cone of light. The light in the central portion of the cone is brighter than the light around the edges of the cone. You can create spot lights using the SPOTLIGHT command or by selecting the spot light from the lights panel.

Fig 6

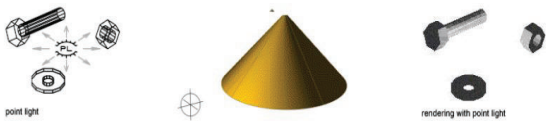
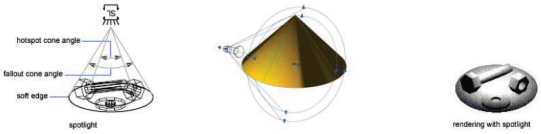


Fig 7



You can also create a free spotlight, by using the FREESPOT command. A free spotlight is similar to a spotlight, but without a specified target.

Weblight : A web light is a 3D representation of the light intensity distribution of a light source. Web lights can only be created when LIGHTINGUNITS is set to SI or American units.

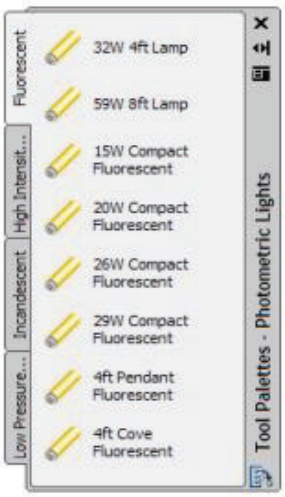
Photometric web lights can be used to represent non-uniform (anisotropic) light distributions derived from data provided by manufactures of real-world lights.

This directional light distribution information is stored in photometric data file in this IES LM-63-1991 standard for photometric data.

Light that uses a photometric web can be added to drawing by using the WEB LIGHT or FREEWEB commands.

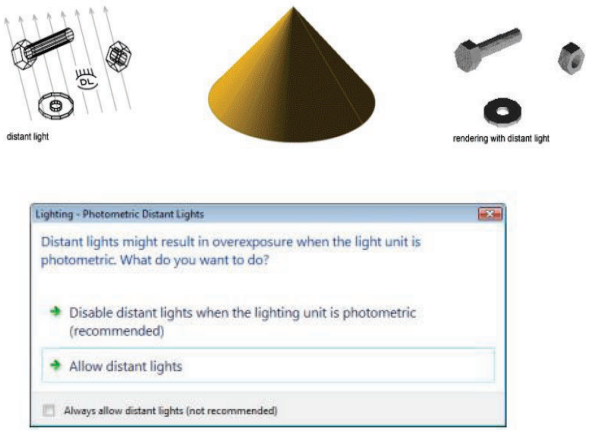
Commonly used lamps for defining photometric lights-including fluorescent, low pressure sodium, incandescent, and high intensity discharge-are available on the photometric lights tool palette. (Fig 8)

Fig 8



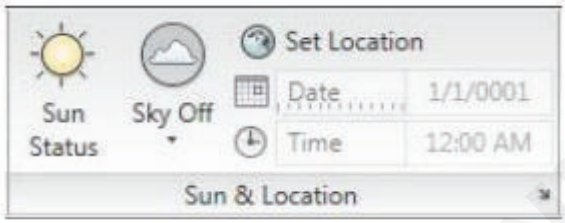
Distant Light (Fig 9) : A distant light emits light that travels in parallel rays in one direction and does not diminish over distance; it is as bright on each face it strikes as it is at the source. You specify a FROM point and TO point anywhere in the viewport. Distance lights are useful for uniformly lightning objects or a backdrop.You can create distance lights using the DISTANTLIGHT command or by selecting the distant light from the lights panels. (Fig 9)

Fig 9



Sunlight : The sun is a light that simulates the effect of sunlight and can be used to show how the shadows cast by a structure affect the surrounding area. The sun and location properties are controlled using tools in the sun & location panel on the render ribbon bar. (Fig 10)

Fig 10



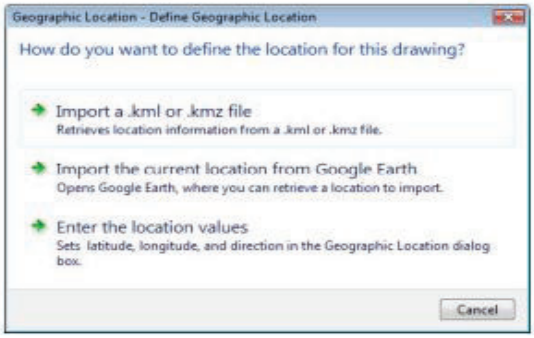
When you click the location button, you can choose the method you want to use to define the location for the drawing (Fig 11)

Select enter the location values to specify the geographic location within AutoCAD. You can then specify latitude and longitude, or click the use map button to select the location using a map. (Fig 12)

Once selected, the sun properties can be changed in the sun properties palette.

Sun and sky are the primary sources of natural illumination in AutoCAD.

Fig 11



The option to choose the sky background is only available when the using photometric lighting.

The sun and sky background can be interactively adjusted in the adjust sun & sky background dialog box, which can be activated by clicking the button on the sky properties title bar in the sun properties palette.

Including sky illumination adds extra light to a scene, simulating the effect of light scattered by the atmosphere throughout the scene. (Fig 13)

Fig 13

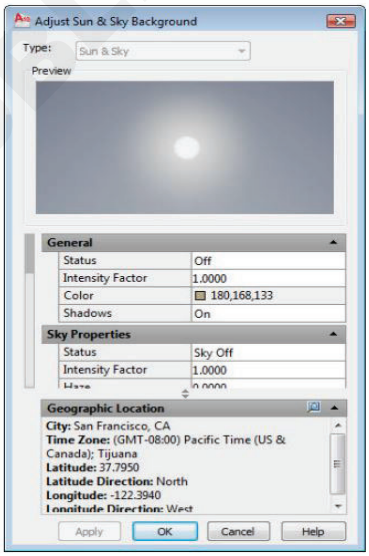
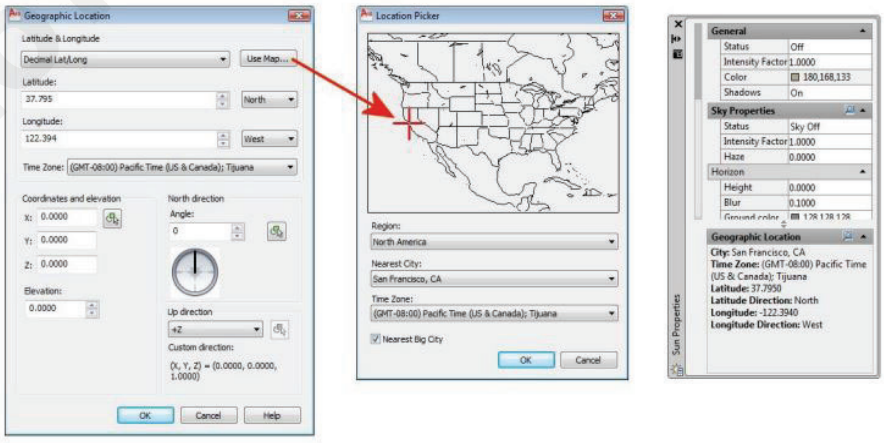
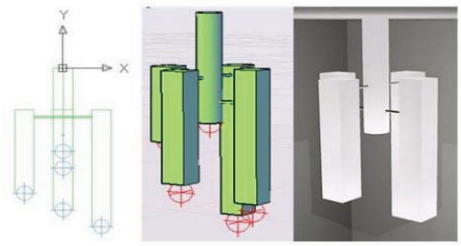


Fig 12



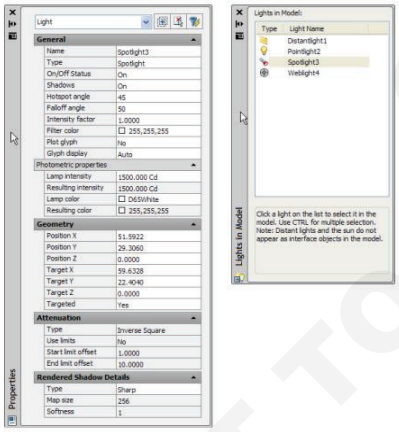
Using Luminaire Objects: AutoCAD enables you to embed photometric lights in blocks that also contain geometry, thus creating light fixtures that model both the physical and photometric properties of actual lighting fixtures. After modelling the 3D representation of the light, select the photometric lights from the photometric lights tool palette, position them within the model of the physical light, and then create a block of the light objects and 3D representation of the lights to create the light fixture with photometric properties. (Fig 14)

Fig 14



Controlling the Location and Properties of Lights : With the exception of the sun and lights in blocks and xrefs each light you add to the drawing is listed by name and type in the Lights in Model palette. When a light is selected in the list, it is selected in the drawing and vice versa. Once selected, all of the properties palette of the light can be changed in the Properties palette. (Fig 15)

Fig 15



You can control any of the following properties individually for each light in the drawing:

- **Type:** Specifies the type of light: point light, spotlight, web light.
- **Status:** Controls whether the light emits light when the default lighting is turned off.
- **Shadows:** Controls whether the light casts shadows. To be displayed, shadows must be turned on in the visual style applied to the current viewport.
- **Intensity:** Sets a multiplier that controls the brightness. Intensity is not related to attenuation.
- **Color:** Sets the color of the light emitted.

Selecting the light with a right-click, a shortcut menu is displayed that provides the following options for adjusting the placement of the light:

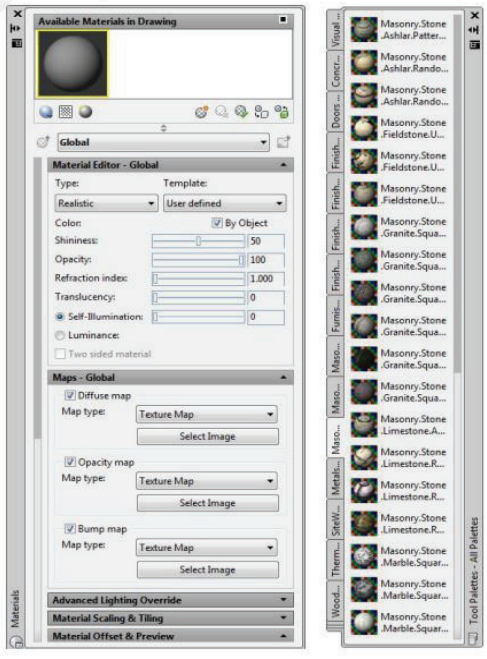
- **Move** Activates the MOVE command. Used to change the position of the light.
- **Rotate** Activates the ROTATE command. Used to change the orientation of the light. In addition, you can use the ROTATE, 3DROTATE, and ROTATE3D commands.
- **Flip** Rotates the target of the light in the opposite direction.

Working with materials : Attaching realistic materials to objects in your model truly brings those objects to life. By attaching materials and adjusting the way that they appear on those objects, you make the flat surfaces appear to be made out of real brick and mortar. You attach materials using the tools on the Materials panel located on the Visualize ribbon bar.

AutoCAD comes with a library of more than 400 predefined materials.You can install the materials library by using Add/Remove Programs to install additional AutoCAD components.

The materials available in the current drawing appear in a materials window. The GLOBAL material is always in the drawing and is the default material for all objects that have not yet been assigned a material. The materials in AutoCAD's material library are available on tool palettes. Once a material is added to the drawing, it is also displayed as a swatch in the Materials window. (Fig 16)

Fig 16



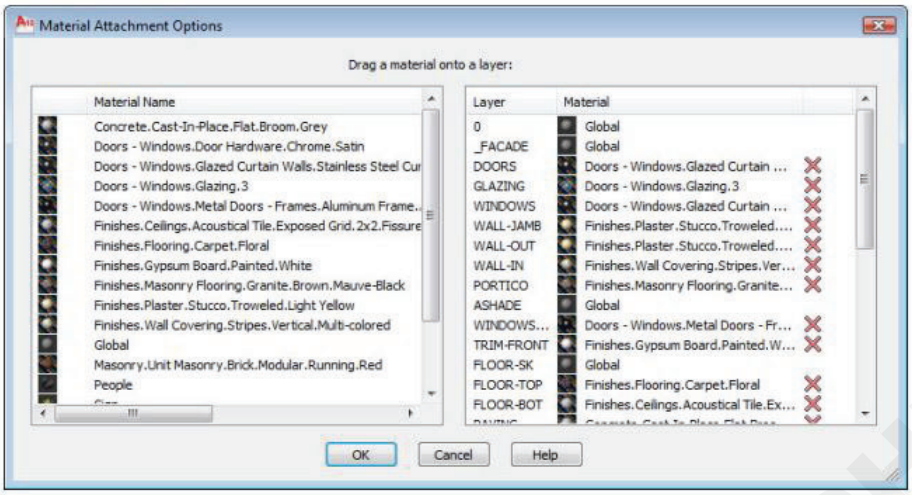
Applying materials to objects and faces

You can attach a material to an object, individual faces, or to all objects on a particular layer.

- To attach a material to an object, simply drag the material onto the object.

- To attach a material to an individual face, press the CTRL key while dragging the material onto the face of an object.
- To attach materials to objects by layer, use the Material Attachment Options dialog box (displayed by clicking the Attach By Layer tool in the Materials panel of the Render ribbon bar. (Fig 17)

Fig 17



The left side of the dialog box shows the materials available in the current drawing. The list on the right shows the layers in the drawing. To attach a material to a layer, simply drag it from the list on the left and drop it onto the layer in the list on the right. The material is attached to all object on the layer whose material property is set to BYLAYER (the default).To remove a material from a layer, click the adjacent Detach button.

Creating and modifying materials : Each material is defined by a number of qualities. The available options depend on the template used:

- Realistic and realistic metal templates: materials based on physical qualities
- Advanced and advanced metal templates: materials with more options, including properties that you can use to create special effects, such as simulated reflections

You can create and modify materials in either the material tool palettes or the materials window.

The controls in the material editor section of the material window (or tool properties dialog Box) let you adjust the qualities of the material

Template specifies the types of material

Color displays the select color dialog box, where you specify the color of the material

By object sets the color of the material based on the color of the object it is attached to

Diffuse sets the main color of the material (advanced and advanced metal templates only)

Ambient sets the color that that appears on faces lighted by ambient light only (advanced and advanced metal templates only)

Spherical determines the color of a highlight on a shiny material (advanced template only)

Shininess controls the reflective quality of the material

Opacity controls how much light passes through the surface of the object (not Available for metal material types)

Refraction controls how reflective the material is (advanced templates only)

Refraction index control the bending of light rays as they pass through translucent material. At a value of 1.0 object behind the material do not distort, while at 1.5 they would be greatly distorted (Not available for metal templates)

Self –Illumination controls the appearance that light is being emitted by an object. For example to simulate neon light, set a value greater than zero. No light is cast on other objects. (Not available for metal templates)

Translucency controls the percentage of light scattered within the object (not available for Metal material types)

Luminance causes material to simulate being lit by a photometric light source; how much light is emitted is a selected value un photometric units. No light is cast on other object.

Two-sided sets the property of the material as two sided so that both sides are rendered In the scene

Using texture maps : Texture maps add additional realism to a material. Maps assign a pattern or texture to material's color. The color of the map replaces the material's diffuse color. For example, if you want a wall to make out of brick, you can choose a map with an image of bricks. This is the most common kind of mapping. You can use most common raster image formats to create texture maps, including BMP, GIF, JPEG, PCX, PNG, TGA and TIF.

You can also use a procedural map, such as checker, marble, noise, speckle, tiles, waves, and wood. The procedural maps have properties that you can adjust, such as the size and spacing of grain in a wood material, to achieve the desired effect.

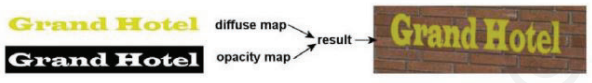
Diffuse map provides a pattern of colors for the material.

Reflection map simulates a scene reflected on the surface of a shiny object

Opacity map create the illusion of opacity and transparency.

Bump map simulates a bumpy or irregular surface. (Fig 18)

Fig 18



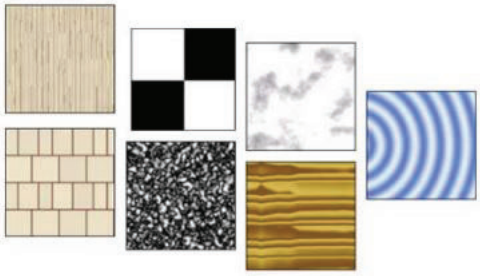
Note that in order to see through the transparent portions of the opacity map, you mush map the material onto the entire object, not just onto a face. Black represents areas that are transparent while white areas are opaque. (Fig 19)

Fig 19

Procedural maps : Procedural maps add further realism to a material. Auto CAD includes a number of procedural maps, including checker, marble, noise, speckle, tiles, waves, and wood. (Fig 20)

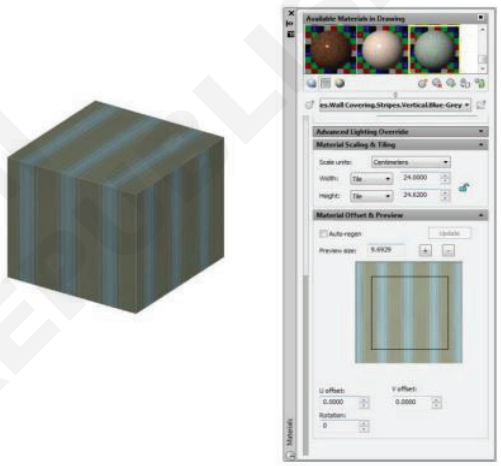
Procedural maps can be generated in two or three dimensions and you can nest additional texture or procedural maps within a procedural map to add depth and complexity to the material.

Fig 20



Modifying map properties : Map properties can be modified to create complex patterns by chancing the map settings.map properties are now controlled within the materials palette in the scaling & tiling area. The controls in this area are only available for texture maps and checker and tile procedural maps. Each map has its own scaling and tiling factors. (Fig 21)

Fig 21

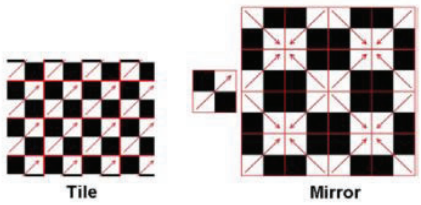


When you sale a scale from the scale units drop-down, the map is scaled to the face or object using a fixed or real-world scale. When you select fit to gizmo, the map is scaled to fit the face or object. You can also use the other controls to adjust the scaling and tiling of material. When you select none, the pattern is not repeated. Tile repeats the pattern as a series of tiles while mirror doubles the maps, flips the doubled copy, and then repeats the doubled pattern as a series of tiles. (Fig 22)

Preparing your own bitmaps : Most common raster image formats—BMP, GIF, JPEG, PCX, PNG, TGA, and TIF—can be used as maps. You can capture images for use in creating new material by scanning them or using a digital photo.

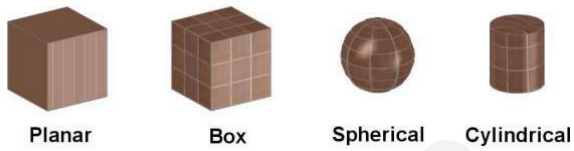
Adjusting material mapping : After you attach a material with a texture, you can adjust the orientation of the texture map on the object or faces. Material mapping to an object improves the fit:

Fig 22



- **Planar** maps the image onto the object as if was projected from a slide projector onto a flat plane. The image is not distorted, but the image is scaled to fit the object. This mapping is most commonly used for forces
- **Box** maps an image onto a boxlike solid. The image is repeated on each side of the box.
- **Spherical** warps the image both horizontally and vertically. The top and bottom edges of the bitmap are compressed to point at the north and south poles of the sphere
- **Cylindrical** maps the image onto a cylindrical object so that the bitmap's horizontal edges are wrapped around the object. The height of the image is scaled along the cylinder's axis.
- If you need to make further adjustments, you can use the material mapping grip tool that is displayed on the object to move or rotate the map on the object. (Fig 23)

Fig 23



Ceiling

Objectives: At the end of this lesson you shall be able to
- **explain different types of ceiling**
- **explain false ceiling in details**
- **explain the materials used for false ceiling.**

Introduction

Ceiling is an overhead interior surface that covers the upper limit of a room. It is generally not considered a structural element but a finished surface concealing the underside of the floor or roof structure above. Ceilings are classified according to their appearance or construction.

They are generally two categories of ceiling:

1 True ceiling

2 False ceiling

True ceiling

In this type of ceiling is the type of ceiling where pure R.C.C is used without any other further improvement except for paint and plastering.

Ceilings based on shape are as follows:

Ceiling forms

Single slope or shed form may lead the eye upwards towards the edge or down towards the eave line, depending on the location of the day lighting sources within the room.

Gabled ceilings expand space upward towards the ridge line, depending on the direction of any exposed structural elements, the gabled form may direct our attention to the height of the ridge or to its length.

A pyramid ceiling directs the eye upward to its peak, a focus that can be accentuated further with an illuminating skylight.

A vaulted ceiling directs our eyes upward and along it leads to movement and is a centralised form that expands space upward and leads to attention on the space beneath its center.

Freeform ceiling contrast with the planer quality of the true ceiling and therefore attract our attention. Whether curve near form comes which is derived on nature, they are decorative and can often dominate the interior space.

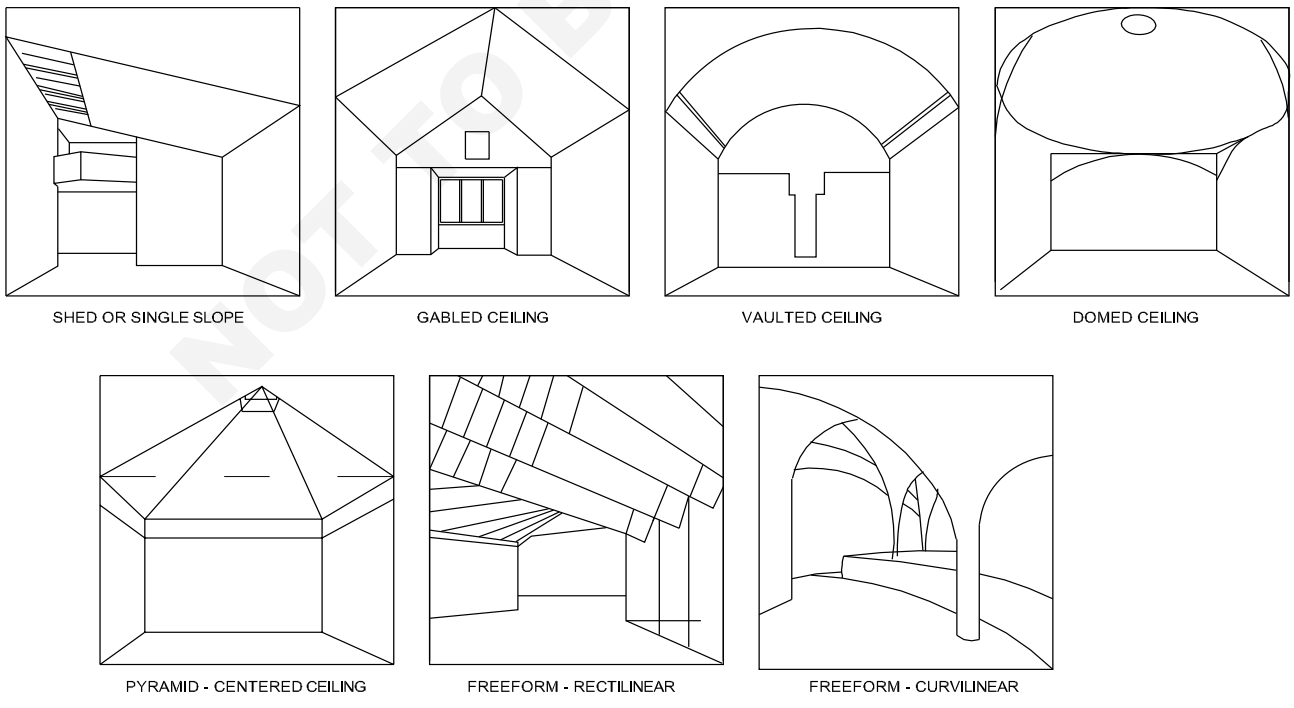
False ceiling

1 A false ceiling forms a canopy above our head.

2 It covers the real ceiling which is made of cement, sand, metal aggregate, etc.

3 Technically, it is a 'suspended ceiling' and is fitted underneath the roof.

Fig 1



CEILINGS

Need for a false ceiling

The plenum or gap between the true and false ceiling provides a coverage and passage for

1 Electrical conduits for overhead light fittings.

2 Air conditioning ducts

3 Smoke & fire detection systems

4 Plumbing lines for water, gas, chemicals or hazardous materials

5 False ceiling helps reduce the volume of a room for efficient air conditioning.

6 It helps reduce the heating up of a room through the ceiling above.

7 It helps conceal dampness or other defects of the true ceiling.

8 Improves aesthetic appeal of the room

Types of suspended ceilings

The materials commonly used are:

i Plaster of paris (POP) fixed to a suspended GI grid

ii Gypsum board panels fitted to a suspended GI grid

iii Plaster glass board ceiling systems

iv Mineral fibre board ceiling systems

v Metal ceilings

vi Wooden or plywood or particleboard panels

vii Polystyrene foam panels

viii Reinforced cement boards

1 P.O.P

For interior surfacing this materials is widely used because rapid curing, relative ease of molding, shaping and low cost and is a durable material. Because of the water bound into its molecular structure P.O.P is highly fire resistant.

POP panels

POP panels of convenient sizes are used

1 Panels are backed with a lining of hessian or Nylon or glass fiber mesh.

2 Panels are 12-25 mm thick, with dimensions from 2' to 4' square.

3 Casting is done on site.

4 POP ceilings are economical, convenient and quick to complete.

2 Gypsum board ceiling panels

i Gypsum (Calcium sulphate) mixed with fillers & reinforcements to make gypboard panels

ii Gypboard suspended ceilings are versatile & easy to construct

iii Excellent surface finish owing to veneer plaster coating

iv Improved fire resistance and blocks passage of heat

v High thermal insulation ability

vi Lends itself to any type of finish painting, wallpapering, ceramic tiles, etc

vii Is very light-weight compared to similar building materials.

3 Plaster glass board ceilings

i Panel size, strength & accoustic properties are better

ii POP boards are impregnated with glass fibre mats

iii Used improved version of POP ceiling

iv In cinema theatres and sound recording studios

4 Mineral fibre board ceilings

Armstrong mineral fibre acoustical ceilings are available in different textures:

i Fine fissured.

ii Sand fine texture.

iii Sand perforated.

iv in squares 600 x 600 mm or in rectangles 600 x 1200 mm.

v Thickness varies between 15 mm to 19 mm.

5 Metal ceiling

Metal strips for false ceiling

i Metal ceilings comprise long sections of mild steel or aluminium.

ii Available in various colours powder coated.

iii Applications in railway booking halls, hospitals and Airport lounges.

iv Durable and long lasting.

v Provision for ceiling lights can be provided for.

6 Wooden & plywood panels

Consists of wooden grid with peripheral sections.

i Can be created with various patterns & designs.

ii Paint & lacquer finishes can be achieved.

iii Teak, cedar or pinewood may be used.

iv Disadvantages of wooden ceilings are proneness to damp, termites and flammability.

v Maintenance and care are essential.

7 Polystyrene foam panels

Popularly known as thermocol, easily available in sheets

i Thickness varies from 12 mm to 25 mm

ii Lightest material used in false ceiling panels

iii Grid is made of aluminium with GI suspension wires

iv Lightweight, economical, easy to construct

v Not very damp prone, also not flame retardant

8 Reinforced cement boards

i These are cement based boards comparable to gypboard.

ii Grid employed and mode of construction are similar to that of gypboard.

iii Termite proof, moisture resistant, fire resistant.

iv Asbestos free, environment friendly, easy to paint, nail, screw, drill.

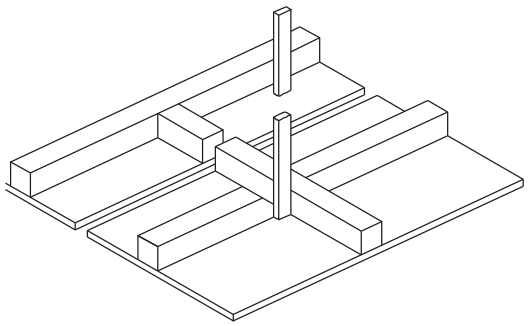
v Reinforced with silica or quartz, available in self embossed textures.

Fixing systems

1 Concealed G.I. framework

In this system, various G.I. components are used to form a suspended framework of size 610 mm x 1220 mm.

Fig 2



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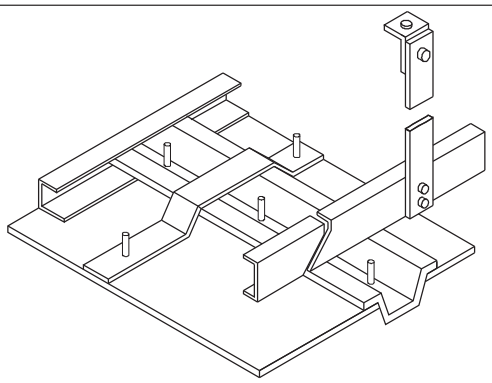
E-board classic 4 mm, 5 mm or 6 mm thick is then screwed on the underside of the framework with self tapping screws.

Concealed timber framework

This system consists of seasoned timber sections, making a framework of 610 mm x 1220 mm using timber sections 50-75 mm thick and 50-75 mm wide.

Fig 3



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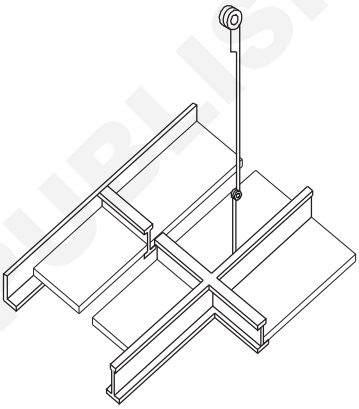
2 Exposed aluminium framework

In this system, aluminium sections are suspended from the ceiling to from a modular grid.

4 mm/6 mm thick E-board classic of size 610 x 610 mm/ 610 x 1220 mm are placed inside the grid and secured with clips from the inner side.

Fig 2



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Types of false ceiling and its manufacturers

	Types of false ceiling	Manufacturer
1	Plaster glass board ceiling systems	Saint gobain
2	Mineral fibre board ceiling systems	Armstrong Celotex
3	Metal veiling	M/s Interach
4	Wooden panels wood panels	Indigenous
5	Polystyr foam (Thermocol)	Indigenous (panels manufactured by M/s BASF etc)
6	Particle board panels	i Gyp board ii Jolly board iii Bison panel

7	Reinforced cement board	M/s Eternit Everest Ltd.,
8	POP board	Indigenous pop is available from market.
9	Gyp board	M/s India gypsum
10	Ceiling tiles	i India gypsum
		ii Jolly board
		iii Diamond board

Types of ceilings: There are different types of ceiling used for commercial and residential place. They are as follows;

1 Grid ceiling

2 Coffered ceiling

3 Coved ceiling

4 Plain ceiling

Grid ceiling: This ceiling is suspended from (or drop from) an existing ceiling or support system. a grid ceiling is a false ceiling in the sense that is not the part of a permanent support structure such as floor joints or a cement floor/ceiling. The main benefit of a suspended ceiling (grid ceiling) is to provide a clean, smooth finish to the internal ceiling of a room whilst hiding electrical wires pipe work and other services.

The typical buildings that use suspended ceiling are offices, hospitals, schools, retail units, industrial units.

Coffered false ceiling: a coffered ceiling is created with coffered panels or "coffers". Coffers are such as panels attached to a suspended (drop) grid to create a new ceiling with depth and architectural interest. Deep coffers add visual weight to a room while shallow coffers create a lighter feel.

A coffered ceiling is a series of indentations or hollows on the surface of ceiling. Coffered ceiling decoratively hide ceiling imperfections and create the illusion of height. Historically the design is considered dignified and formal.

These ceilings in residential homes are not load bearing. They are not part of home structural system. It is purely decorative. This type of ceiling style is recommended for rooms that are on the larger side and ceiling 9 feet high or taller.

Coved ceiling: A coved ceiling has had the visual appearance of the point. Where the ceiling meets the walls improved by the addition of coving. It can also refer to a ceiling like in a mosque. Cove ceiling are a beautiful addition to any room or hall way.

However they are usually very expensive and time consuming. This particular ceiling will eliminate those hard 90° angles by creating a soft smooth and rounded finish. This can be used to create a more elegant finish.

Plain ceiling: This plain ceiling is a secondary ceiling that is mainly done with plaster of paris or gymsum board material. It comprises gymsum board that is cut into various shapes and designs to give a definitive look to room. The trend of flat and simple ceilings have fallen way side. Now a days people are eyeing on products that make the typical flat ceiling look attractive but with minimum costing.

These ceilings are crafted from a wide range of materials such as POP, gymsum board asbestos, sheets, panels, wood. These are usually mounted at a minimum distance of 8 inches from the original ceiling.

Finishing materials used for false ceiling

Laminate: Laminates are known for their durability and reliability. Since, it looks like wood and you stick it to a composite base. It is extremely durable and resist scratches and stains.

Veneer: Veneers are usually not as durable as laminates. They require maintenance and care since they are prone to scratches. The veneers generally remain intact between 3 and 10 years. Life style choices, consumes foods. Oral hygiene habbits will impact the life expectany of composite veneers. The standard veneer sheet thickness is 0.4 mm, 0.5 mm, 0.55 mm or 0.6 mm. A common wood veneer is more economical. It is ideal for interior decor in homes.

Stone: The stone ceiling is the third unlockable ceiling. A ceiling provides protection from the elements giving bonuses to hypo and hyperthermic insulation. Stone ceiling requires placement on a wall, pillar, foundation or another ceiling. It requires support from a nearby foundation or pillar.

Glass: Glass is susceptible to design elements such as colouring laminating and patterning. Besides glass is a good insulator. Glass and mirrors materials can aid in creating beautiful false ceiling. These can serve aesthetically and functionally very nice.

However glass/stained glass and mirror will be used in combination with other materials. Glass in varied forms stained glass etched glass etc., creates a nice ambiance. The back-lit glass can amp up the interior spaces and troutfarm them instantly.

While glass with its transparency and translucence can create a nice ambiance, the mirror with it reflectance can create the illusion of a bigger space. The material has limited use but it is easy to maintain. It provides thermal insulation. This will be used in a nice way to infuse art in your space and add to the functionality too.

Acrylic sheet: These false ceiling materials are light in weight, moisture resistant and reduces condensation and subsequent dripping from ceiling onto the work, surface. This can be easily suspended from the main ceiling.

This is the transparent plastic material with outstanding strength. Stiffness and optical clarity. It has superior weathering properties compared to many other transparent plastics.

MDF material: Medium density fibre board. It is used in dry environment. MDF is an excellent material that can be used as backing for shingles of any kind of roof. It is durables of as well as flexible. It is heavier. It can not support too much of weight.

MDF: It heavier. It can not support too much of weight.

Paints: It is best to use flat paint for the ceiling tiles and semi-glass paint for the metal gridding. You should also use metal primer on the gridding before hard. Primer will prevent oxidation and will ensure an even paint coat.

Wall paper: It is also refered to today as wall covering is a cost efficient way to change your interior. Decorating with wall paper is a way to change your interior space without too large of a commitment. This material used in interior decoration to decorate the interior walls of domestic and public building.

Fabric: Interior textiles also known as home furnishing textiles includes specialised textiles used in home, office, hospital, hotels, schools, aircraft and automobiles interior. It is an object having three dimensions like length, width and depth there main steps in designing a fabric structure shape finding, loading and patterning/ detailing.

Stainless steel: This material creating sleek, clean lines has become a staple in modern design. Designees and architects are using interior metals because they add dimensions and texture to any space. Modern metal become popular because of their ability to manuplate natural light to create open dry spaces.

Wood: Thus incorporating wood in your home interiors will ensure rapid cooling and heating of the space. It also absorbs noise and atmospheric carbon making the space much healthier for you. Wood is one of the most durable materials out theme, making it favourite amongst home designer.

Flooring

Objectives: At the end of this lesson you shall be able to
- **explain introduction components of flooring**
- **understand different types of ceiling**
- **understand false ceiling in details**
- **explain the materials used for false ceiling.**

Introduction

The purpose of a floor is to provide a level surface capable of supporting the occupants of a building, furniture equipment and sometimes, internal partitions. To perform this function, and in addition, other which may vary according to the situation of the floor in the building and the nature of the building itself, a floor must satisfy the follwing requirements.

- Asequate strength and stabilty
- Adequate fire resistance
- Sound insulation
- Damp resistance
- Thermal insulation

The floors resting directly on the ground suface are known as ground floors, while the other floors of each storey, situated above the ground level are known as upper floors.

The problems of strength and stability are usually minor ones at ground and basement levels since full support from the ground is available at all points. However, major problem of ground floors is damp exclusion and thermal insulation. Moisture is generally present in the ground, which may pass into the building through the floot unless measures are taken to check it.

The upper floors have the major problems of strength and stabilty since they are supported only at thier ends,on walls, beams etc. The stunctural design of a floor has to be such as to support the loads set up by the use of the building, in addition to the self weight and the weight of partitions etc.Upper floors do not have problems of damp resistance,though sound insulation is generally an important factor in the design, the problem kof fire resistance does not arise for the lowest floor of a building,but is often important for upper floors.

components of a floor

A floor is composed of two essential compnents:

- Sub-floor, base course or floor base
- Floor covering,or simply, flooring,

The floor base is a structural component, which supports the floor covering. For the ground floors, the object of floor base is to give proper support to the covering so that it does not settle, and to provide damp resistance and thermal insulation.

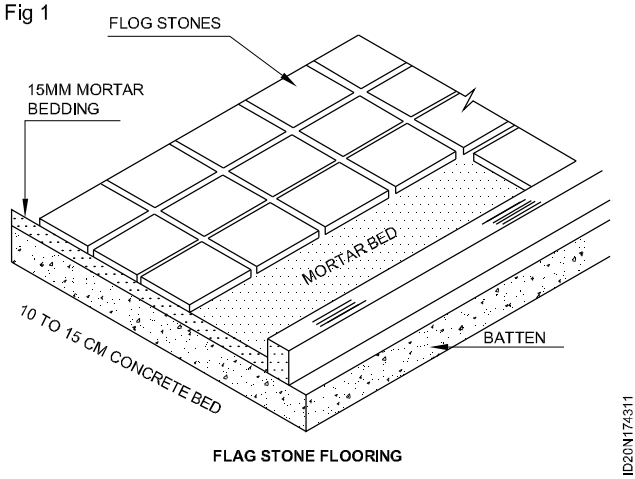
Ground floors may either rest directly on the ground, or may be supported a little distance above the ground, The floors suppoted directly on the ground are known as solid floors. while the floors supported above the ground level are called suspended floors.

Types of flooring

- Flag stone flooring
- Mosaic flooring
- Marble flooring
- Timber flooring
- Vinyl flooring
- Cork flooring
- Tiled flooing
  - a Ceramic file
  - b Linoleum flooring (covering)
- PVC flooring
- Glass flooring

1 Flag stone flooring (Fig 1)

Fig 1



FLAG STONE FLOORING

Flag stone is any laminated sand stone avaiable in 2 cm to 4 cm thickness, in the form of stone slabs of square (30 cm x 30 cm, 45 cm x 45cm or 60 cm x 60cm)or retangular size (45 cm x 60 cm). This type of work is also called paving. the stone slabs are laid on concrete base. The sub-soil is plroperly compacted, over which 10 to 15 cm thick lime concretor lean cement concrete is laid This forms the base course of the floor. The flag stones(stone

slabs)are then laid over 20 to 25 mm thick layer of bed mortar (Fig 11.4). in laying the slabs, work is started from two diagonlly oppsite corners and brought up from both sides. A string is stretched between two corner slabs laid first to correct level. Other slabs are then so laid that their tops touch the string. If any particular slab falls lower than the string level, It is re-laid by putting fresh layer of stiff mortar. When the stone slabs are properly set, motar in the joints is raked out to a depth of about 15 to 20 mm and then flush pointed with 1:3 cement mortar.proper slope is given to the surface for drainage, the work is properly cured.

2 Mosaic flooring : Mosaic flooring is made of small pieces of broken tiles of china glazed or of cement, or of marble, arranged in different pattern. These pieces are cut to desired shapes and sizes. A concrete base is prepared as in the case of concrere flooring, and over it 5 to 8 cm thick lime- surkhi mortor is spread and leveled, over an area which can be completed conveniently within working period so that the mortar may not get dried before the floor is finished. on this, a 3 mm thick cementing material, in the form of paste of two parts of slaked lime, one part of powdered marble and one part of puzzolana material, is spread and is left to dry for about 4 hours, Therafter, small pieces of broken tiles or marble pieces of different colours are arrenged in definite patterns and hammered into the cementing layer, the surface is gently rolled by a stone roller of 30 cm dia. And 40 to 60 cm long, sprinkling water over the surface, so that cementing material comes up bthrough the joints,and an even surface is obtained.

3 Marble flooring : It is a superior type of flooring, used in bath-rooms and kitchens of residential buildings, and in hospitals, sanotoriums, temples etc. where extra cleanliness is an essential requirement. Marble slabs may be laid in differend sizes usually in rectangular or square shapes.The base concrete is prepared in the same manner as that for concrete flooring. Over the base concrete, 20 mm thick bedding mortar of either 1:4 cement: sand mix 1 (lime putty): 1 (surkhi): k1 coarse sand mix is spread under the area of each individual slab. The marble slab is then again lifted up, and fresh mortar is added to the hollows of the bedding mortar. The mortar is allowed to harden slightly, cement slurry is spread over it, the edges of already laid slabs are smeared with cement slurry paste, and then the marble slab in question is placed in position. it is gently pushed with wooden mallet so that cement pastes oozes out from the joint which should be as thin as possible (paper thick). the ozzed out cement is cleaned with cloth. the paved area is properly cured for about a week.

4 Timber flooring : Timber flooring is used for caropentry halls, dancing halls, auditoriums, etc. they are not commonly used in residential buildings in India, because timber flooring is also quite costlier, However , in hilly areas, wherer temperature drops very low, timber flooring is quite common. One the major problems in timber flooring are the damp prevention. this can be done by introducing D.P.C. layer below the flooring

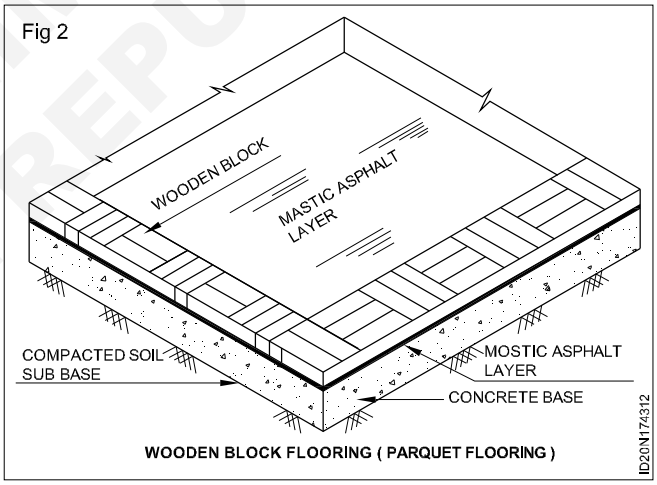
Timber floors can either be of' suspended type' (i.e.. Supported above the group or' solid type' (fully supported on the ground), an alternative sketch of 'suspended' or 'supported' timber flooring is shown in Fig 11.5. the hollow space between the flooring and over site concrete is kept dry and well -ventilated by providing air bricks in the outer walls, and voice in the sleeper wall. The flooring consists of boarding supported on bridging or flooring joists of timber, which are nailed to the wall plates at their ends. Sleeper walls are not spaced more than 1.8 to 2 m. There are 2 types of timber flooring.

1 **Wood plank flooring :** Wood plank flooring is also typically nominal 3/4 '' (19mm) Thick, In widths ranging from 3 to 10'' (76 to 250 mm)and is available in random lengths.

2 **Wood parquet flooring:** Wood parquet flooring consists of small wood strips available in individual slats, or is formed into panels or tiles that are arranged to form a pattern . thickness varies from 5/16'' (8mm) to 3/4'' (19 mm) for individual strips and square panels. Some of the common siwes are 6'' x6'' (152 x 52mm), 9''x 9'' (228 x 228), 12'' x 12''(304x304).

Where the problems of dampness is not acute, timber floors may be supported on the ground all along. For this type of construction, base concrete is first laid in 15 to 20 cm thickness. Over it, a layer of mastic asphalt is applied. Wooden block flooring is then laid over it, as shown in Fig 2

Fig 2



WOODEN BLOCK FLOORING (PARQUET FLOORING)

Wooden blocks parquet flooring are short but thick (with sizes 20x 8cm to 30 x 80cm and thickness 2 to 4 cm) and are laid in suitable designs.) In order to fix the wooden floor on concrete slabs, longitudinal nailing strips, with bevelled section, are embedded in concrete at suitable interval. Sometimes, special concrete, called nailing concrete may be used as an used for nailing down the flooring. (Fig 3)

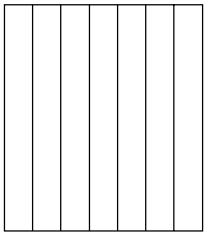
Vinyl flooring

Sheet vinyl

1 Homogeneous or solid sheet vinyl: It is expensive and has superior resilience to indentation.It has no backing material and is suitable for heavy-wear applications.

2 Backed sheet vinyl: It consists of a vinl wear layer that is bonded to a backing, with or without an interlayer between the two.

Fig 3



PARQUET FLOORING

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3 Transparent or translucent vinyl: It is produced by applying a clear vinyfilm over a printed surface.

Vinyl tile

1 Vinyl composition (VCT): It is less expensive than solid vinyl tile

2 Solid vinyl tile: Solid vinyl tile is a homongeneous vinyl tile, containing more PVC than VCT. It offers better resistance to rolling and indentation.

Tiled flooring : Tiled flooring is constructed from square, hexagonal or other shapes, made of clay (pottery) cement concrete or terrazzo. These are commonly used in residential houses, offices, schools, hospitals and other public buildings, as an alternative to terrazzo flooring, specially were the floor is to be laid quickly. Tghe method of laying tiled flooring is similar to that for flag stone flooring except that greater care is required. Over the concrete base, a 25 to 30 mm thick layer of lime Mortar 1:3 (1 lime and 3 sand or surkhi) is spread to serve as bedding. This bedding mortar and the tiles are laid flat over it gently pressing them into the bedding mortar with the help of wooden mallet, till levelled surface is obtained. Before laying the tiles, thin paste of cement is applied on their sides, so that the tiles have a thin coat of cement mortal over the entire perimeter surface/ Next day, the joints between adjacent tiles are cleaned of loose mortaretc/ To a depth of 5 mm, using wire brush, and then grouted with cement mortar etc. To a depth of 5 mm, using wire brush, and then grouted with cement slurry of the same colour shade as that of the tiles. The slurry is also applied over the flooring in thin coat. The flooring is then cured for 7 days, and then grinding and polishing is done in the same manner as that for terrazzo flooring.

Tile types : There are a variety of types, including ceramic mosaic, quarry. Paver, decorative, mounted and conductive tile.

1 **Ceramic mosaic tiles:** They are made of either porcelain or natural clay and may be plain or have and abrasive mixture throughout.

2 **Quarry tile:** It is a glazed or unglazed tile made from natural clazy or shale. Quarry tile may be provided with an abrasive grit on the surface to make it slip resistant

3 **Pave tile:** It is a glazed or unglazed porcelain or natural clazy tile

4 **Decorative thin-** wall tile: It is a glazed tile with a thing body that is usually nonvitreous. It is suitable for residentail purposes.

5 **Mounted tile:** It is assembled into units or sheets to facilitate handling and installation. This tile may be face mounted, back mounted or edge - mounted. Material applied to the face of this tile is usually easily removed, but material bonded to the back is intergrated to the tile installation.

6 **Conductive tile:** It has specific properties of electrical conductivity but retains other normal physical properties of tile.

Ceramic tile flooring : Ceramic tiles is made from either natural clay or porcelainand is glazed or unglazed.

1 Porcelain tiles: They are dense, impervious, fine grained and smooth with a sharply trimmed face.

2 Natural clay tiles: They are ceramic mosaic or paver tile with a distinctive textured appearance.

3 Glazed tile: They have an impervious facial finish of ceramic materials that is fused to the body of the tile. The body may be or impervious.

4 Unglazed tiles: They are hare, dense tiles of uniform composition that derives colour and texture from the materials used in its fabrication.

Water absorption of ceramic tile

Type	Water absorption	Ceramic material	Use
Nonvitreous	More than 7%	Natural clay	Not for use in continually wet locations.
Semivitreous	More than 3.9% but not more than 7%	Natural clay	Not for use in continually wet locations
Vitreous	0.5 - 3%	Natural clay	For use in continually wet locations.
Imptervious	0.5% or less	Porcelain	For use in continually wet locations; superior wear resistance.

Asphalt flooring : Asphalt flooring are of many types:

i Asphalt mastic flooring

ii Asphalt tiles flooring

ii Asphaltic terrazzo, and

iv Acid proof mastic flooring.

1 **Asphalt mastic flooring :** Asphalt mastic is a mixture of sand (or grit) and asphalt in the ration of 2:1, mixed hot and then laid in continuous sheets. It can also be applied cold, by mixing with mineral oil and

asbestos. The thickness of the asphalt mastic my be 2.5 cm for ordinary construction.It is laid on cement concretebase course.The mix is poured on the concrete base, and is spread by means of trowel to get levelled surface.On the top of the surface, a thin layer of sand is spread, which is thenrubbed with a trowel. The joints of mastic asphalt laid on successive days are properly lapped.

2 **Asphaltic tiles :** These are prepared asphalt, asbestors fibres, inert materials and mineral pigments, by pressing the mix in different sizes (20 cm square to 45 cm square). With thickness varying from 3 to 6 mm. These tiles are either directly cemented to concrete base or asphalt saturated felt. Asphaltic tiles are cheap, resilient, sound proof, non absorbant and moisture proof.

3 **Asphaltic mosaic :** This is prepared similar to mastic asphalt, except that marble chips are used in the place of sand/grit. Asphalt may be either in black or other suitable colour, and is laid in hot condition.

4 **Acid proof mastic flooring :** Acid proof blocks of asphalt are available, whic are manufactured from moulding acid proof asphalt and inert crushed rock aggregate under high pressure. The asphalt blocks are first laid on concrete base then acid proof asphalt is uniformly spread over the surface of the blocks. Find sand is spread over the liquid asphalt before it hardens.

5 **Plastic or p.v.c flooring :** It is made of plastic material called poly-vinyl-chlorid (P.V.C) fabricated in the form of tiles of different size and different colour shades. These tiles are now widely used in all residential as well as non-residential buildings. The tiles are laid on concrete base. Adhesive of specified make is applied on the base as well as on the back of P.V.C tile with the help of a notched trowel. The tile is laid when the adhesive has set sufficiently (Say within 30 minutes of its application) It is gently pressed with the help of a 5 kg weight wooden roller and the oozing out adhesive is wiped off. The floor is washed with warm soap water before use P.V.C tile flooring is resilient, smooth, good looking and can be easily cleaned. However, it is costly and slippery, and can be damaged very easily when in contact with burning objects.

6 **Glass flooring :** This is special purpose flooring, used in circumstances where it is desired to transmit light from upper floor to lower floor, and specially to admit light at the basement from the upper floor. Structural glass is available in the form the upper floor. Structural glass is available in the form of tiles or slabs, in thickness varying from 12 to 30 mm. These are fixed in closely spaced frames so that glass and the frame can sustain anticipated loads. Glass flooring is very costly, and is not commonly used.

Floor coverings : There are two major categories of soft floor coverings.

a Carpets

b Rugs

Carpets : Carpets can be laid over an existing floor or over a subfloor with and underlayment pad. The carpet fibers are mad up of any of the following materials

1	Wool	2	Acrylic
3	Nylon	4	Polyester
5	Olefin	6	Cotton

Carpet tiles are modular pieces of carpet, which are installed with adhesives. They offer the following advantages:

1 They can be easily cut to any odd shapes with minimum wastage.

2 Individual tiles can be replaced if worn or damaged.

3 Carpet tiles can be moved easily and reused.

Carpet construction

1 **Tufted carpet:** Tufting involves stitching face yarns into a backing material with multi needled machines. The fibres are secured to the pre woven backing with a heavy latex coating. A secondary backing may be added for greater dimensional stability.

2 **Woven carpet:** Woven carpet is longer wearing and more stable than tufted carpet. but it is lower and more expansive to produce. There is no separate backing since the backing yarns are interwoven with the face yarns.

3 **Fusion bonded:** Fusion bonding is a method where in face yarns are heat fuse to a vinyl backing that is supported by other materials.

Carpet cushion

1 **Fiber cushions:** They are made up of natural fiber, synthetic fiber or combination of both. Antimicrobial treatments are recommended for natural fiber pads because they are susceptible to moisture.

2 **Sponge rubber.** They are generally open cell foams and highly compressible.

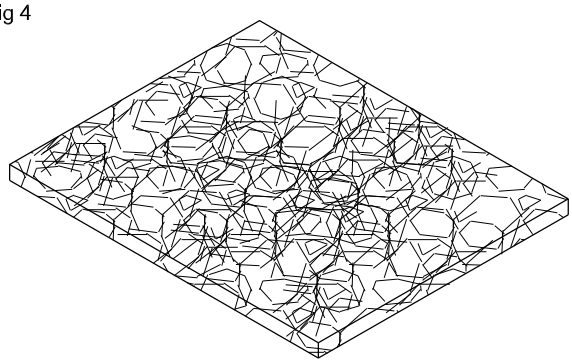
3 **Polyurethane foam:** Bonded polyurethane foam is manufactured from scraps of foam bonded together through and adhesive and heat fusion process. Densified foam is denser and highly resistant to bottoming out. (Fig 4)

Rugs (Fig 5) : Oriental rugs are produced in a broad geographic region encompassing the near east, Asia, india, and parts of Eastern Europe. Two types of techniques can be used to develop the carpet pattern: Handknotting and flat weaving.

1 Handknotted rugs with face pile are greatly priced for their artistry, patterns and color.

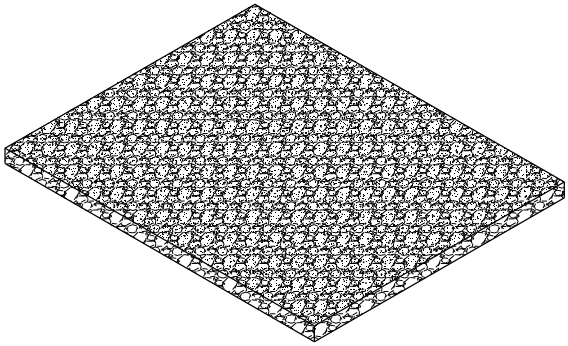
2 Flatwoven, pileless rugs are easier to produce than knotted rugs and are less costly.

Fig 4

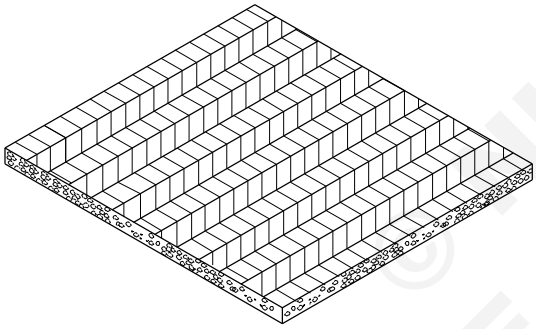


HIGH-DENSITY JUTE

FIBER CARPET CUSION



BONDED POLIURETHANE FOAM



SPONGE RUBBER CARPET CUSHION

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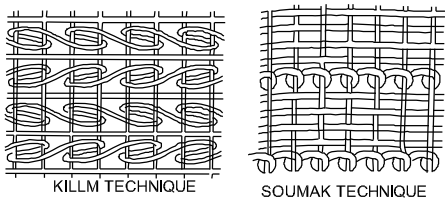
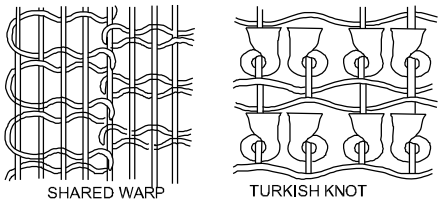
Fig 5



KILLM TECHNIQUE

SOUMAK TECHNIQUE

FLATWEAVE TECHNIQUES



SHARED WARP

TURKISH KNOT

FLATWEAVE COLOUR CHANGE

RUGS

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Carpentry joints - 1

Objectives: At the end of this lesson you shall be able to
- **define the term carpentry and joinery**
- **state the different technical terms in carpentry**
- **state the principle of joints**
- **enumerate classification of joints**
- **explain the types of lenthening joint.**

Introduction: Now a days wood is a valuable building material, which is not easily available everywhere, so one has to learn with more care about carpentry joints and fasteners and fixtures. By the study of these a trainee can select a right joint for a right position and to make that joint in the right way.

Definition: The timber which is to be used for the structural purpose (such as doors, windows, frames, trusses etc) is to be dressed plained framed and placed in position. Thus a carpenter constructs permanent timber work such as roofs, floors etc. as well as temporary timber work such as scaffolding, shoring , centering etc.

The term joinery is used to indicate the art of preparing internal fittings and finishing of timber. Thus a joint construct timber works such as door, windows, stairs floorboard, furniture, cup-boards etc. Thus the joinery is used for delicate construction required precise workmanship for enhancing the architectural beauty of timber. In India the workman who is employed for the work of carpentary and joinery is known as carpenter.

Principles covering the construction of joint

The joints play the most important role in timber construction because they improve aesthetic appearance, provide structural stability and facilitate the construction. However they form the weakest part of a timber structure. Hence the following general principle baed on the recommendations of Proff: Rankine, should be observed in the construction of timber joints.

The Joint should be cut and placed in such a way that it weaken the connection member to the minimum.

Each abutting surface of a joint should be as far as possible, normal to the line of pressure coming upon the joints.

Each abutting surface of a joint should be designed for the maximum compressive stress likely to come upon it.

The surface of a joint should be formed and fitted accurately so that there is even distribution of pressure.

The fastenings, used to connect members may be so proportional that they possess equal strength in relation to the member which they connect.

The fastening should be placed and designed so as to avoid failure of a joint by shear or crushing.

The joint should be simple as far as possible.

Classification of Joints : Joints are classified into the following six categories.

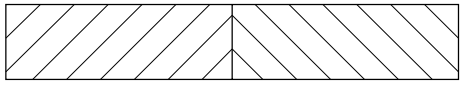
- Lengthening joints.
- Widening joints
- Angle joints
- Oblique - shouldered joint
- Bearing joint
- Framed joint.

Widening Joint

These joints are also called side joints or boarding joints and are used for extending the width of boards or planks. The members are placed edge to edge. These are used for wooden doors, floors, tables etc.

a Butt joints (Fig 1) : These are also known as square plain or ordinary joints are it is used for ordinary purposes.

Fig 1



BUTT JOINT

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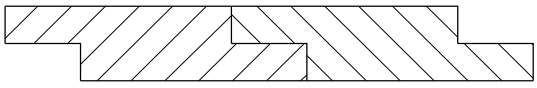
b Rebated joints (Fig 2) : It is formed by overlapping cut portions. The joint remains dust proof after the shrinkage of timber.

Fig 2



REBATED JOINT

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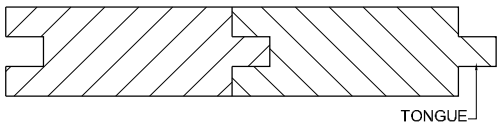
Tongued and grooved joint (Fig 3) : It is formed by making fillet in one piece and groove in the other.

Dowelled Joint (Fig 4) : It is formed by making grooves in the centre portion at the end of each piece and inserting dowels of gun metal brass, bronze or copper. This joints is very strong.

Fig 3



TONGUED AND GROOVED JOINT

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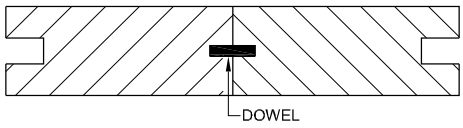
Fig 4



DOWELLED JOINT

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Carpentry joints - II

Objectives: At the end of this lesson you shall be able to
- **explain the bearing joints**
- **explain the angled joint (cornoer joints)**
- **explain different types of fastenings and their uses.**

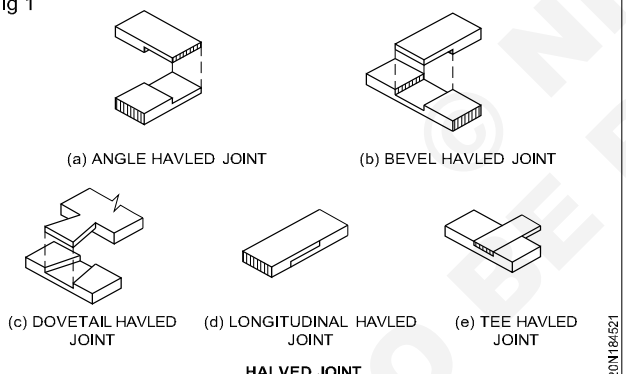
Bearing joint

Bearing joints are provided when two members meet at right angles to each other.

Bearing joints are of the following types

1 **Halved Joint (Fig 1):** These joints are formed by cutting through half the depth of each member meeting at right angle, so that top surfaces of both the members flush. Various forms of halved joints are angle halved joint, longitudinal halved joint, tee-halved joint, bevelled halved joint and dovetail halved joint.

Fig 1



HALVED JOINT

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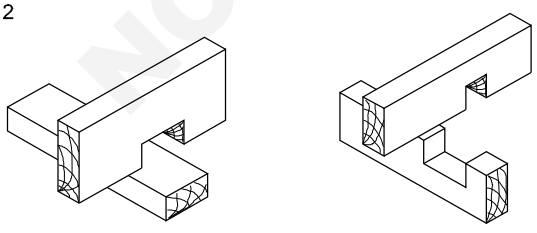
2 **Notched Joint (Fig 2):** This joint is formed by cutting notch in one or both pieces. The former is known as single notched joint while the latter is known as double notched joint.

Fig 2



NOTCHED JOINT

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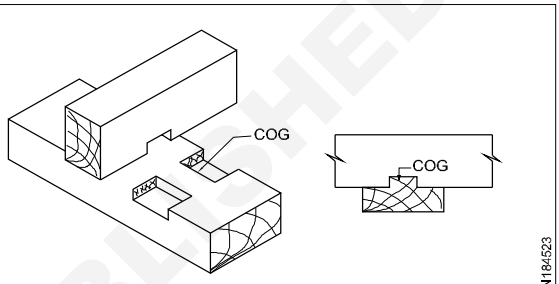
3 **Cogged joint (Fig 3):** This joint is formed by cutting small notch in the upper timber member and providing notches on the lower member with a projection in the centre. The projection is known as cog. The upper piece in which small notch has been formed, accommodates this cog.

Fig 3



COGGED JOINT

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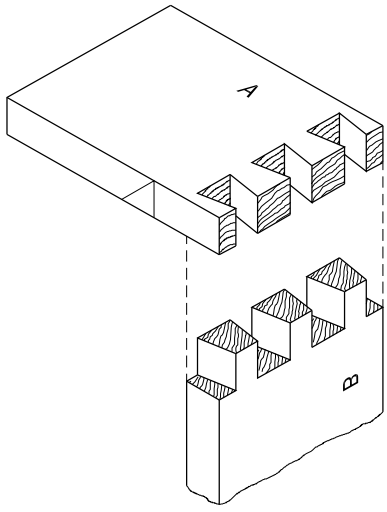
4 **Dove-tailed joint (Fig 4):** This joint is formed by cutting wedge shaped pieces from each member and by hooking the projection of one member into other. This joint is used for curves of sky-lights and corners of boxes, cabinets, drawers etc.

Fig 4



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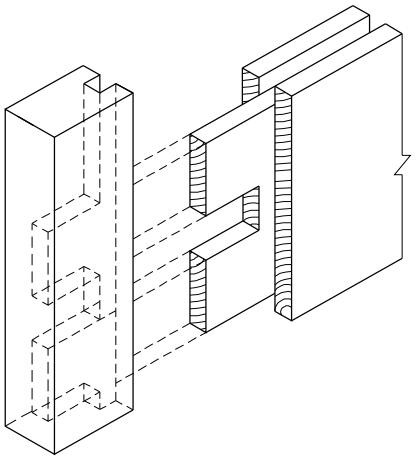
5 **Double mortise and tenon joint (Fig 5):** This joint is formed by cutting projection known as tongue or tenon in one member which fits into a slot called mortise, cut into the other member.

6 **Mitre half lap joint :** The mitre- half lap joint is used to hide end grains of woods in picture frames, mouldings rafter and drip caps etc.

There are some heavy duty half lap joints which will resist pulling stresses in one direction. Straight bevel

half laps are used for lengthening wall plates, joints and rafters. (Fig 6)

Fig 5



DOUBLE MORTISE AND TENON JOINT

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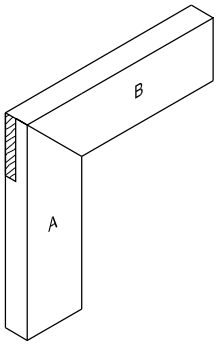
Fig 6



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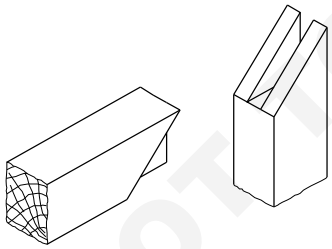
7 Mitre corner bridle joint (Fig 7) : One or both sides of the socket may be mitred as required. It is used where a stronger joint than the mitred halving joint is required on either plain or moulded timber as on mirror frames etc.

Fig 7



MITRED BRIDLE JOINT

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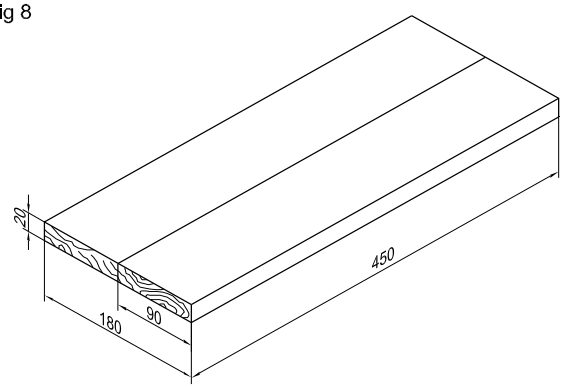
8 Broadening joints : These joints are used to produce wide boards from a number of narrow boards by joining them edge to edge.

Butt joints : In the simplest form of butt joint the edges are shot square butted together and held in place by means of glue or corrugated box fasteners. (Fig 8)

It is used in table tops and cores for veneers (core board).

Cheap constructional work, such as packing cases, corrugated fasteners are often used to hold the pieces together and seldom used in cabinet work.

Fig 8



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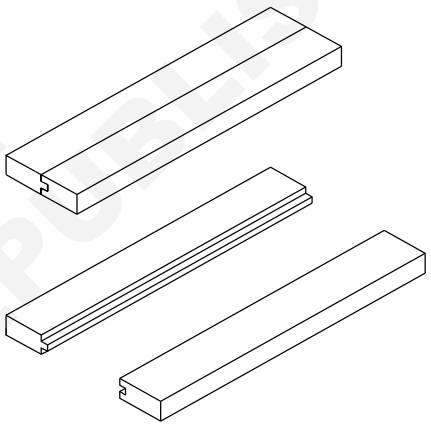
9 Tongued and grooved joint (Fig 9): A common form of widening joint used in flooring boards and better types of packing cases etc., When worked by hand a pair of planes called matching planes are used one plane producing a tongue and the other a groove into which the tongue fits. It this joint is used for desk tops, etc., glue is necessary to make the joint permanent.

Fig 9



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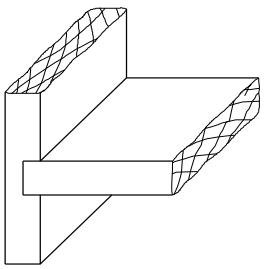
Housing joints : The housing joint consists of sinking the one end or edge of one member into a groove or trench in the face of another member. It is mainly used in fixing shelves or divisions in book-cases, cabinets, treads of step ladders, treads of stairs etc.,

Types of housing joints

Full housing joints (Fig 10) : The whole end or edge is fitted into an enough trench and the joint is visible on both sides of edges.

Fig 10



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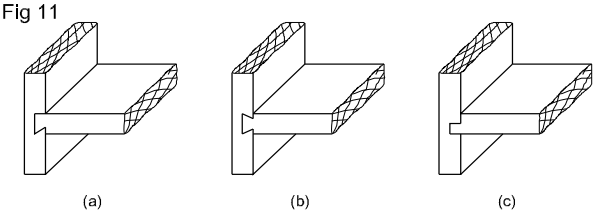
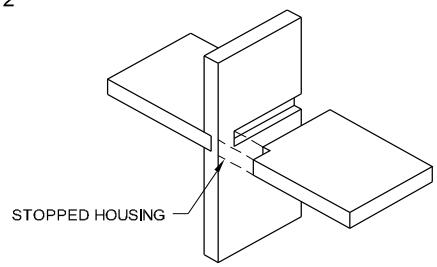
Dovetailed housing joint (Fig 11) : Wherever a stronger joint is required it is used. The end of the shelf is dovetailed on one or both sides and fitted into dovetailed trench. The depth of the trench is about 1/3rd thickness of the plank.

Fig 11



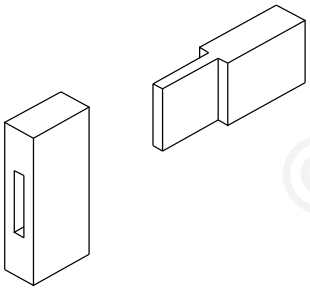
Stopped housing joint (Fig 12) : For improved appearance, this is used in preference to through housing. The end of the trench is stopped back from the front edge. The end of the shelf notched to suit so that in the assembled joint the trench is not seen.

Fig 12



Common mortise and tennon joint (Fig 13): They are used in the same thickness and where a rail muts stile some distance from the end

Fig 13



3 **Plain Mitred Joint (Fig 14):** The joint is formed by cutting the edge of both the members by an angle.

4 **Mitred and feathered joint (Fig 15):** In this an additional wooden member called feather is inserted in the middle of the mitred joint.

Fig 14

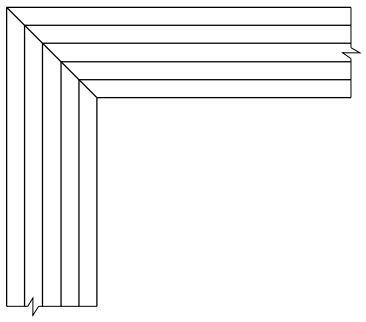
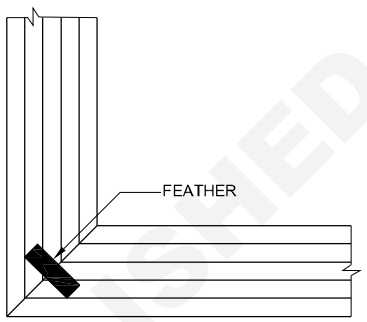
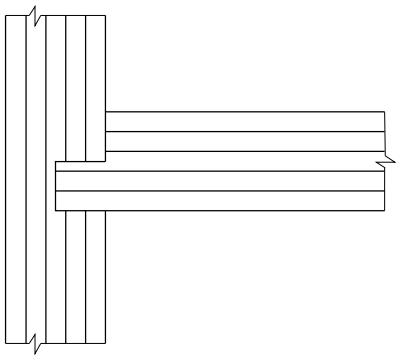


Fig 15



5 **Shouldered and house joint (Fig 16):** In this joint only a part of one member is fit into the corresponding depression of the other.

Fig 16



Joints used in furniture

Objective: At the end of this lesson you shall be able to
- **state the uses of joint for a small table.**

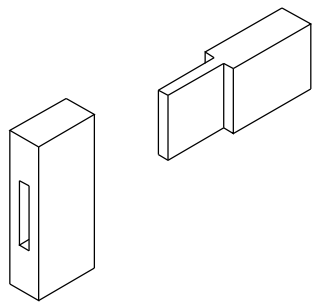
Common mortise and tenon joint (Fig 1): They are used in same thickness and where a rail meets some distance from the end. The tenon is the full width of the rail and passes through the stile. It is used to bottom cross rail (foot rest).

Stub mortise and tenon or (stump) (Fig 2): When the tenon does not pass right through the material it is know as stump or stub tenon. It is used in both ends of the bottom rail and both side of the leg and front bottom drawer rail so that the end grain is not seen on the edge of the stile.

Haunched mortise and tenon joint (Fig 3): It is used where the rail meets the leg at the end of the top on both side.To prevent the tenon from slipping out of the end of the mortise, the tenon is cut narrower and the mortise reduced to suit.

Single dovetail joint on the top end of the front legs (Fig 4): This joint is very strong used for narrow pieces of such as brackets top. These are the strongest form of an angle joint used in leg at the end of the top front drawer rail.

Fig 1



THROUGH MORTISE AND TENON

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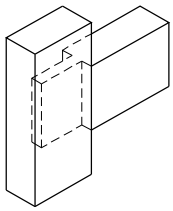
Fig 2



STUB MORTISE AND TENON

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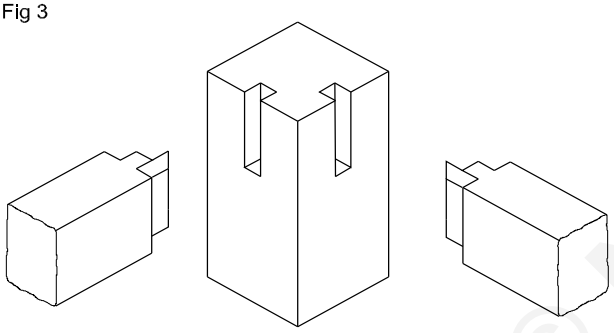
Fig 3



HAUNCHED AND MITRED MORTISE AND TENON

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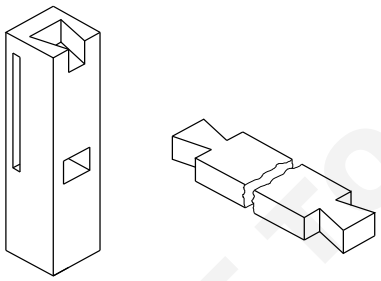
Fig 4



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Full housing joint

Fig 5

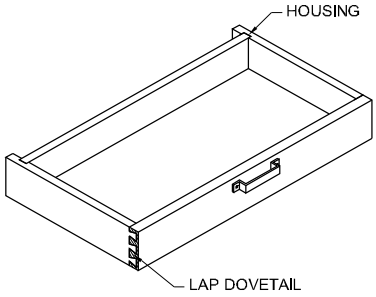

TABLE DRAWER

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The whole end or edge is fitted into an enough trench and joint is visible on both sides of table drawer back stile edges it is joint used in drawer back stile is not seen on the edge of the stile.

Lap dovetail joint (Fig 5)

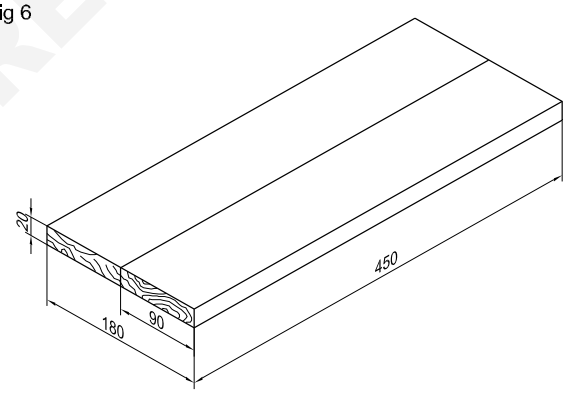
The lap is left on outside of the pins to cover the end grain of the dovetails. The lap is left on both pieces to cover the end grain of the pins as well as the end grain of the dovetails it is joint used in drawer front stile.

Butt joints : In the simplest from of butt joint the edges are shot square butted together and held in place by means of glue or corrugated box fasteners (Fig 6).

It is used in table tops and cores for veneers (core board).

Cheap constructional work, such as packing cases, corrugated fasteners are often used to hold the pieces together and seldom used in cabinet work.

Fig 6



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Joints used in doors/windows

Objective: At the end of this lesson you shall be able to
- **state the uses of joint for doors and windows.**

Mortise and tenon joint (Fig 1)

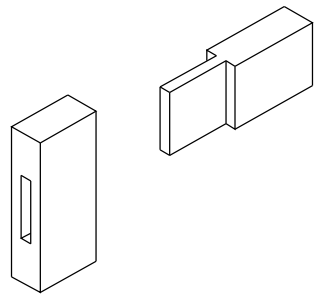
- Mortise and tenon joint used in framed doors, frames for cabinets.
- **Stup mortise and tenon joint (Fig 2)**
- Stub mortise tenon joint used in framed lock rail for doors.

Double mortise and tenon joint (Fig 3)

This joint mostly used for doors and windows bottom rail and table top rail.

- **Tusk tenon and mortise joint (Fig 4)**
- Tusk tenon and mortise joint used in framed by wooden floors.
- **Henched mortise and tenon joint (Fig 5)**
- Henched mortise and tenon joint used in framed by top rail for doors.

Fig 1



THROUGH MORTISE AND TENON

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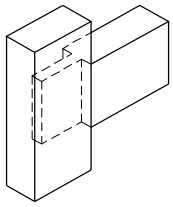
Fig 2



STUB MORTISE AND TENON

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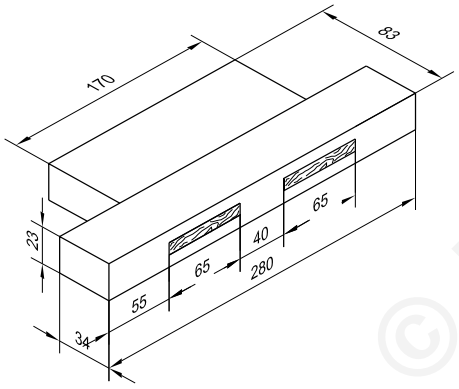
Fig 3



DOUBLE MORTISE AND TENON JOINT

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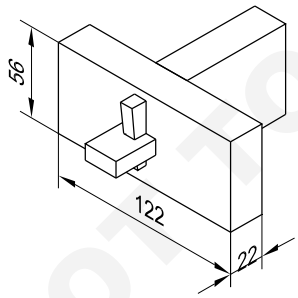
Fig 4



TUSK TENON AND MORTISE JOINT

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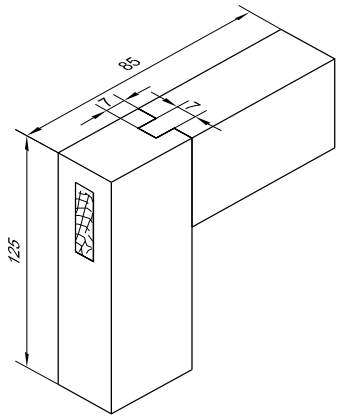
Fig 5



ASSEMBLED VIEW OF HENCHED MORTISE AND TENON JOINT

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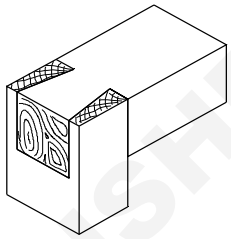
Fig 6



SINGLE DOVETAIL JOINT

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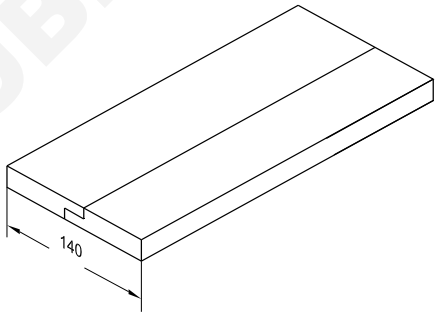
Fig 7



REBATE BUTT JOINT

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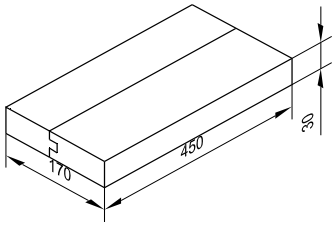
Fig 8



TOUNGE AND GROOVE JOINT

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Fig 9

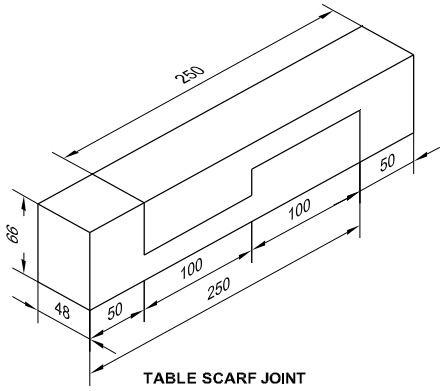

TABLE SCARF JOINT

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Dove tail joint (Fig 6)

- Dove tail joint used in framed by door frame.
- **Rebated, tongue and groove joint (Fig 7&8)**
- Rebated, tongue and groove joint used in framed by ledged doors.
- **Table scarf joint (Fig 9).**
- Table scraf joint used in framed by rails.

Paints and Polishing/Varnishing

Objectives: At the end of this lesson you shall be able to
- **define paint**
- **explain different type of varnishing**
- **state the preparation of polish and applying**
- **explain different type of paints and painting techniques.**

Paint : Paint is any pigmented liquid liquefiable or solid mastic composition that after application to a substrate in a thin layer converts to a solid film. It is most commonly used to protect colour or provide texture to objects. Paint is typically stored sold and applied as a liquid. Paint can be made or purchased in many colours and in different types, such as water colour or synthetic. Most paints are either oil based or water based and each has distinct characteristics. There are four main components in paint they are resin, additives, solvent and pigment. The resin is the binder that holds all the pigments together. It allows the product to adhere to the surface. The excellent quality paint mix is consists of pigment - 20%, solvent - 15%, Bider - 40%, extender - 20%, additive - 5%. The excellent quality paint is believed to be not porous that means water doesn't absorb in to the paint.

Types of paints: There are different types of paints available in the market as per our requirement. They are as follows.

1 **Synthetic Enamel:** It is a solvent based paint which gives a long lasting glossy finish. It is recommended for interior usage on wood, metal and cement plaster surfaces. Synthetic enamel paints can be used all primers. The product dries at temperature by oxidation and polymerization. Neo synthetic enamel are used on various substrates like wood, metal furniture, train coaches automobile industries. This paint film exhibits high gloss toughness and durability for various application. Synthetic enamel can be thinned with white spirit but synthetic thinners are available synthetic enamel dry more quickly and are relatively easy to apply by spray because of this. The synthetic enamel paint can be mixed with reducer in the ratio of 2:1. The reducer and the paint must be from same manufacturer.

2 **Acrylic Emulsion:** Acrylic emulsion paint is a water soluble fast drying paint made up of pigment suspended in acrylic polymer emulsion. These paints are water soluble but have water resistant property when they dry. The acrylic emulsion paint has the attractive smell. They don't dry or crack in sunlight emulsion paint won't peel off when wet. It is washable and colour won't be fading in time being. Acrylic paint is not water proof either it also needs to be sealed to prevent moisture from seeping. The added benefit of using additives and sealents is that they prevent the colour from fading and increase the surface durability.

3 **Distemper:** Distemper is a decorative paint and a historical medium for painting pictures and contrasted with tempera. The binder may be glues of vegetable or animal origin (excluding egg). Soft distemper is not abrasion resistant and may include binders such as chalk, ground pigments and animal glue. The distemper is popular interior paint for homes. It is used for painting wells and other types of house decoration. Distemper is used to paint walls easier and quicker. They can be directly applied to cemented wall without the need of primer. It is much cheaper than other types of paints. Distemper paint colour will fade faster than emulsion paint.

4 **Epoxy:** Epoxy coatings are used over concrete floor in a variety of commercial and industrial applications such as in manufacturing plants, commercial and retail stores industrial plants, ware house, hospital, showrooms, garage, airoplane, hangers etc., Epoxy paint forms solid layer on the pool surface that is resistant to water chemicals. It is very effective and it can last for up to 10 years. If applied properly prepared surfaces. Ensure that the pool is completely dry before applying paint to it. The primer provides foundation for epoxy paint. The primer forms a base that the layer of paint will adhere to it. The industry epoxy application last between 5 to 10 years. The epoxy paints shield against chemicals, oils and wear.

5 **Nitro cellulose:** The nitro cellulose paint is one of the longest lived modern pigments. It promoted the mass production of the automotive industry. Now a days it is also used in the manufacture of toys and numerous products in the market. This paint continue to remain one of the most effective fast drying organic finished available allowing minimal waste and the dust collection while drying. The nitro cellulose paint used for fine carpentry and joinery work. It is the best option to carry out finishes in wood or wood surfaces of interior furniture. Nitro cellulose lacquer is made by mixing fast drying solvents with wood and cotton pulp containing cellulose that has been broken down by nitric and sulphuric acid. It give evaporative finish. Each new coat of lacquer blends in to all the previous coat making it easy to repair.

6 **Metallic paint:** Metallic paint is also called metal flake or polychromatic is a type of paint that is most common. On new automobiles. Metallic paint can reveal the contours of body work more than non metallic or solid paint. Metallic paint added with small aluminium particles or other metals in order to produce a shiny effect and depth to the surface. Especially emphasized in body work contours. Metallic paint holds up better than a standard finish. It resists bleaching or fading better and

maintains a nice glass longer than a standard finish. Metallic paint is water based now hazardous and suitable for both. Interior and exterior use. Metallic paint is durable, long lasting and perfect for both commercial and domestic applications.

7 **Texture paint:** Texture paint of heavy consistency and coarse grain consisting usually of gypsum and sand with water thinned binder and used for creating a rough patterned effect on a wall. To achieve unique and interesting design wall texture paint can be used to hide imperfections in a room. The texture helps to cover those tricky cracks or dents that regular paint often can not tackle. There are different types of textured paints can be used on your wall. Here are some example to help get those creative ideas flowing.

Sand textured paint: This paint contain sand like additives and comes in to two forms pre-mixed and self post mix. Pre-mixed already was additives post mix allows you to mix it manually.

Knock down textured paint: These are knocked down with putty knife before it dries. The texture is tough and durable.

Popcorn textured paint: This paint is hiding imperfections on dry walls. The paper based Styrofoam additives gives it a rough fluffy look that resembles popcorn.

8 **Lime wash paint:** Lime wash is a finish that gets its textural veneer from added sand stone aggregate. This finish has an almost chalky look to it and when in a can. It appears like putty than thin paint, though the walls treated in it are soft to the touch. Lime wash is made from limestone that's been crushed, burned and mixed with water to make a lime putty. Lime wash requiring renewal coating every five to seven years the lime wash dry very quickly. It is natural and mineral based and non-toxic.

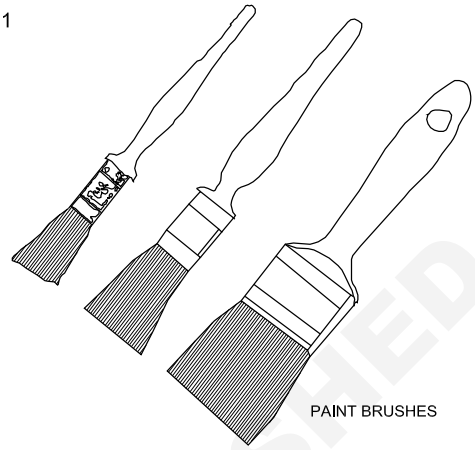
9 **Exterior paint:** Exterior house paint is made for painting the shingles or siding of your home not the walls of your living room. The best exterior paint for your project can improve your homes appearance and also protecting it from moisture, fading and temperature changes. Different types of exterior paints are available for every part of home's exterior including siding. Fences, doors, gutters and more. Exterior paint is made to survive inclement weather. It is resisting mold, mildew, fading, cracking, chipping and more. Where as interior paints are made to resist stains. Interior paints made with chemicals that are safer for breathing. Exterior paints protect from ultra-violet radiation caused by sunlight and also from fungal growth. The ideal weather suitable for exterior painting is early summer and early fall with minimal rain and minimal fluctuation in temperature from day to night. This will ensure the paint goes on smoothly and has the chance to dry and cure properly.

Painting techniques: The fundamental painting techniques and styles is going to drastically help when you are starting out on your artistic journey using paint. In essence this means logging some knowledge of colour tone, brush work, texture and composition to make you to create your own master pieces with confidence.

Work especially when using slow drying paints. It's impossible to work on top of heavy, wet paint. In the same way work up to highlights, adding the brightest (and usually heavier) paint at the end. The different type of painting techniques are followed some of the familiar painting techniques are given below

By brush: The main brush techniques are (Fig 1)

Fig 1



PAINTING TOOLS

- Use your little finger as a guide for straight confident lines.
- Let the brush rest lightly on your finger then drag it towards you without any downward pressure.
- Move the brush quickly and lightly in all directions.
- A piece of old towel is handy for keeping your hake dry.

The round brushed are to be used for small strokes and filling in smaller areas. Flat brushes are good at spreading paint evenly and quickly over a canvas or panel. Brushes are labeled with names lime flat or round or bright or shader or fan or angle. Usually the smaller the number smaller the brush larger the number longer the brush. There are different type of painting technique used with round brush and flat brush.

- Dry brush
- Round brush technique
- Angle brush technique
- Flat brush technique
- Cross-hatching
- Double and triple loading
- Blending
- Stippling
- Using a fan brush
- Splatter painting

1 Dry brushing is a technique used by artist to make the paint look featherly or dry. Any brush can be used for this technique. Dry brush strokes are light and need no water on the brush. Medium rounded brushes are used for free "style looking strokes". Generally the round brushes are used in more depth strokes. An angle brush is a handy brush to grab. If you want to painting trees or want to achieve a nice zig-zag. Stroke or when painting large object, this angle brush will be suitable.

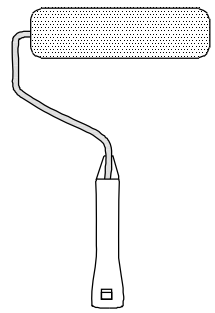
When you use an angle brush try experimenting with the pressure of your holding it. When press hard and light, turning your hand at different angles. The line will get thicker and then thinner when you turn your hand. The highest corner point in the angle used to paint fine lines. You can also use an angle brush for double loading. Double loading of brush is adding two different colours to the brush without mixing them. You can use flat brush or angle brush for double load. Bright brushes have slightly shorter bristles and provides better control.

Cross hatching means that strokes are over lapping going in two different directions. Many combinations can be done with cross hatching. Using the stipplings technique is more effective in other mediums like oil pastel.

A fan brush can be used to create a lot different techniques. The best fan brush technique is painting pine trees. A fan brush can be used for creating grass effects and other interesting ground and natural textures.

2 **By roller (Fig 2):** The painting technique of using roller provides thin uniform and even coats and is an ideal tool for painting large, smooth and well prepared walls, ceilings and large furniture. The roller is more economical to use than the brush. It porous surface holds much more paint and distributes an even layer of paint much faster. The common problem in roller painting technique is fat edges and roller marks. To avoid the above problem while using roller do not submerge the roller in the paint. Try to dip only the nap, then spin it against the screen.

Fig 2



PAINT ROLLER
PAINTING TOOLS

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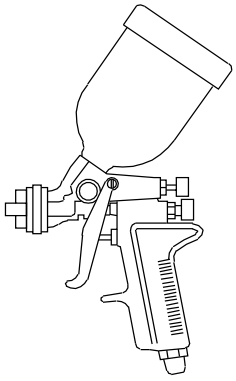
Do not press too hard, when you are smoothing out the paint.

Never start against the edge always start 6 inches from the edge. Unload the excess paint from the open end of the roller before you roll back over the wall to smooth it out. Do this by tilting the roller and applying a little extra pressure to the open side of the roller while rolling it up and down in the area painted.

3 **By spray gun (Fig 3):** The pneumatic sprayer are the best paint sprayer. It is very simple to use. They are cheaper than air less sprayer. While spraying base coat clear coat system the pressure to be maintained between 26-29 PSI.

The paint sprayer is around four times faster than a roller. A paint sprayer is convenient for applying paint is less time, than with brush or roller. Painting with sprayer makes the work easy on big or small jobs. Spraying uses more paint because the sprayer automizes the paint in to tiny droplets. Most of the droplets end up on the surface. But many others drift away. How to thin paint for a spray gun (5 step guide)

Fig 3



GRAVITY FEED GUN WITH CUP ON TOP

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1 Mix the paint with 10% of it volume in water.
2 Pour it through the funnel.
3 Increase the ratio needed.
4 Test it on the test board.
5 Spray paint your wall.

Common painting defects and remedies

Some common painting defects and remedies are discussed below:

a Cracking or chipping - It may be due to excessive use of putty or thick coat of paint or defective surface. As a remedy, use the paint and putty in the required quantities.

b Efflorescence - It may be due to the presence of salts in the building materials like bricks and cement mortar. As a remedy, give a time gap of 6 months including one monsoon between plastering and painting of the surface. Try to use porous paints only.

c Blistering - It may be due to the trapping of air, moisture or solvents between the paint film and the surface. As a remedy, allow the surface to be totally dry before painting and avoid painting under sunlight.

d Flaking- It may be due to improper application of primer coat over putty or shrinkage or expansion of the surface. As a remedy, do not leave gaps in covering putty with primer coat and also see that the surface is clean and dry.

e Patchy finish - It may be due to high paint absorbent nature of the surface. As a remedy, apply an extra coat of primer.

f Poor drying - It may be due to the humidity, poor air circulation, low-temperature or alkalinity of the surface. As a remedy, try to reduce the impact of weather conditions as far as possible by cleaning the surface with white spirit, then wash with soap and water.

g Poor shine - It may be due to the poor surface preparation or presence of oil or thinning of paint. As a remedy, clean the surface thoroughly before painting as per the instructions of the manufacturer.

h Discolouration - It may be due to the exposure to sunlight or chemicals. As a remedy, use light-fast colours with chemical resistant finish or suitable primer.

Introduction of Polishing: It is the process of creating a smooth and shiny surface by rubbing it or by applying a chemical treatment leaving a clean surface with a significant specular reflection. In some materials (Such as metals, glasses, black or transparent stones). Polishing is also able to reduce diffuse reflection to minimal values furniture polishes are pastes, creams Lotions used to clean protect and shine wooden furniture. These products are originally made from natural waxes which were hand to apply and tended to leave a heavy build up over time. Now these formulations combine, natural waxes and oils with petroleum based ingredients and synthetic polymers. These modern formulations can clean the film residue and lay down new polish in a single step. Do periodic stripping of old layers is not necessary. Wood is valuable to the effects of again which means it can become dried out, cracked or stared.

In the biblical times people have recognized the usefulness of coating on wooden surfaces with oil balms and unguents. In the earlier days linseed or cedar wood oil used to treat wood surfaces. Bees wax some times mixed with hard animal fat used as polish in the eighteenth century. In the nineteenth century waxes were discovered and polishes were developed. Later on synthetic polymer emulsions have be introduced which offer significant improvement over wax system. The most widely used polymers are based on silicone oil which provide lubricity and good glass. These provide easy application over a large surface area.

Preparation of french polish

A polish made from shellac dissolved in methylated spirit. This polish is available in India, under the name of "Sheenlac" polish which is extensively used in and out of India.

- Good quality of this polish is obtainable with the following recipe

Recipe: For one litre of French polish

Shella	- 100 grams
Gum mastic	- 10 grams
Gum sandaraz	- 10grams
Gum Benzoin	- 10 grams
Resin	- 3 grams

The along said mixtures to be mixed with methylated spirit mixture and kept in a air tight jar for about 15 days in the sun light to get a good quality of polish.

Polish intensifies the natural beauty of the texture.

- Polish has the excellent qualities of transparent depth, durability and hardness
- It, dries very quickly. It oil besed it dries slowly.

Method of applying french polish

By cotton pad

By brushes

By apraying gun

Application of french polish on wooden surface

Process of polishing

Preparaion of surface

The surface is smoothened by throughly rubbing/sanding it by sand paper.

Puttying

The process of covering with putty on the gap and nail, screw head in the surface.

Stopping

Stopping is done by means of hot weak glue size so that the pores on the surfaces are filled up with boiled linseed oil.

Staining

Staining is done by means change the colour of the wood coats ofpolish.

Polishing

Applied first coat on the cleaned surface. Dry first coat second coat in circular motion.

Apply finishing coat of polish glong the grain.

Other ingredients

1 **Varnish:** Varnish can be applied to both stained and bore wood. Clean the surface before varnish. Do not varnish on wet surface it wise spoil it.

2 **Oil finish:** The oil based wood polish provide luxurious and satin look and finish. The polish/finish can cover the nicks and scrataves and can be applied easily. The finish may dry up slowly.

3 **Wax finish:** Wax finish available in both paste and liquid forms. The surface finish may protect the wood from moisture and other adverse agents and enhance its life. The wax to be dissolved in oil before application.

4 **Shellac:** Shellac finish can dry easily and in legs time. It also act as stain rammer and sealer. So it can be used on dry walls and on curved plaster. The disadvantage of shellac finish is it cannot resist moisture. So it is not recommended on the out door furnitures.

5 **Lacquer:** The lacquer finish are considered one of the best varites of wood polish. The finish provides better surface protection and also dries up faster. It is easy to remove and apply other polish. Whenever required, lacquer finish dries up quickly. Lacquer finish is sensitive to heat.

6 **Water based finish:** This finish can be used on different kind of wood. Decorative wood items handcrafts and articles can use this finish.

7 **Polyurethane polish:** It is ideal for kitchen cabinets cup boards doors and windows. It has water resistant properly. It is not recommended for outdoor furniture.

Varnish:

Types of varnishes

1 **Sprit varnish:** In this sprit is used as a solvent is known as sprited varnish or French varnish. Shellac is dissolved in sprit and the product is applied in a thin layer. Sprit type of varnish give a translucent finish thus showing the grains of the timber.

Varnish: Varnish provide protective coatings for window surfaces. Paintings and various decorative objects. Varnish protects and enhances the appearance of window floor interior wood paneling and trim, and furniture vanish requires on the outside of your surface forming a protective barrier varnishes provide wood with additional durability. So they are often used on areas that get plenty of wear and tear.

This type of varnish used for polishing wood work not exposed to the weather.

2 **Polyurethane varnish:** These type of varnish give a really hard surface and are often used for floors and areas which are going to get a lot of wear and tear. They are heat resistant. It will give clear and tough finish polyurethane varnish do not tend to peventrete the wood. So they often primed with an pol based varnish or a thin shellac solution. They are resistant and other chemicals. They are not resistant to UV (Sun) light. It is exposed outside it will deteriorate quickly.

3 **Oil varnish:** These type of varnishes are made by dissolving hand resins like aurber or copal in oil. They are slow to dry but are the hardest and most durable of all varnishes.

They are suitable for exposed surfaces requiring polishing or frequent cleaning and for superior works.

Turpentine: It should be stored in cool and dry place with tightly sealed containers.

Turpentine can under go auto oxidation in contact with air turpentine is one of the basic raw materials for chemicals for wide range of industries such container o turpentine to be protected from physical damage.

Melamine: Melamine polish is a closed pore polish. It makes the wood now breathable product that protects wood from mainly not and cold surfaces places over it. It offer more glossy appearance then matt finish on created wood panel or surface melamine polish has minimal water resistance. When it is exposed to sum light melamine polish deteriorates. Turning yellow and loosening. It can even clip off at the furniture edges over time melamine is an organic compound made from calcium cyanide combined with formaldehyde to form resin, It is durable non-porous, that resistant plastic. It provides good stain resistance and washability for all surfaces.

Water - based paints

Paint	Surface	Drying	Preparation	Comments
Colourwash	Walls/Ceilings	2-3 days	Seal bare surfaces	Semi-transparent, slow-drying finish. Mainly used for paint effects such as colour washing and dragging. Buy ready-mixed or as base to dilute with emulsion and water. Varnish areas that require regular wiping.
Eggshell (acrylic)	Walls/ceilings /wood	2 - 4 hrs	Seal and prime bare surfaces; may require undercoat	Washable, fairly hardwearing, low-sheen cover. Ideal for kitchens and bathrooms. Thin with water to use as glaze.
Floor (acrylic)	Concrete/wood	1- 4 hrs	Seal, prime bare surfaces with diluted floor paint	Washable, hardwearing, dirt-resistant finish.
Gloss/satin semi gloss	Wood	4-8 hrs	Seal and prime bare surfaces and apply undercoat-unless self-undercoating	Washable, dirt-resistant. Very hardwearing, shiny finish. Unsuitable for heated surfaces. Shows up surface irregularities so thorough preparation is necessary.
Kitchen & bathroom	Walls/Ceilings	1- 5 hrs	Seal bare surface	Washable, moisture, mould, dirt and grease resistant finish. Show up surface irregularities so thorough preparation is necessary.
Matt emulsion	Walls/Ceilings /wood	2 - 4 hrs	Seal and prime bare surfaces; undercoat bare wood.	All-purpose, non-shiny finish. Non light-reflective, so helps to conceal surface flaws on plain walls shows scuff marks and likely to develop sheen with washing. Unsuitable for kitchens and bathrooms unless sealed with PVA or varnish. Varnish if used on wood. Non-drip solid emulsion is ideal for ceilings.

Silk/satin latex	Walls/Ceilings /wood	2 - 4 hrs	Seal and prime bare surfaces; undercoat bare wood	Washable, fairly longwearing, mid-sheen finish. Good for textured wall coverings but will highlight irregularities on a plain wall. Varnish if used on wood. Non-drip solid latex is ideal for ceilings.
Textured	Walls/ceilings	4 - 8hrs	Seal bare surfaces	Gives relief effect that can be patterned using special tools. Good for disguising imperfect walls. Difficult to wash or remove.
Woodwash	Wood	30 mins	Apply to bare wood	Use neat for a matt finish or dilute as wash for (prime MDF) opaque stain or distressed effect. Burnish with wire wool to produce sheen. Polish or vanish surfaces that need regular wiping.

Previously painted/ varnished wood	1. Scrape or sand off flaking, cracking or peeling paint/varnish, then tough up bare areas with a little paint/varnish; leave to dry. If paintwork/varnish is in very poor condition or there is a thick build-up, remove it using a chemical stripper or hot air gun. 2. Wash down the surface with a mild solution of sugar soap or detergent; rinse and allow to dry 3. Lightly sand the surface, then dust it off	No primer needed
Bare metal	1. Rub off light rust with wire wool or wet-and -dry abrasive paper dipped in white spirit; remove heavier rust using a wire brush. 2. Wipe over the surface with a cloth dampened in white spirit. 3. Apply primer, working it well into holes and fixings.	General-purpose metal primer for steel, ironwork and most ferrous metals special metal primer for non-ferrous surfaces, such as galvanized metal. Aluminium brass, General-purpose metal primer for steel, ironwork and most ferrous metals special metal primer for non-ferrous surfaces, such as galvanized metal, aluminium, brass, chrome and copper quick-drying metal primer for new galvanized metal such as window frames. Radiator primer on bare radiators prior to painting with radiator enamel Rust-inhibiting primer for outdoor metalwork, such as exterior pipe work, guttering and railings.
Painted metal	1. Sand off flaking, cracking or peeling paint using a wire brush; if the paintwork is in very bad condition, strip it off using a chemical stripper.Wipe the surface with a cloth dampened with white spirit. Sand the surface using wire wool or wet-and-dry abrasive paper dipped in white spirit. Apply primer to any patches of bare metal.	Prime bare areas as for Bare metal.
Concrete	1. Leave new concrete to dry for two months 2. Prepare as for exterior walls (masonry) 3. Leave to dry thoroughly. Remove any white crystalline deposits using a stiff, dry brush. 4. Apply primer/sealer	Concrete floor sealer is available to stablize and seal concrete floors General purpose(multi-surface) primer/sealer may be used on other concrete surfaces.

Solvent - based paints

Paint	Surface	Drying	Preparation	Comments
Eggshell	Walls/ceilings/wood	12-16 hrs	Seal and prime bare surfaces;	Washable, fairly hardwearing, may require undercoat. low-sheen cover. Thin with white spirit to use as glaze.
Flat oil	Walls/ceilings/wood	8-12hrs	Apply undercoat only matt finish. Show scuff marks.	Washable, fairly hardwearing, flat Can substitute with undercoat.
Floor	Wood/tiles/stone /brick/concrete	16 hrs	Seal; prime bare surfaces with diluted floor paint	Washable, hardwearing, dirt - resistant finish. Shows up surface irregularities so thorough preparation is necessary.
Gloss & Semi gloss	Wood / Metal	12-16 hrs	Seal and prime bare surfaces and apply undercoat - unless self undercoating	Washable dirt-resistant, very hardwearing, shiny finish. Shows up surface irregularities so thorough preparation is necessary.
Satin/ satin wood	Wood / Metal (Special paint)	16 hrs	Seal and prime bare surfaces and apply undercoat - unless self-undercoating.	Washable, very hardwearing mid-sheen finish. Shows up surface irregularities so thorough preparation is necessary.

Partition wall

Objectives: At the end of this lesson you shall be able to
- **define properly of a good partition wall**
- **explain types of partition wall.**

Partition wall: Partitions are non-loaded bearing walls that separate spaces in buildings as well as spatial division they can provide privacy acoustic and fire separation and flexibility of layout partition walls can be solid, typically constructed from brick or block work, or can be a framed construction. The partition wall shall with stand heat, dampness and fungus. It required to carry sanitary fittings and heavy fixtures.

A good quality partition wall must satisfy the following requirements.

- The partition walls should provide adequate privacy to the space.
- The partition wall should be thin so that the maximum floor space is utilized.
- It should act as sound barrier.
- It should be light so that self-weight is less on the structure.

Advantages of partition wall

- Divide the whole area into many room.
- Provide privacy to the inmates from sight and sound.
- Partition wall are light in weight and cheaper in cost of construction.
- Occupy less area
- They can be easily constructed in any position.

Types of partition walls for homes and offices

Partition wall are vertical dividers which are used to separate building internal spaces into rooms and circulation areas like corridors. Types of partition walls and their applications are discussed in the following sections.

Types of partition walls

Depending upon the material used partition wall may be divided into the following different types:

1 Brick partitions wall
2 Glass partitions wall
3 Concrete partitions wall
4 Plaster slab partition wall
5 Metal lath partition wall
6 Aluminium partition wall
7 Wood-wool partition wall
8 Timber partitions

Brick partition wall : There are three types of brick partition walls which include plain brick partition wall, reinforced brick partition wall, and brick nogging partition wall.

Plain brick partition wall (Fig 1A)

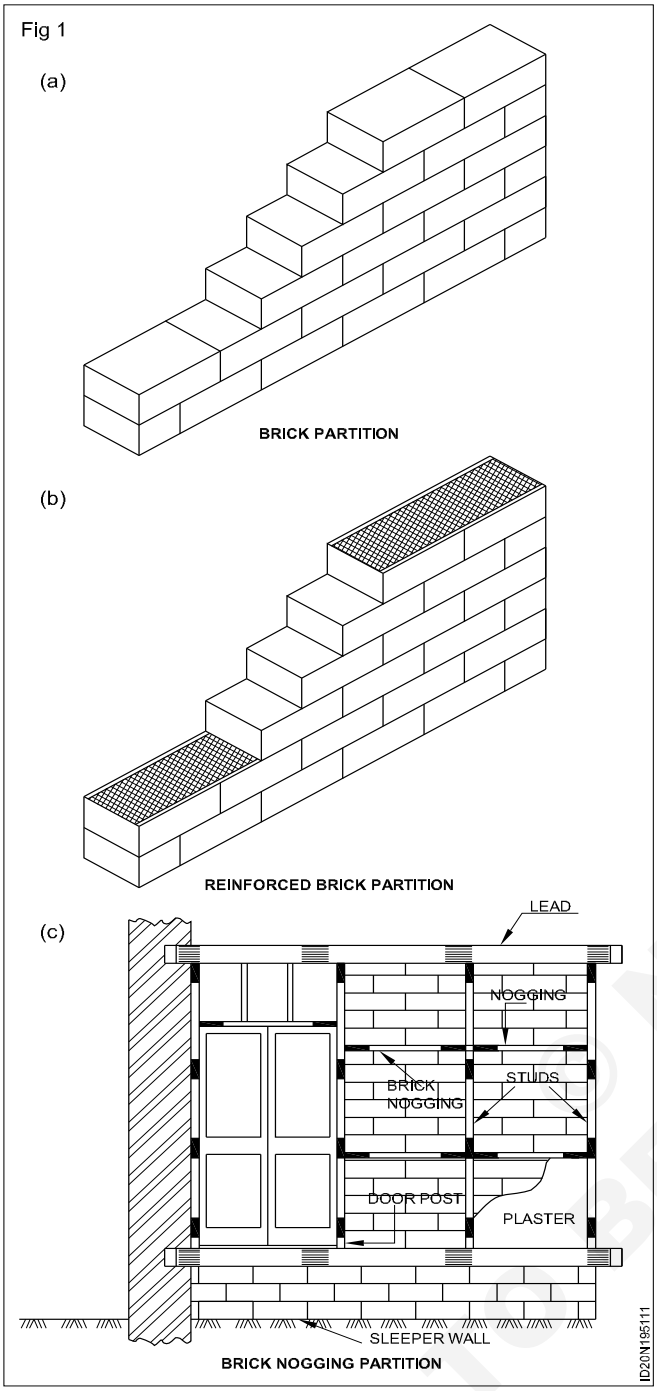
- It is constructed from plain bricks, and it is common and cost effective
- The bricks are laid as stretchers in cement mortar.
- Thickness of plain brick partition wall is 10 cm or half a brick.
- Recommended height is maximum 2m for construction in a day.
- It is plastered on both sides
- Strong and fire resistant if the brick wall is constructed properly.

Reinforced brick partition wall (Fig 1B)

- It is similar to plain brick partition but reinforced brick Is much stronger due to the placement of reinforcements.
- Reinforcements, which is in from of wire mesh strips or iron bare, are placed at every third or fourth course.
- Reinforced wire strip width ranges from 25mm to 28mm and thickness is l.6mm.
- Steel bar diameter is 6 mm
- The thickness of the wall equal to lOcm or half a brick
- This type of partition wall used when better longitudinal bond is need and when the partition wall has to support other super imposed loads.

Brick nogging partition wall (Fig 1C)

- Brick nogging partition wall consists of brick work built within a framework of wooden members.
- The timber framework consists of vertical posts (studs). Horizontal members (nagging), sill, and head as explained in
- Studs spaced at 60 cm to 150 cm and held in position by nagging pieces.
- The nagging pieces are housed into the studs at 60 cm to 90cm apart vertically.
- The wooden framework provide stability to the partition against lateral loads and vibrations caused due to opening the adjoining door and windows
- The bricks are commonly laid flat, but they also may be laid on edge

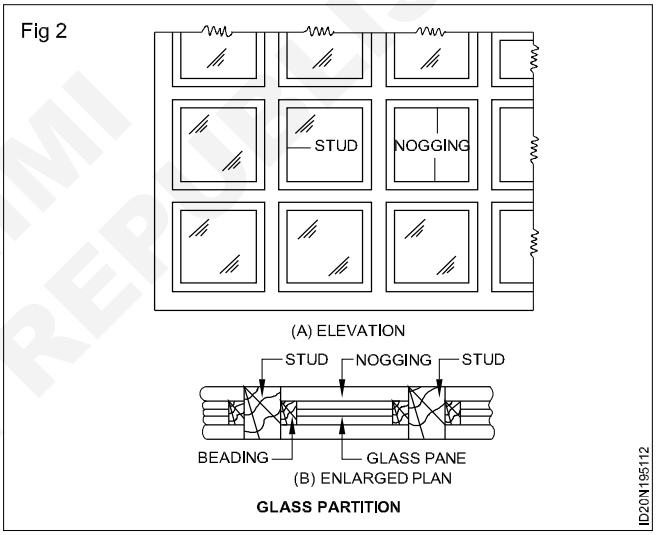


- The brickwork is plastered from both sides.
- Cement mortar prop 1:3 is used
- The size of the studs and nogging
- For l0cm thick partition wall, the studs and nogging should be 15 cm wide so that after the brickwork is plastered from both the faces, the timber framework may finish flush with the wall face.
- The surfaces of the timber frame work coming in contact with brick work are coated with coal tar.
- This type of partition wall suffers from the drawback of the timber getting delayed.
- The mortar used may not stick well to the timber members and thus the brickwork is likely to become loose after sometime.

Glass partition walls : They are cheap, light, and easy in construction and provide reasonable privacy and sound insulation. such walls are constructed from glass sheet or hollow glass blocks which will be discussed below.

Glass sheet partition wall

- It is constructed by fixing sheet of glass in a wooden framework.
- Glass sheets are fixed in timber framework using timber beadings or by putty.
- The wooden framework consists of a number of horizontal and vertical posts, suitably spaced, to divide the entire area into a number of panels.
- The panels might be rectangular or square and their size varies with the choice of individual.
- Glass sheet partition wall is light, vermin proof, damp proof, and sound proof.
- Wired glass, bullet proof glass, and three-ply glass are examples of strong glass sheets which are suitable for glass sheet partition wall construction (Fig 2).

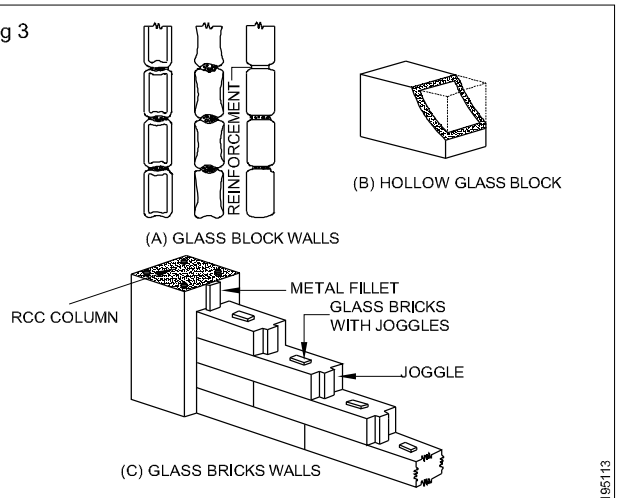


Hollow glass block partition wall

- It is constructed from hollow glass blocks.
- Hollow glass blocks are translucent glass units which are light and manufacture with various thicknesses, shapes, and sizes.
- The size of square usually (14 x 14 cm or 19 x 19 cm), with a normal thickness of 10 cm.
- The hollow blocks are light weight.
- The jointing edges are painted internally and sanded externally to form a key for morter.
- The front and back sides are either decorated or left plain.
- Block glass is laid in cement –lime mortar-fine sand
- All joints shall be filled adequately
- Metal strip reinforcement is placed at every third or fourth course for block height up to 15.

- Reinforcement is placed at every course if the blocks height exceeds 25cm
- There is another type of glass block with joggles and end grooves as well (Fig 3).

Fig 3



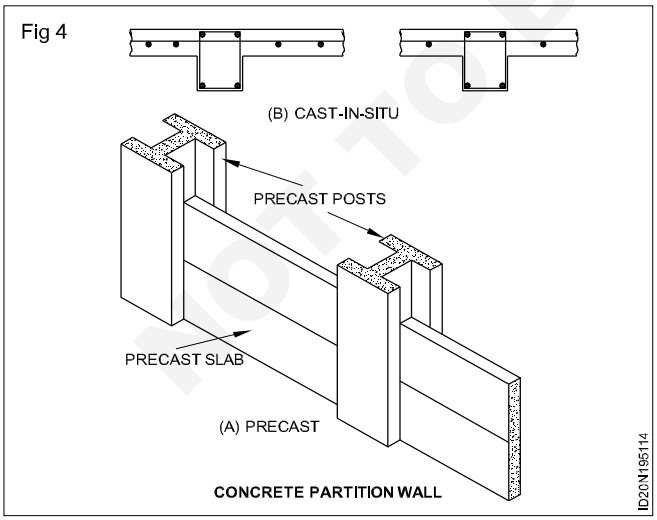
GLASS BLOCK AND GLASS BRICKS WALLS

Concrete partition wall: It consists of concrete slab, plain or reinforced, supported laterally by vertical members. These slabs may be either precast of cast in situ.

Cast in situ concrete partition wall

- Thickness ranges from 80mm to lOOmm
- It is poured monolothically with intermediate columns
- It is rigid and stable both in vertical and horizontal directions but the framework is costly.
- The reinforcement consisting of mild steel bars or B R C fabric is placed in the center of the wall thickness.
- Concrete mix usually adopted in the work is MIS(1:2:4) (Fig 4).

Fig 4



CONCRETE PARTITION WALL

Wall partitions constructed from special precast units

- The wall is constructed from precast T-shaped or L-shaped units
- Light weight, hollow block.
- Cement mortar mix (1:3) issued for joining

Plaster slab partition wall

- Plaster slabs or plaster boards are made from burnt gypsum or plaster of paris, mixed with sawdust or other fibrous material to reduce its weight
- Units of plaster slab prepared in an iron or timber mould with size 1to 2m long, 30cm high and 50 to lOOmm thick.
- They are equipped with suitable grooves to create rigid joints
- Plaster slab surface may be smooth or rough. The former is not plastered but rough surface act as key for plaster (Fig 5).

Fig 5

Metal lath partition wall

- Metal lath partition wall are thin, strong, durable and considerably fire resistant.
- Metal lath partition walls are constructed by placing 2cm or 2.5cm channels vertically (called studs) and fixing metal lath to it on one side.
- Plaster is applied to both the sides of the metal
- If hollow partition is required, metal lath is fixed to the channels on both the sides and then plaster is applied (Fig 6).

Wooden partition wall

Wooden partition consist of wooden framework properly supported on floor and fixed to the side walls.

The wooden frame work is made of horizontal and vertical members covered with board on one side or both the sides of the frame.

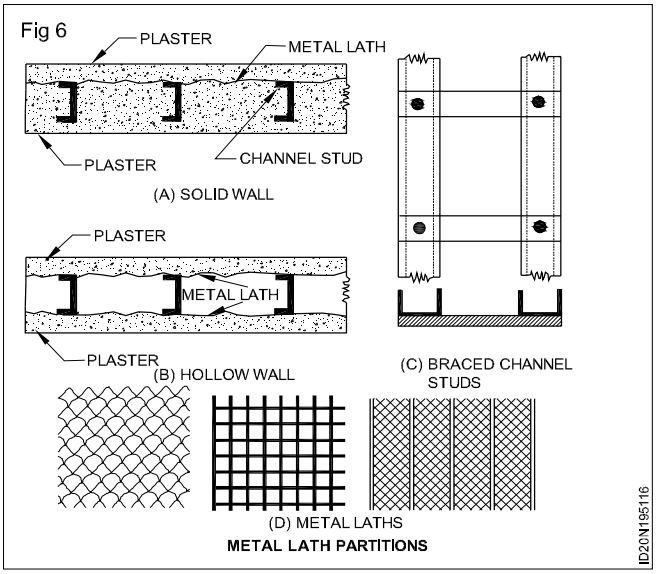
Types of wooden partition

– Common or stud partition

– Trussed or braced partition

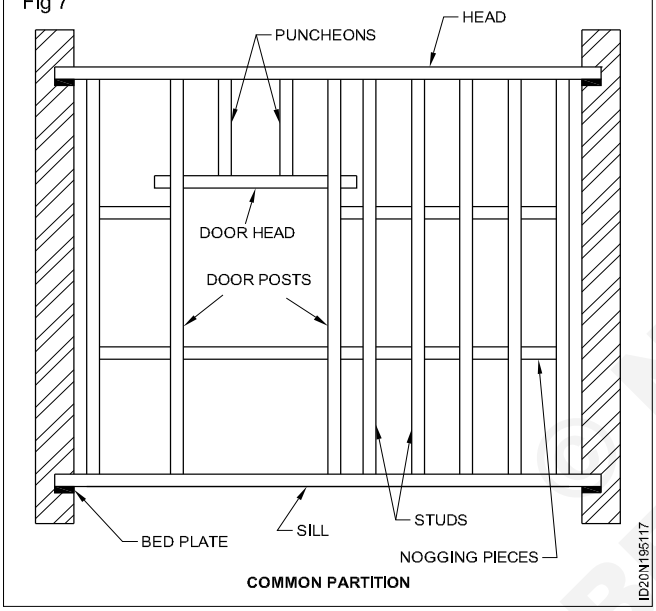
Common or stud partition (Fig 7) : These partitions consist of vertical members called the studs, which are bridged between two horizontal members.

Fig 6



METAL LATH PARTITIONS

Fig 7



COMMON PARTITION

The upper and lower horizontal members are respectively called as the HEAD and SILL. The short horizontal pieces are called NOGGINGS.

The short nogging pieces are used to make the studs more stiff. The nogging pieces are fixed tightly between the studs and nailed or screwed.

A stud of short length as on opening is called PUNCHEON. The studs are generally of section 10cm x 5cm. The head and sill are generally of section 100cm x 7cm.

The partition can be fixed either by providing plywood sheets or by inserting wooden panels.

The spacing of studs depends on the nature of finishing of the partition. Generally the spacing is about 30cm x 50cm.

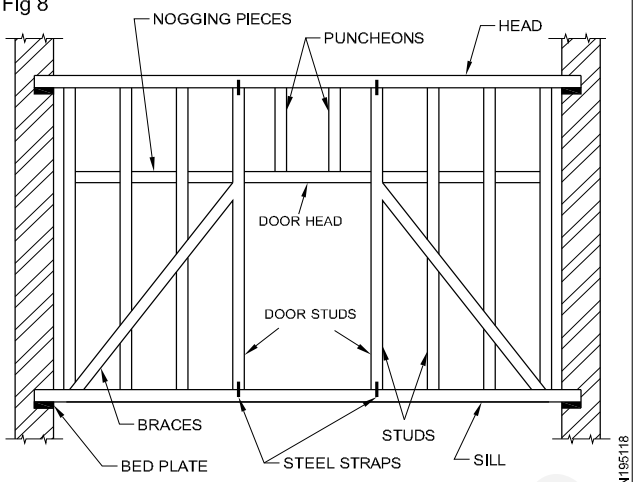
Trussed or braced partition (Fig 8)

These partitions are similar to the stud partition.

Braces (inclined members) steel straps and steel bolts are additionally used in these frame work.

These partitions carry some floor loads in addition to their own weight

Fig 8



TRUSSED PARTITION

An additional horizontal members called “INTER TIE” used between the head and sill to make the frame more rigid and strength.

The ends of the head and sill are made to rest on stone template embedded in the wall.

It is necessary to make the centre line of the various members of the frame work to avoid the development of transverse stresses.

The steel straps and steel bolts can be provided at all the joints.

The finishing of partition can be done as in case of the common partition.

Requirements of partition

The partition wall should be strong enough to carry its own weight.

The partition wall should be strong enough to resist impacts developed due to the uses of the building.

It should have the capacity to support the suitable decorative surfaces.

It should be thin, cheap, light, fire-resistant and easy to construct.

Aluminium partition section

Introduction : Nowadays, aluminium partitions are commonly used in making offices, cabins, showrooms, factories etc and very popular in public and commercial buildings.

Old type fabricated steel frames at windows are getting replaced by aluminium window frames.

Use of aluminium sections substantially decreased use of wood in the above applications.

Aluminium partition sections are decorative in appearance, easy to construct, air leak proof, light in weight, easy fitting of glasses or prelaminated particle boards in the frames and ease in availability in market make these sections widely accepted all over. Interior decorators are recommending the use of aluminium partitions.

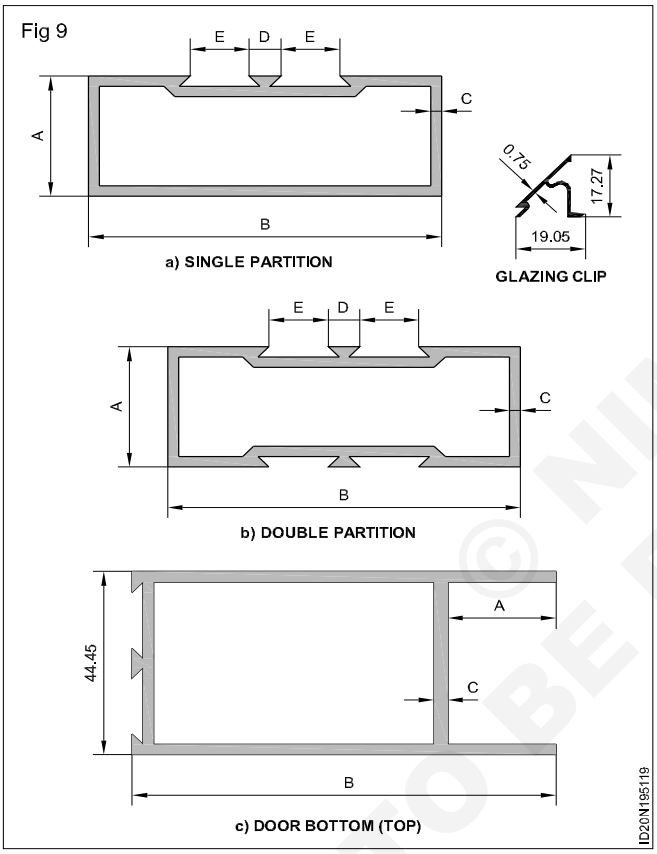
Aluminium partition sections are made of aluminium alloy extrusions (as per IS 733-1983 and IS 1285-1975). They are available in natural and electrolytic colour anodised finish. These are available in wide range of sizes.

The aluminium partitions are slim and attractive, elegant and functional in design, enabling optimum utilisation of available space. They are very durable and easy to maintain.

Frames should be wiped with a soft piece of cloth only.

Aluminium Partition Sections

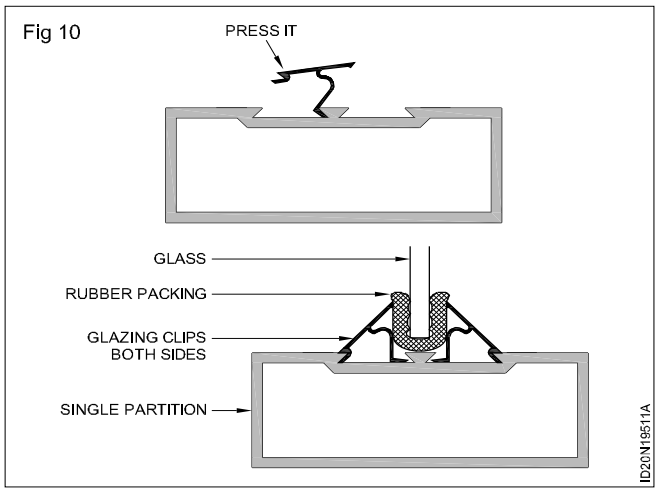
Fig 9 shows different partition sections, used to construct partitions. Single partition, double partition, rectangular tubes, partition split, glazing clips are different partition sections.



Single partition is used when prelaminated particle boards or glasses are to be fitted on one side only. Double partitions are used where glasses or prelaminated particle boards are fitted on both sides of it.

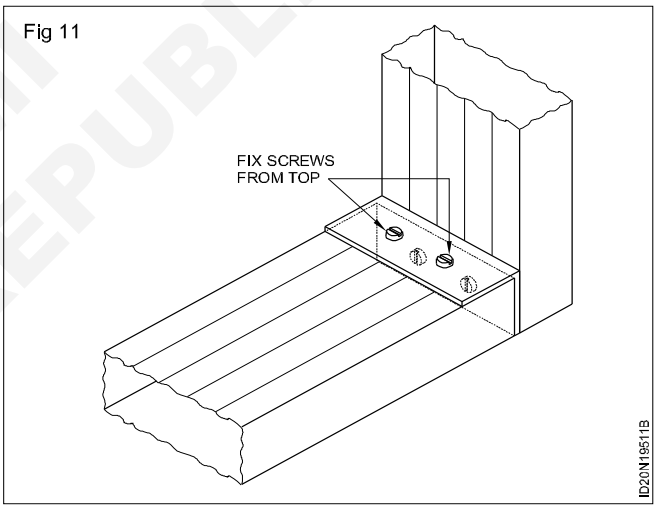
Glazing clips are engaged in the grooves of the single or double partition from side facing each other and glasses alongwith rubber packing or prelaminated particle board which are fitted between their gap. Because the gap between the glazing clips is maintained 2 to 3 mm less than the thickness of prelaminated particle board or glasses with rubber packing and the thickness of the section is 1 to 1.5 mm, the prelaminated particle board or glasses gets fitted with slight pressure from sides and gets tight.

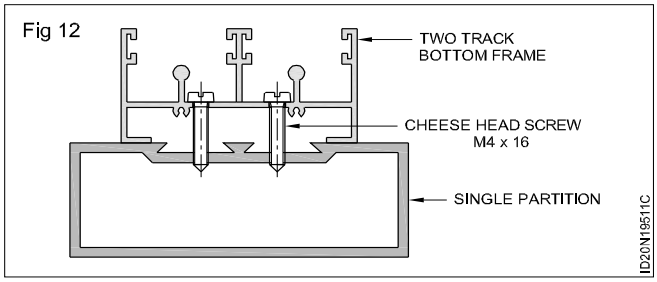
Fig 10 shows, the fitment of glass on single or double partition using glazing clips. When prelaminated particle boards or Novapans are to be fitted, no rubber packing is required.



Partition sections are fitted to each other at right angles, using aluminium angle piece and metal screws. (Fig 11) while joining the sections, drill the holes of diameter equal to root diameter of screw. While rotating the screw, as it is an aluminium material and section is thin, the screw gets tightened by self tapping. (Fig 12)

Partition frames are fixed to the walls and grout with metal screws and rowl plugs in holes.





Plumbing

Objectives: At the end of this lesson you shall be able to
- **state the purpose of house drainage**
- **explain types of drainage plumbing system.**

House plumbing

House plumbing is the collection and conveyance of liquid refuse upto the public drain adn sewers. Certain part of the building are set apart for this purpose. The positions of various sanitary conveyances and other conveniences are marked on the plan of the building. The drainage lines from the places of collection, leading to the sewer are also shown on the same plan with necessary appurtenances. Sanitary conveyances include lavatory blocks comprising of water closets and urinals, and bath rooms. Other conveniences comprise kitchen sinks and washing places.

Purpose of building drainage

1 To dispose off liquid waste as early as possible

2 To prevent entry of foul gases from the sewer to the building

3 To dispose off the storm water into open surface drain

4 To facilitate quick removal of foul matter

5 To provided health condition in the building

Principles of house drainage

1 For proper design and construction of house drainage system, the following general principles are adopted.

2 The entrances to drains should be outside the building.

3 The drainage systems should have proper ventilation.

4 The drains should not pass through building, but should pass by the side of the building.

5 The drains should not be laid close to trees.

6 The drain should be laid at gradients for self cleansing.

7 The drain should be laid straight between points of access. All changes of direction or gradient should be open for inspection.

8 Branch drains should be as small as possible.

9 All the connections should be oblique, so that the incoming drain faces the direction of flow of the sewage.

10 The size of drains should be just sufficient to meet the requirements.

11 The pipe joints should be water tight and made from non - absorbent materials.

12 The house drain should be connected to public sewer only when the public sewer is deeper than the house drain.

13 The house drain should contain sufficient number of traps at suitable points.

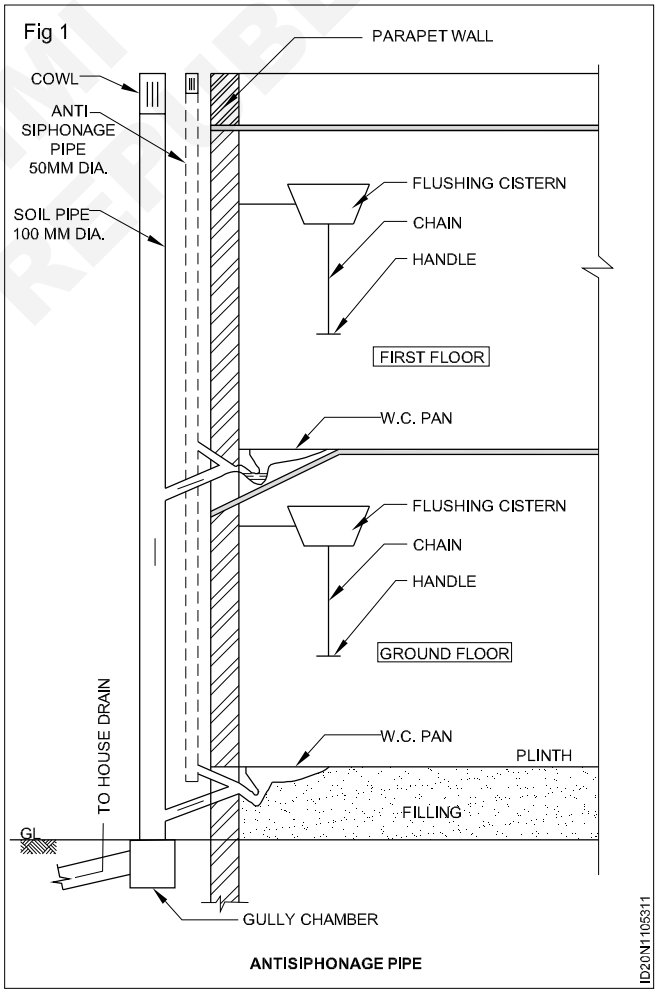
14 The house drain should be separated from the public sewer by a trap to prevent the entry of foul gas in to houses.

15 It is preferable to provide a separate system of drains to take the rain water.

Terms related to house drainage (Fig 1)

Anti - siphonage pipe - It is a pipe which is installed in the house drainage to preserve the water of traps. It maintains proper ventilation. It does not allow the siphonic action to take place.

Fig 1



Cowl - It is provided at the top of vent pipe. It prevents the birds from building the nests. It is provided with slits or narrow openings. It escapes the foul gas from septic tank or the drainage line.

Fixture drain - It is the outlet pipe from the trap of a fixture to make its connection any other drainage pipe.

Fresh air inlet - This is provided at the last manhole, which connects the house drain with the public sewer for admitting fresh air. This dilutes the sewage gases. It is kept at about 2 metres high above the ground level. It is provided with mica flap one way valve at its top. This valve opens inwards and admits fresh air.

Horizontal branch - It is a drain pipe extending laterally from a soil or waste stack or house drain. It receives the discharge from one or more fixture drains and conduct it to the soil or waste stack or house drain.

Horizontal pipe -It is any pipe or fitting which make an angle of less than 45° with the horizontal.

House drain or building drain- It is that part of the lowest horizontal piping of a plumbing drainage system. It receives discharge from soil, waste and other drainage pipes within the building and conveys it to the house sewer.

House sewer or building sewer - It is that part of the horizontal piping of a plumbing drainage system that extend from the end of the house drain or building drain to the public sewer or other outlet.

Siphonage - Due to siphonic action, water seal or traps may break. This is known as siphonage and it is induced when water is suddenly discharged from a fixture on the upper floor.

Soil pipe - It is any drainage pipe that carries liquid wastes containing human excreta.

Stack - A stack is any vertical line of drainage i.e., soil, waste or vent pipe.

Vent pipe - The pipe installed for ventilation of sewers is known as vent pipe. It is provided to protect the water seal of traps against siphonage and back flow.

Waste pipe - The waste pipe is any drainage pipe that carries liquid wastes that do not include human excreta.

Types of drainage plumbing system - There are four system adopted in plumbing of drainage work in a building.

1 Single stack system

2 One pipe system

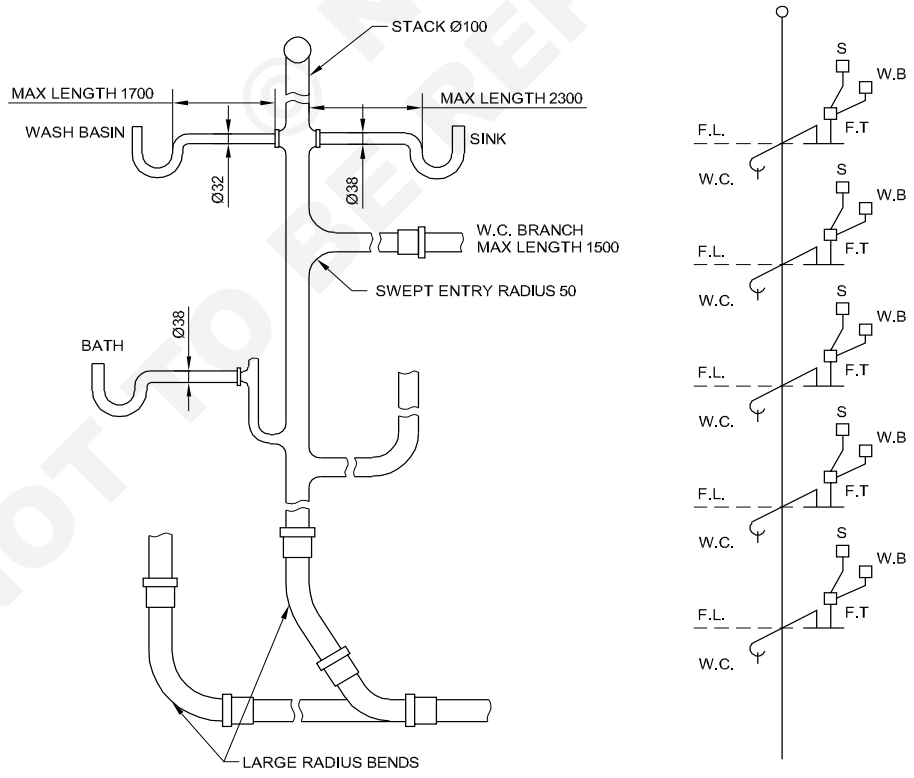
3 Single stack system (partially ventilated)

4 Two pipe system

1 The single stack system - This is the name given to a simplifide one - pipe system. All ventilating pipes are committed. The stack itself provides ventilation by restricting the flow into the stack upto certain limits. (Fig 2)

The single stack system is used only in buildings with a maximum ground floor and four upper floors having two bathroom units and two sinks at each floor.

Fig 2



SINGLE STACK SYSTEM

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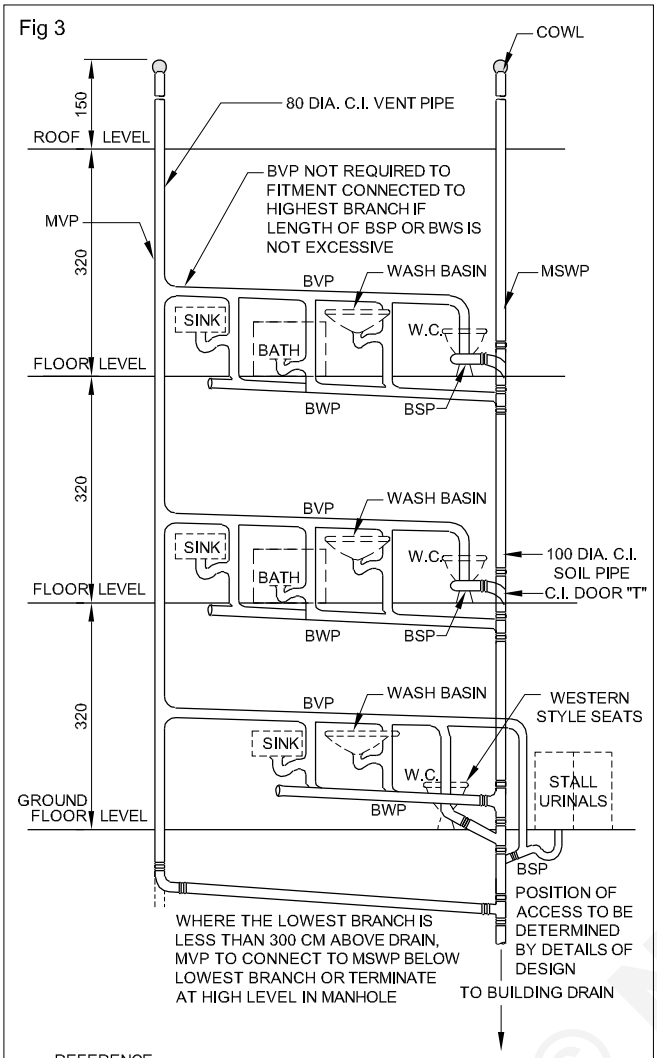
2 The one - pipe system - In this system a single soil waste pipe conveys both soil and waste from all appliances directly into the building drain. It is an easy to install and economical system. Fig 3 shows a single pipe system.

Fig 3



REFERENCE:-

MVP :- MAIN VENT PIPE
MSWP :- MAIN SOIL AND WASH PIPE
BSP :- BRANCH SOIL PIPE
BVP :- BRANCH VENT PIPE
BWP :- BRANCH WASTE PIPE
BSP :- BRANCH SOIL PIPE
W.C. :- WATER CLOSET

ONE PIPE SYSTEM

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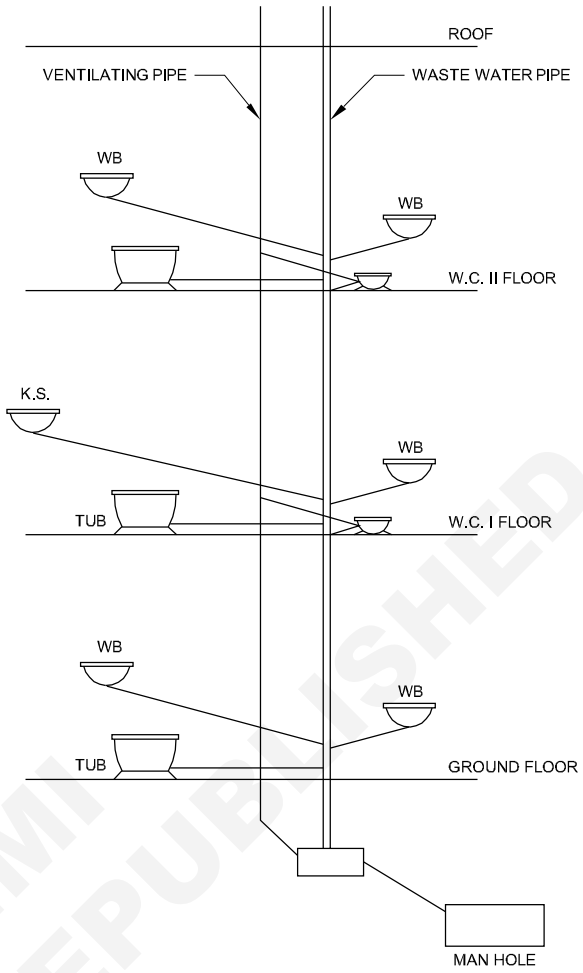
3 Single stack system (partially ventilated) - This system combines both the one - pipe and single stack system. In this system, only one soil waste pipe conveys both soil and waste. The separate vent pipe provides ventilation only to the traps of water closets.(Fig 4)

Fig 4



SINGLE STACK SYSTEM (PARTIALLY VENTILATED

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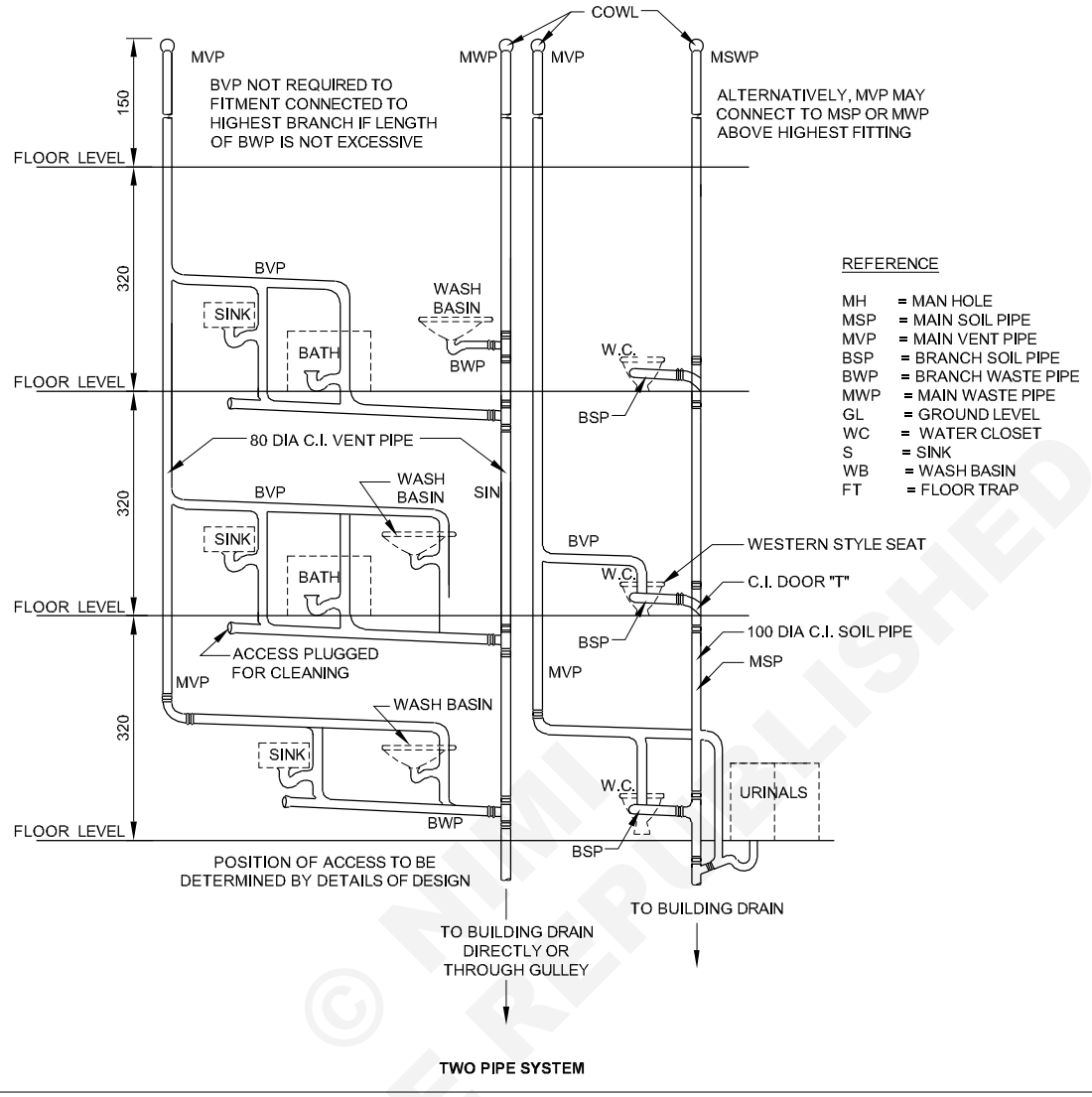
4 The two - pipe system (Fig 5) - Different waste pipes are used for drainage of waste from bath, kitchen and W.C's. The soil pipe conveys discharges from water closets, urinals, and similar soil appliances directly to the drainage system. The waste pipe conveys waste from ablutionary and culinary (sinks, wash basins, showers, bathrooms and kitchens) appliances to the drainage system directly or through a traped gully where desired.

This system is installed on the face of a side wall or a pipe duct in the case of multistoreyed buildings. In multistoreyed buildings where the number of floors exceeds four, this system is preferred.

Fig 5



TWO PIPE SYSTEM

Traps and uses/Sanitation fittings

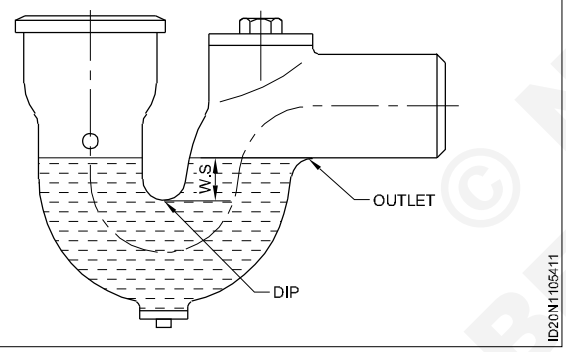
Objectives: At the end of this lesson you shall be able to
- **define traps**
- **state the different types of traps and uses.**

Funcitons and types of traps being used in sanitary plumbing systems

Definition:

Traps may be defined as fittings, placed at the ends of the soil pipes or the sullage pipes (waste pipes) to prevent the passage of foul gases from the pipes to the outside. This is possible because traps does enclose or maintain water seal between the pipe and the outside. This water depth does not allow gases to escape to the outside of the pipe. The efficiency and effectiveness of a trap will depend upon the depth of the water seal. Greater is this depth, more effective the trap will be. This water seal generally varies from 25mm to 75mm, 50mm being quiet common in most of the traps. (Fig.1)

Fig 1



Qualities: A good trap should posses the following qualities:

– It should provide sufficient water seal (50mm - or so) with large surface area. The seal of a trap is the water between the outlet and the dip.

– Its interior should be smooth so as not to obstruct flow and the trap should thus be self cleansing

– It should be provided with an access door for cleaning and

– It should be made of some non absorbent material.

Foul gases produced in the sewers, drains, waste-pipes may cause nuisance by entering in houses through house-connecting pipes, if their passage is not checked by some suitable devices. The devices which are used to stop the escape of foul gases inside or outside the houses are known as traps. The traps generally consist of a bend tube which provides a water seal between the atmosphere and the sewer gas. The efficiency of the traps depends on the depth of water seal, deeper the seal more efficient will be the trap

The following are the requirements of a good trap:

i It should be made of non-absorbent material.

ii It should provide sufficient depth of water seal all times (about 50 mm) having large surface area.

iii It should be self-cleaning and should not obstruct the flow of sewage.

iv It should be provided with access door for cleaning.

The water seal of the trap can break under the following conditions :

i If there is any crack in the bottom of seal or the joint is faulty.

ii If for a long time the seal is not in use, its water will evaporate in the atmosphere.

iii If due to blockage or any other reason there is increase in the pressure of the sewer gases it will pass through the water of seal.

iv If partial vacuum is created in the sewer fittings, it will suck up the seal water. To avoid the breakage of due to this reason, the portion between the trap and the soil pipe should be connected to the vent pipe.

Types: Depending upon their shapes, the traps may be of three types i.e P-trap, Q-trap and S-trap.

A trap essentially consists of a U tube, which retains water, acting as a seal, between the foul gases (inside the pipe) and the outside atmosphere. They are largely used for baths, sinks and lavatories. In all such needs, they are made with enlarged mouth, so that the waste pipe may be thoroughly flushed out.

Depending upon their use, the traps may again be of three types i.e Floor trap, Gully trap and Intercepting trap.

These three different types of traps are briefly described below:

Floor traps: (Fig 2) These traps are generally used to admit waste water (sullage) from the floors of rooms, kitchens, baths, etc. into the said room drain (sullage pipe). These are invariably provided with cast iron or galvanized or stainless steel gratings (Jallis) at the top, so as to prevent the entry of solid and larger sticky matter, into the drain pipe, to avoid frequent blockage. A commonly used patented name of such a trap is Nahani trap. (Fig 2a)

The following types of traps are most commonly used in practice:

a P, Q and S - Traps : These traps are classified according to their shape. They essentially consist of a

U-tube which retains water acting as a seal between the foul gas and atmosphere. (Fig 3)

Fig 2

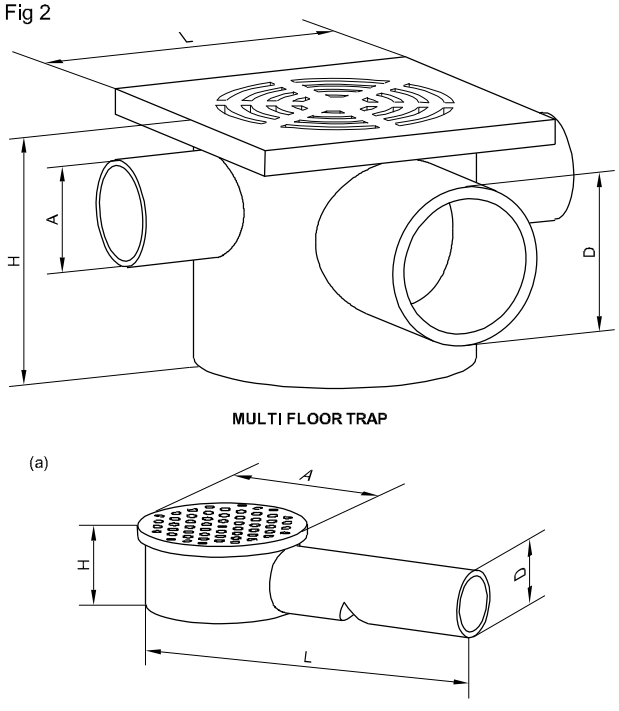
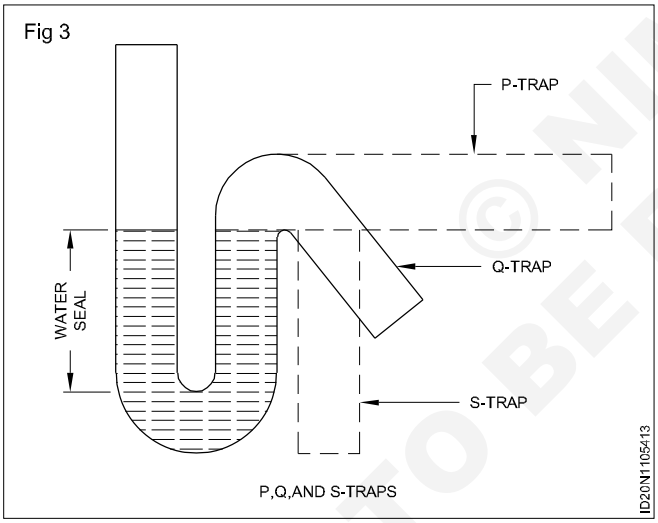


Fig 3



b Gully-traps : This trap is provided at a different places in the drain pipes. Waste water from sinks, bath etc., entries in through back inlet and unfoul water from the sweeping of rooms, counrtyards etc. enters from the top, wehre a coarser screen grating is fitted to check the soil matter (Fig 4 & 5).

A gully trap or a gully is often provided at the junction of a room or a roof drain and the other drain coming from bath, kitchen etc. The foul sullage from baths, will enter through the side inlet (called back inlet) and the unfoul room washings or rain water from roof or courtyard will enter from the top.

Gully traps may either have a S-trap or a P-trap. The water seal is usually 50mm to 75mm deep. The top of the trap is covered by a C.I grating to exclude the entry of coarser materials to avoid blockage. (Fig 4)

Fig 4

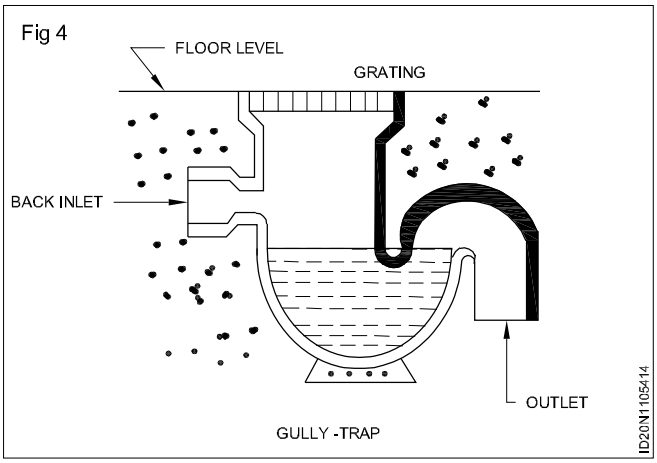
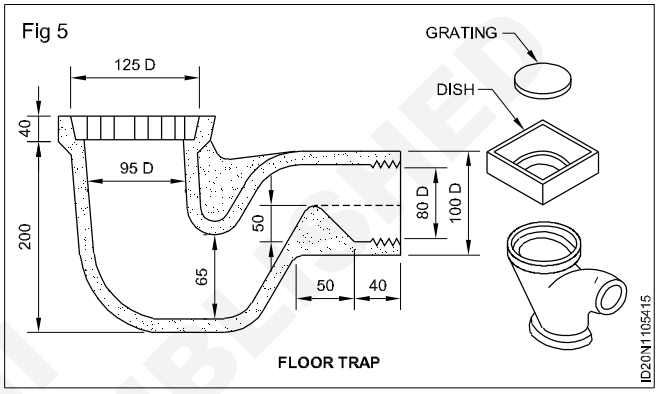


Fig 5



Gully Trap Chambers

The Gully Trap Chambers shall consist of brick masonry chambers suitable for the specified size of the Gully Traps. The traps shall be glazed stoneware of approved make.

Construction of Gully Trap Chambers shall consist of the following :

a Excavation and refilling after construction of chamber.

b 1:3:6 RCC bed concrete required for embedding the Trap.

c 230 mm thick Brick Masonry in C.M. 1 : 6.

d 20 mm thick W.P. plaster from inside and smooth from outside in C.M. 1 : 6 trowell smooth by cement floating on all surfaces.

e RCC 1:3:6 coping 100 mm thick for having cast iron cover frame. (Dimensions shall suit the brick work)

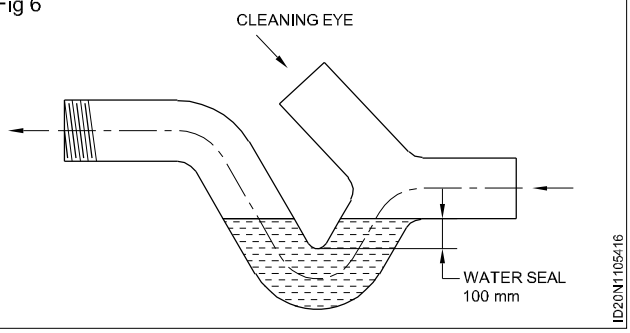
f Cast iron frame and cover size fixed in coping & painted in 3 coats of anti-corrosive bitumastic paint.

g All the work necessary for satisfactory working of the same.

Intercepting traps: (Fig 6) An intercepting trap is often provided at the junction of a house sewer and a municipal sewer, so as to prevent the entry of the foul gases of the municipal sewer, into the house drainage system. This trap at such a junction is often provided in a small man-hole constructed just near the house, either outside in the street or in a corner inside the house boundary. This trap is provided near its top with an access gate or a plug, called cleaning eye for removing silted matter from inside the trap incase of blockage. It has a high depth of water seal, say

about 100mm. It is interesting to note the merits and demerits of an interceptor, which are given below.

Fig 6



Merits of interceptors: Foul gases of public sewer cannot pass through the interceptor, and hence prevented from entering the house drainage system. If the interceptor is not provided these gases will enter the vent pipes of the house drainage system, and spread around in the surrounding atmosphere causing serious air pollution.

Harmful pathogenic bacteria contained in the public sewers are thus prevented from entering the house drains, due to the presence of the interceptor.

Properly designed and constructed interceptors can quickly remove the foul matter of the house drains into the public sewer.

Demerits of interceptors: If the discharge from house drains is small, the solid heavy matter may be retained in the trap and may start decomposing, producing foul gases. The basic purpose of interceptors of preventing foul gases, will then no longer be served.

If the lid or the plug is not fitted properly, or is broken, foul gases from public sewer will do enter the house drain.

Cleaning through the inspection arm of the trap is not easy.

Interceptor itself forms an obstruction to the normal flow of sewege.

Omission of interceptors from house drains is found not to present too serious a difficulty or a problem.

Presence of interceptors installed by house owners, is found to seriously affect the ventilation of public sewers, as in such cases, the foul gases of public sewers will find an outlet only through the ventilating columns, which are provided at the head of every branch sewer and at other key points in the city sewerage system. Hence, if interceptors are allowed, then public sewers will need greater ventilation arrangement, and hence involving more expenditure, consequently leading to greater taxis on the public.

In view of the difficulty, the city municipality itself decides whether to allow the house owners to install or not to install interceptors.

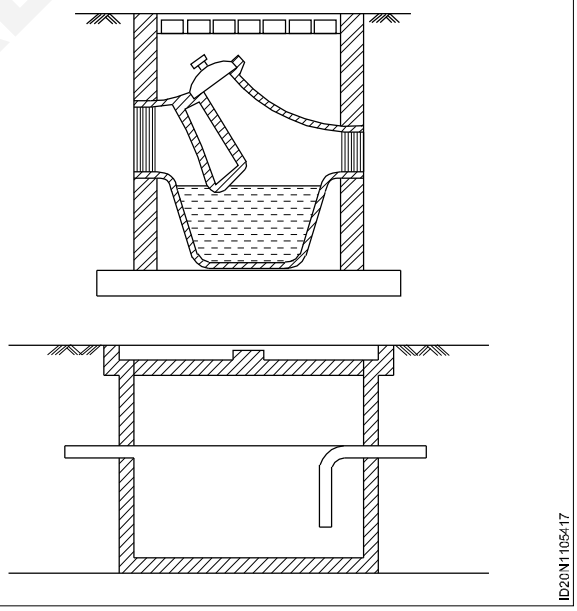
Traps which are fittings or parts of appliances that retain water so as to prevent the passage of foul air into the building should be properly sited. A trap may be formed as an integral trap with the appliance during manufacture or may be a separate fitting called an attached trap which may be connected to the waste outlet of the appliance.

Traps should always be of a self - cleaning pattern. A trap which is not an integral part of an appliance, should be directly attached to its outlet and the pipe bore should be uniform throughout and have a smooth surface.

Traps for use in domectic waste installations and all other traps should be conveniently accessible and provided with cleaning eyes or other means of cleaning.

Grease trap (Fig 7) : A grease trap is a plumbing device that is installed in a sanitary drainage system to trap or intercept non petroleum FOG from a waste water discharge. Waste water flows from the sink of drain into a tank. Grease trap works by slowing down the flow of Warm/not greasy water and allowing it to cool. As the water cools, the grease and oil in the water separate out and float to the top of the trap. The cooler water. Minus the grease continues to flow down the pipe to the sewer. Generally in home it is not required. The grease traps should be cleaned out every 1-3 months, depending on usage. After the grease trop is cleaned, the company will take the waste to a treatment facility. The grease trap waste can be recycled.

Fig 7



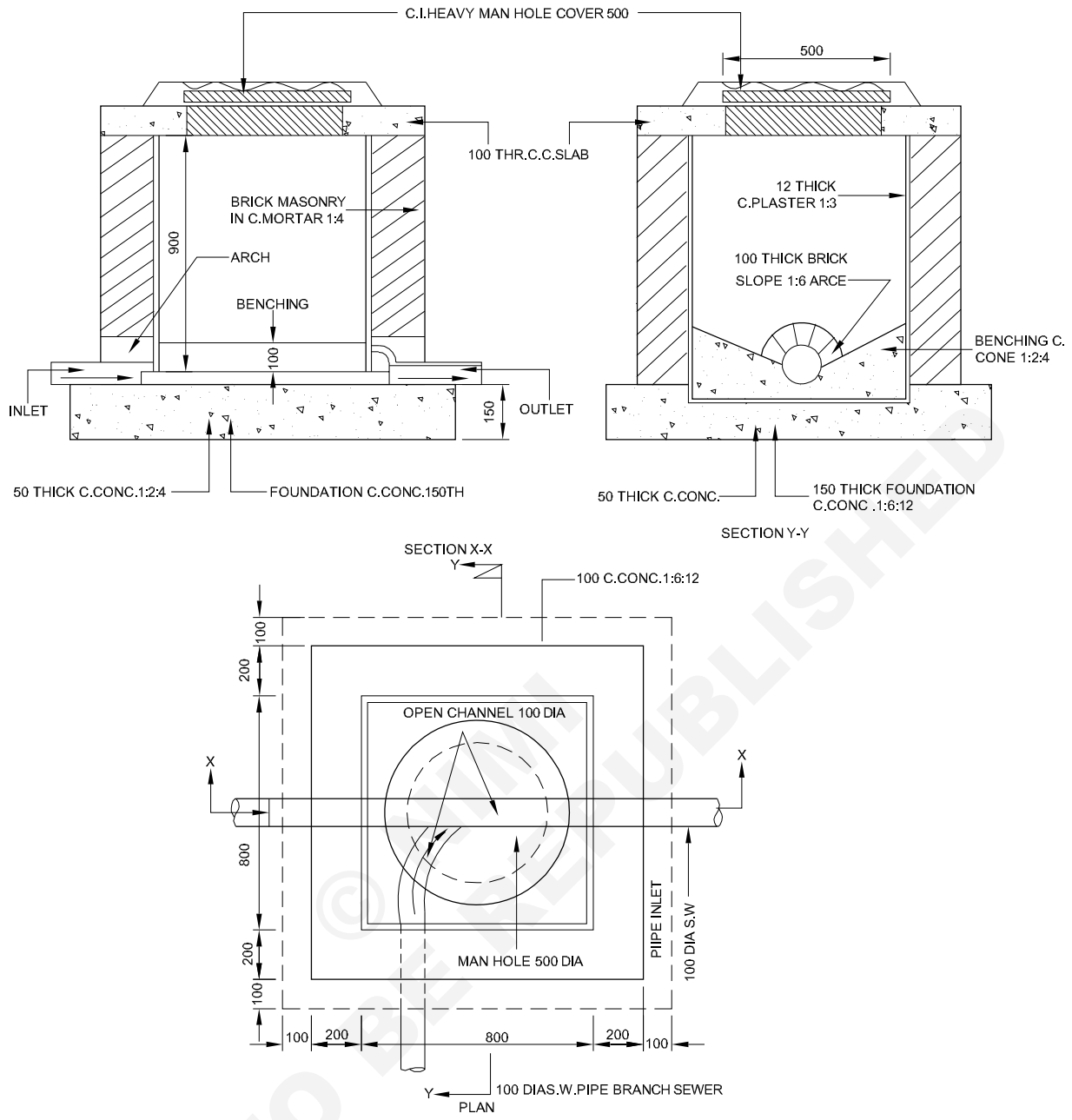
Waste water disposal - Inspection chamber

Objective: At the end of the lesson you shall be able to
- **state about inspection chamber.**

Inspection chamber: It is a water tight chamber constructed in any building drainage system which takes wastes from gully traps/soil pipes and disposes off to manhole with access for inspection and maintenance.

Inspection chamber is provided very near to the gully traps/ soil pipe lines of the building and it should be provided within 6 meters from the gully traps. (Fig 1)

Fig 1



Septic tank

Objectives: At the end of the lesson you shall be able to

- **describe the septic tank**
- **state points be considered to form the septic bank**
- **state the construction about the septic tank**
- **specification about the septic tank.**

Septic tank: Septic tanks are provided where there is no municipal sewege system.

Septic tanks are recommended for individual houses and small colonies having a population of 300 or less.

Septic tanks are constructed with brick/stone masonary or concrete walls. (Fig 1)

Important points

1 The inlet and outlet pipes are to be bent downwards.

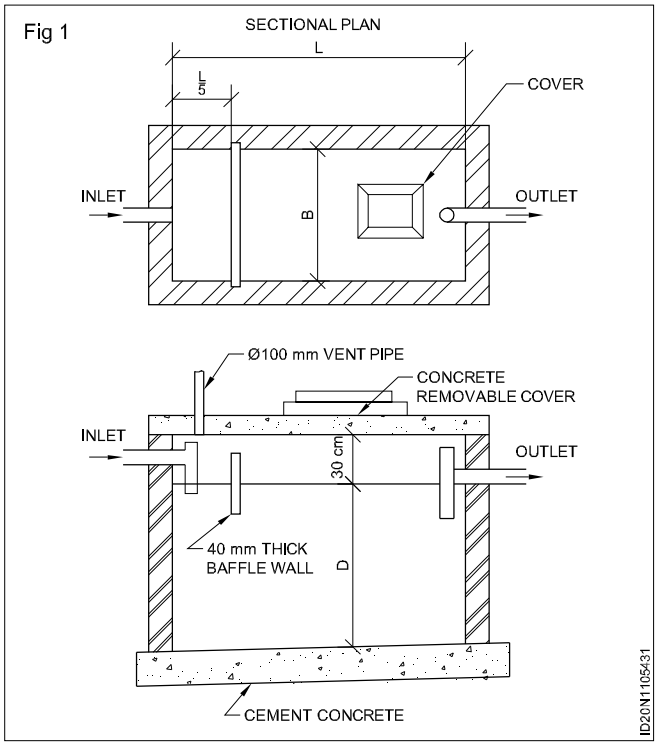
2 The centre of outlet pipe should be 5 to 7 cm below the centre of inlet pipe.

3 Waste water lines carrying excessive detergent and disinfectants should not be connected to a septic tank.

4 A vent pipe (CI/AC/PVC) should be provided on the covering slab (minimum - 100 mm).

The sewege undergoes treatment in a septic tank, the effluent i.e. waste water may still contain toxic and the effluent cannot be considered safe. Therefore the septick

tank effluents are disposed off by soil absorption system. Following are the methods for the disposition of effluent.



Construction details: Following are the construction details of septic tanks:

It is rectangular in plan, the length is usually 2 to 4 times the breadth.

For smaller tanks liquid depth of 100 cm is provided, for larget tanks it may be upto 180 cm. Free board of 30-45 cm is provided above the level of liquid for fixing of pipes, scum, gases, etc.

An elbow pipe, usually T-pipe submerged to a depth of 15-25 cm below the liquid level is provided as inlet pipe. More number of inlet pipes may be provided for larger tanks.

Single elbow or T-shaped outlet pipe is provided. It should also be submerged at least 15cm below the liquid level. For very large tanks, weir type outlet similar to settling tanks are provided.

Usually R.C.C. slab with C.I. manhole covers are provided.

Ventilation pipe of usually 10 cm diameter of A.C. or C.I, is used for taking out the foul smells. Their tops are provided with cowls.

Figure shows the plan and sectional elevation of a septic tank which is most suitable for domestic purposes. The minimum width and liquid depth of the septic tanks should be one cubic metre. The length of tank should be 2-4 times the width. Table 1 gives the suitable sizes of septic tanks which correspond to figure.

Pipes

Objective: At the end of this lesson you shall be able to
- **explain the soil pipe and waste water pipe and uses.**

Soil pipe : This type of pipe will carry water and solids into the sewer. It has got specific quality. First it is of a dimension to allow solid waste to pass. Second it is vented in a very specific way to maintain a safe environment and reduce odors. Soil pipes are vented high at the top or near to the top of the building. To allow gases produced by waste to vent safely into the atmosphere such gases can be harmful to health. So venting them high keeps them out of the way. This is the vital feature of soil pipe and it forms part of regulations too. The cast iron pipes are used in the olden days. But now a days soil pipes are made from the plastic. The soil pipes which are made up of UPVC are widely used in the residential drainage system, because of its high durability and resistance. UPVC pipes are also economical. The diameter of soil pipe generally bigger than waste pipes.

Waste water pipe: It is a smaller diameter pipe that carries waste water from your sink, washing machine shower bath and any other appliance you may have that uses water. It will be narrower than soil pipe. As the waste pipe is only designed to carry water. It also does not need the same venting system as a soil pipe. Waste water does not typically generate harmful gas so does not need to be vented high above the ground level. These waste pipes can be mounted on the floor in between the floor joists. On average trenches should be around 12-24 inches deep and wide enough to house your waste pipe comfortably before filling it in with soil and sod.

Erecting of rain water pipe system

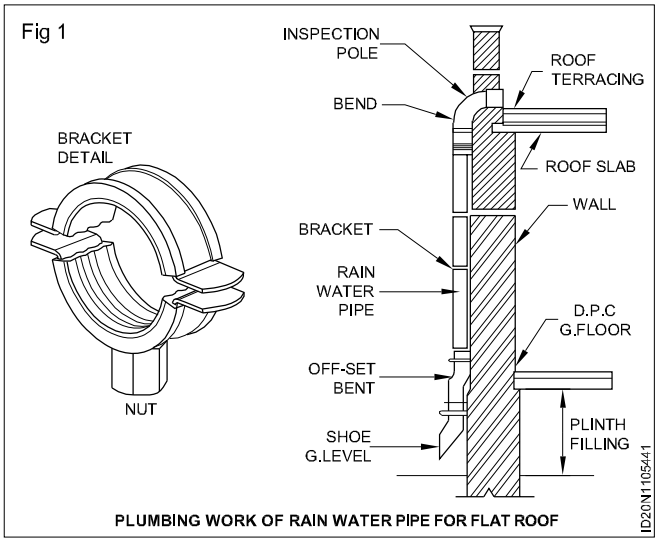
Objectives: At the end of the lesson you shall be able to
- **state the installation of rain water pipe from roof to ground**
- **fix the rain water gutter with rain water pipe.**

The pipe laid to collect the rain water from the roofs is known as rain water pipe. The water from the flat as well as sloppy roofs is to be connected and brought on the ground level, from where it is allowed to flow in open drains.

Rain water pipes for drainage of roofs (Fig 1). The roofs of a building shall be so constructed or framed as to permit effectual drainage of the rain water there from by means of a sufficient number of rain water pipes of adequate size so arranged, jointed and fixed as to ensure that the rain water is carried away from the building without causing dampness in any part of the walls or foundations of the building or those of an adjacent building.

The rain water pipes shall be fixed to the outside of the external walls of the building or in recesses or chase cut or framed in such external walls or in such other manner as may be approved by the administrative authority.

Fig 1



PLUMBING WORK OF RAIN WATER PIPE FOR FLAT ROOF

A rain water pipe conveying rain water shall discharge directly or by means of a channel into or over an inlet to a surface drain or shall discharge freely in a compound, drained to surface drain or shall discharge freely in a compound, drained to surface drain but in no case shall it discharge directly into any closed drain.

Whenever it is not possible to discharge a rain water pipe into or over an inlet to a surface drain or in a compound, drain to surface drain or in a street drain within 30m from the boundary of the premises, such rain water pipe shall discharge into a gulley trap which shall be connected with the street drain. Such a gulley trap shall have a screen and a silt catcher incorporated in its design.

Rain water pipes shall be constructed of cast iron, asbestos cement, galvanized sheet or other equally suitable material and shall be securely fixed. The latest practice, however, is not to use the pipes made from galvanized sheets for rain water services. Cast iron rain water pipes and fittings shall conform to IS: 1230 -1979. Asbestos cement building pipes and gutters and fittings (Fig 2) (spigot and socket type) shall conform to IS: 1626 (Part 1) 1980, IS 1626 (Part 2) 1980 and IS: 1626 (Part 3) 1981. Sizing of rain water pipes for roof drainage: Rain water pipes shall be normally sized on the basis of roof areas according to Table as under. A bell mouth inlet at the roof surface is found to give better drainage effect, provided proper slopes are given to the roof surface.

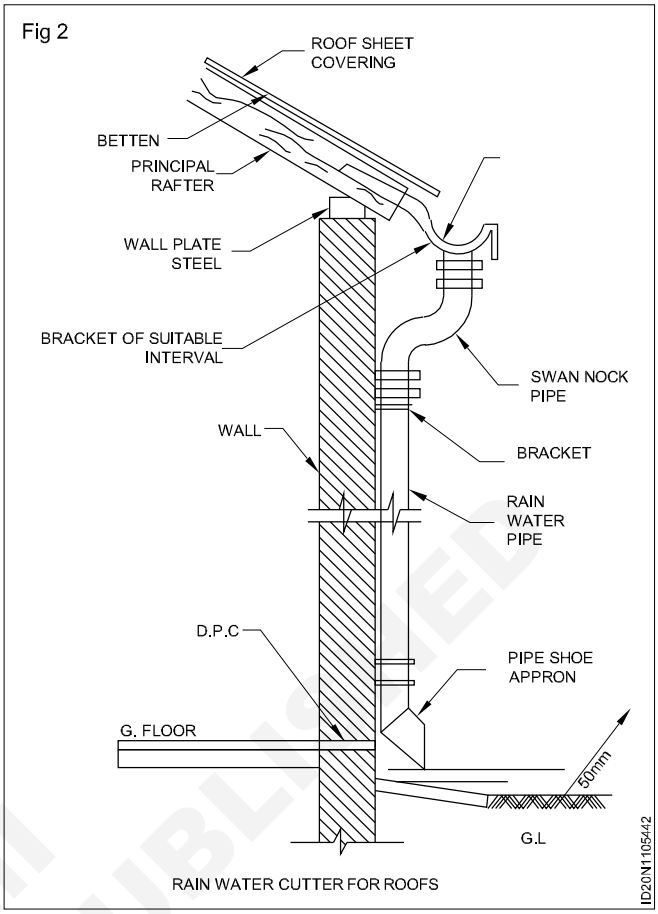
The spacing of pipes depends on the position of the windows and arc openings but 6m aparat is a convenient distance. The strainer fixed to the bell mouth inlet shall have an area 1½ to 2 times the area of pipe which it connects.

Laying of rainwater pipe

1 Correct threading, the same which is on the specials should be done on the pipes.

2 All the joints should be made water-tight by wrapping jute thread and white lead paint in the threads, while screwing.

Fig 2



RAIN WATER CUTTER FOR ROOFS

3 Over-screwing should not be done in any case, otherwise it may split or crack the parts of the fittings, socket, elbow, tee or cross etc.

4 While measuring the length of pipes for cutting, due to allowance for the space of fittings should be made, otherwise the length of the pipes may be more or less.

5 All the pegs should be fixed with their broader end inside the wall and smaller size in face of the wall.

6 Only the required size whole should be made in the wall for fixing of pegs, brackets etc. de-shape the pipe and make it oval in section.

7 While bending the pipes on the bending machines, care should be taken otherwise it may also press the pipe and give more bend than desired.

8 The cutting of the pipes should be done properly, it should be at right angle to the axis of the pipe.

9 The pipes should be fixed with pipe-hooks art proper place. These hooks should be driven in the masonary joints.

10 In case of accidents first-aid facilities should be available.

In the buildings, various types of sanitary fittings are required to collect the water. These all fittings can be broadly classified as :

Sl. No.	Dia. of pipe mm	Average rate of rainfall in mm					
		50	75	100	125	150	200
		Roof area in square metres					
1	50	13.4	8.9	6.6	5.3	4.4	3.3
2	65	24.4	16.0	12.0	9.6	8.0	6.0
3	75	40.8	27.0	20.4	16.3	13.6	10.2
4	100	85.4	57.0	42.7	34.2	28.5	21.3
5	125			80.5	64.3	53.5	40.0
6	150					83.6	62.7

Sanitary fittings and uses

Objectives: At the end of this lesson you shall be able to
- **state different types of sanitation fitting and uses.**

Sanitary Fittings : In the buildings, various types of sanitary fittings are required to collect the water. These all fittings can be broadly classified as :

1 Ablution Fittings

a Wash basins b Sinks
c Bath tubs d Flushing cisterns

2 Soil Fittings

a Water closets b Urinals c Bidets

All types of sanitary fittings should be fixed as far as possible against an external walls, so that the apartment in which they are placed can be provided with natural light and air, and also their wastes can be easily collected in drain. The floors of the rooms in which sanitary fittings are fixed should be of a non-absorbent material with curved angles at the junction with walls from sanitary points of view.

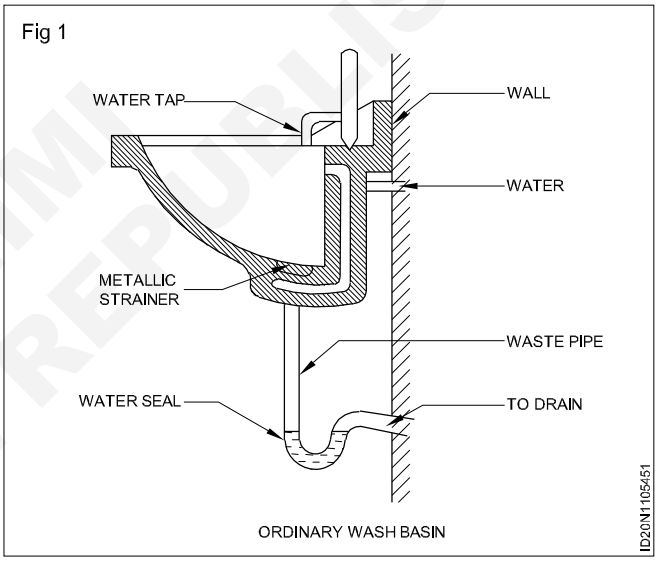
Wash Basin (Fig 1) : The wash basins are available in various patterns and size in the market. There are mostly three patterns: (a) Flat back for mounting on walls, (b) Angle back for fixing at the junction of two walls, and (c) Circular or oval for fixing in tables or rocks. Flat back basins are provided with double or single tap holes. All the wash basins should be of one pipe construction and have should have slotted overflow hole. All the internal angles are designed so as to facilitate cleaning. The wash basins are provided with a circular waste hole in the bottom the basins are provided with an integral soap holder recess with drains into the bowl.

For holding water in the bowl these are provided with tapering rubber plugs, which can be fitted in the outlet. This plug is fixed to a chain secured by a stay. (Fig 2)

The usual size of wash basin are:

Pattern	Size
Flat back (Fig 3)	630 x 40 mm
	550 x 400 mm
Angle back (Fig 5)	600 x 480 mm
	400 x 400 mm
Oval (Fig 4)	570 x 420 mm

Fig 1



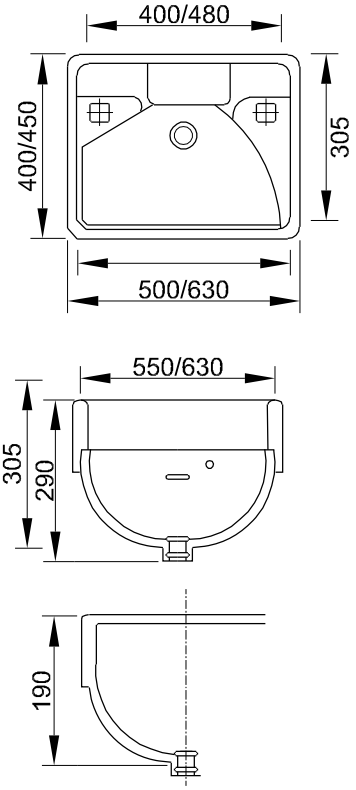
ORDINARY WASH BASIN

Specifications for wash basins (as per C.P.W.D) : Wash basins shall be of white vitreous China conforming to IS : 2556 (Part I) - 1967 and IS : 2556 (Part IV) - 1967. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole.

Each basin shall have a circular waste hole each basin shall be provided with a non-ferrous 32 mm waste fitting. The quality of the glazing of the pedestal shall be exactly the same as that of the basin. It shall be capable of supporting the basin rigidly and adequately height from the floor to top of the rim of basin 75 to 80 cm.

All the waste fittings shall be brass chromium plated or as specified

Fig 2



PLAN,SECTION AND SIDE SECTION OF FLAT BACK WASH BASIN

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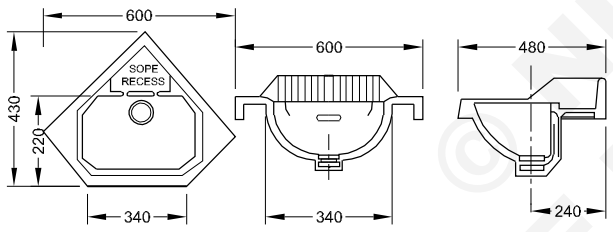
Fig 3



PLAN,SECTION AND SIDE SECTION OF ANGLE WASH-BASIN

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The following tolerance may be allowed on dimensions specified

a On dimension 75 mm and over ± 4 percent

b On dimension less than 75 mm ± 2 mm

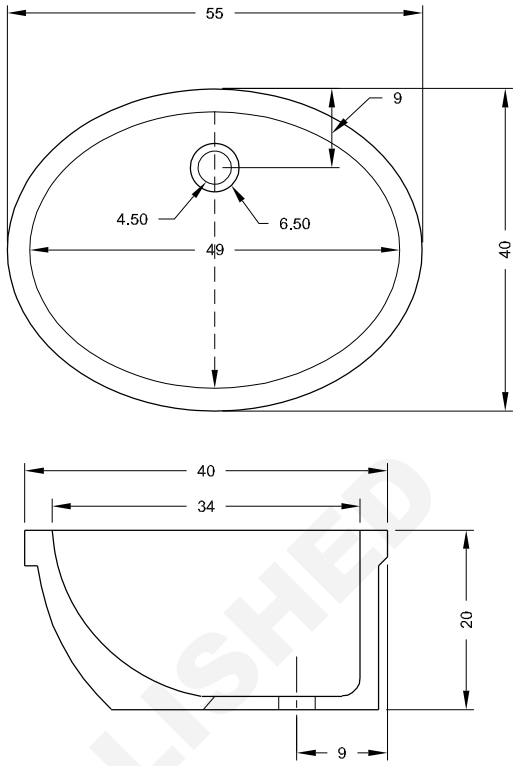
c Diameter of the waste hole ± 3 mm

Sinks (Fig 6) : There are rectangular shallow receptacles suitable for kitchens or laboratory. Fig 8 shows a kitchen sink which is mostly used. It is on one piece construction, provided with or without rim.

The floor of the sink is given a slope towards the waste outlet. The sinks are provided with circular waste hole. All the kitchen sinks are provided with a draining board which is fixed on the right of the user.

Kitchen sinks (Fig 7)	600 x 450 x 150 mm
	600 x 450 x 250 mm
	750 x 450 x 250 mm
Laboratory sinks (Fig 8)	400 x 250 x 150 mm
	450 x 300 x 150 mm
	500 x 350 x 150 mm

Fig 4



PLAN AND SECTION OF OVAL WASH-BASIN

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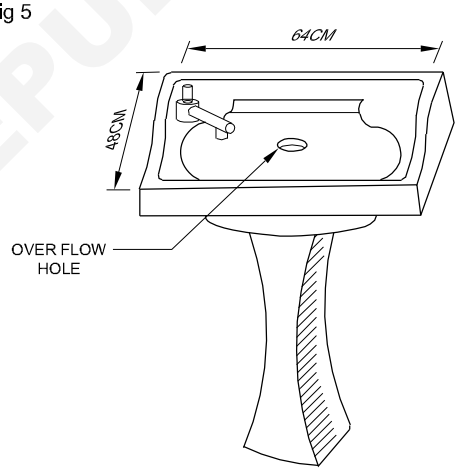
Fig 5



PEDESTAL WASH BASIN

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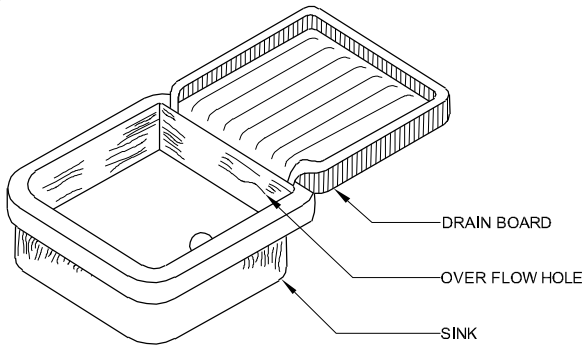
Fig 6



SINK
(KITCHEN)

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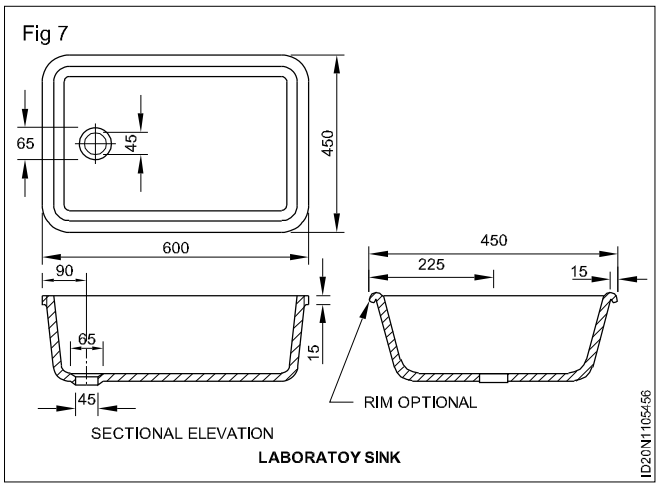
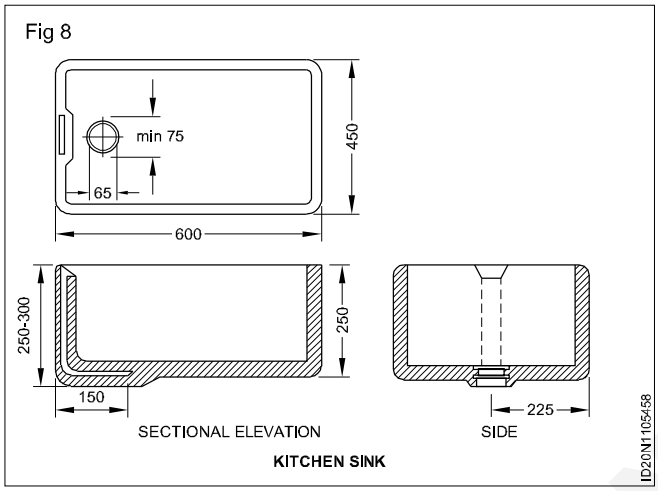
600 x 400 x 200 mm





The height of the top of the sink from the floor should be 80 cm.

Bath tub (Fig 9) : Bath tubs may be made of various materials, such as enamelled iron, plastic, cast iron porcelain enamelled, marble or fire clay etc. For high class residential buildings marble, plastic or enamelled iron or fibre galss baths are used.

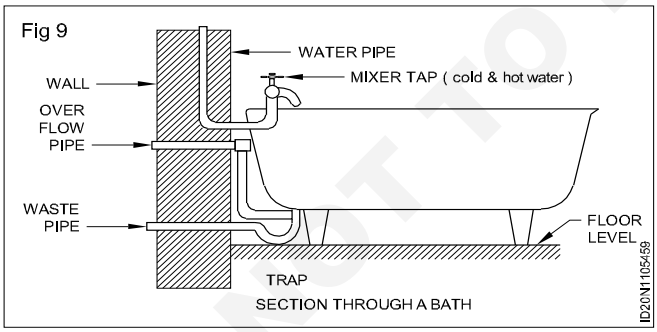
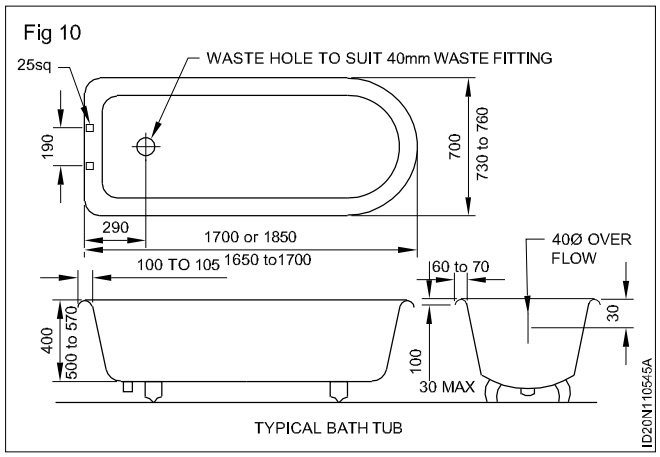


Fig 10 shows the section through a bath. The bath may be parallel or taper, the latter type being more popular. It is provided with one outlet of 4 to 8 cm and one inlet pipe for filling it. In some cases, two taps are provided one for hot and another for cold water supply. The bath should also be provided with one over-flow pipe to take excessive water. The waste pipe of bath is provided with a trap, to prevent the foul gases from entering in the bath-room.

The usual dimensions of bath are: length 1.7 to 1.85 m, width 70 to 75 cm depth near pipe side 43 to 45 cm, overall height with feet 58 to 60 cm.



Specifications of Bath Tub (Enameled Sheet Steel) (as per C.P.W.D) (Fig 10) : The bath tube shall conform to I.S.: 3489 -1966. The bath tub shall be such as to ensure a suitable finished surface for the reception of the enamel. Any welded surface shall be adequately cleaned off inside and outside the bath tubs.

The interiors of the bath tub shall be adequately and evenly coated with vitreous enamel. The enamelling shall conform to I.S. : 772 - 1973. Thickness of the enamel shall not be less than 0.2 mm and not more than 0.5 mm.

Flushing Cisterns

These are used for flushing water closets and urinals after use. There are several varieties of flushing cisterns. High-level cisterns are intended to operate with a minimum height of 125 cm between the top of the pan and the underside of the cistern. Low-level cisterns are intended to operate at a height not more than 30 cm between the top of the pan and the underside of the cistern. Cistern may be of cast iron, glazed earthenware, glazed vitreous ware or pressed steel or any other impervious material. Now-a-days plastic cisterns are also available in the market.

three types are there

1 Low level flushing cistern

2 hign level flushing cistern

3 auto matic flushing cistern

Cistern shale be of cast-iron, vitreous chin or pressed stall and plastic as specified company.

With the requirement 08 IS.744-197, I.S. 2326 - 1970 and I.S 7231 - 1994 respectively

Water closet: This is a sanitary appliance to receive the human excreta directly and is connected to the soil pipe by means of a trap.

The water closets are classified as follows:

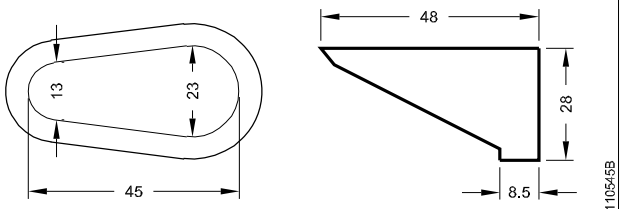
A Squatting types of Indian type water closet

i Long pan pattern (length 450, 580, 680 mm) (Fig 12)

ii Orissa pattern (length 580, 630, 580 mm) (Fig 13)

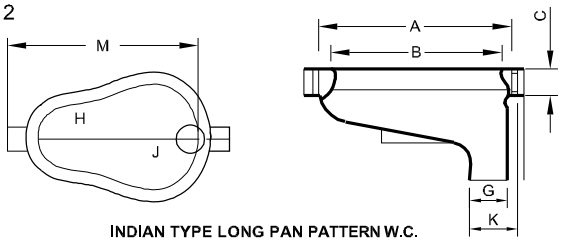
iii Rural pattern (length 425 mm) (Fig 11)

Fig 11



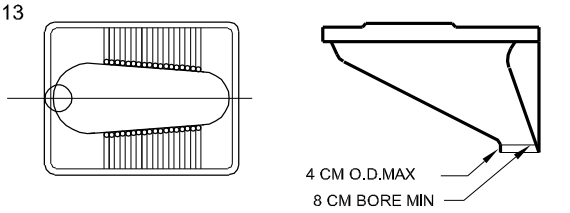
RURAL PATTERN W.C.

Fig 12



INDIAN TYPE LONG PAN PATTERN W.C.

Fig 13



ORISSA PATTERN W.C.

Fig 12 shows the section through an Indian type water closet. This is manufactured in two different pieces; (a) squatting pan and (b) trap. The pan is provided with an integral flushing rim of suitable type. The inside of the bottom of the pan should have sufficient slope towards the outlet for quick disposal during flushing.

They are made of vitreous china clay. The inner portion is glazed to make it easy in cleaning. The pan is connected to the anti-syphon or vent pipe.

Specifications of Water Closet (as per C.P.W.D)

Squatting pans : Squatting pans shall be of white vitreous china conforming to I.S.; 2556 Part I - 1967 for General requirements and relevant I.S. codes for each patterns as described below :

i Long Patterns - conforming to I.S.: 2556 (Pt. III) - 1967

ii Orissa Pattern - conforming to I.S.:2556 (Pt. III) - 1967

iii Integrated types conforming to I.S.:2556 (Pt. XIV) -1974

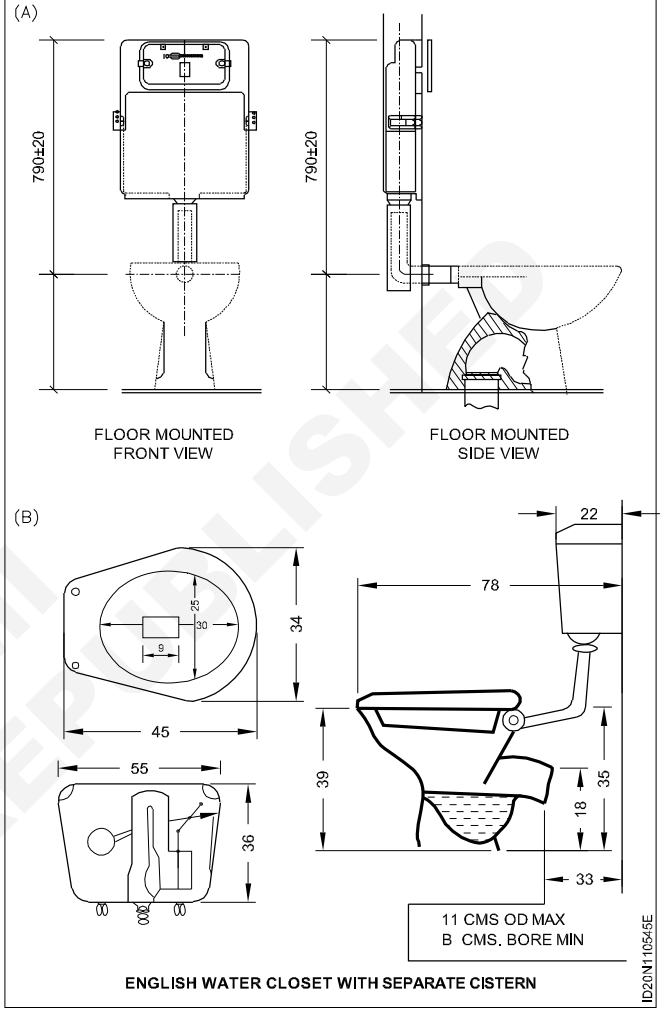
Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes. The flushing rim and inlet shall be of the self draining type. It shall have a weep hole at the flushing inlet shall be in the front, The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. Trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia.

i The top surface of long pattern pan shall not at any point vary from its designed plane or contour by more than 6 mm for size 580 mm and by more than 10 mm for size 630 mm and measured vertically.

This value shall not exceed 10 mm in case of Orissa pattern pans.

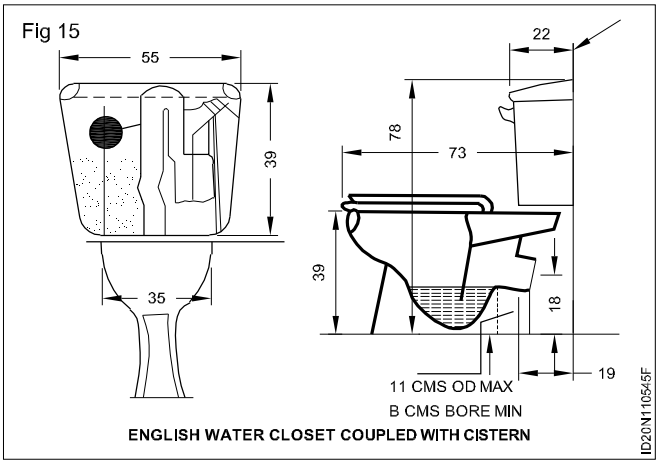
ii European water closet (Fig 14, 15, 16 & 17)

Fig 14



ENGLISH WATER CLOSET WITH SEPARATE CISTERN

Fig 15



ENGLISH WATER CLOSET COUPLED WITH CISTERN

a On dimension 50 mm and over ± 4 percent

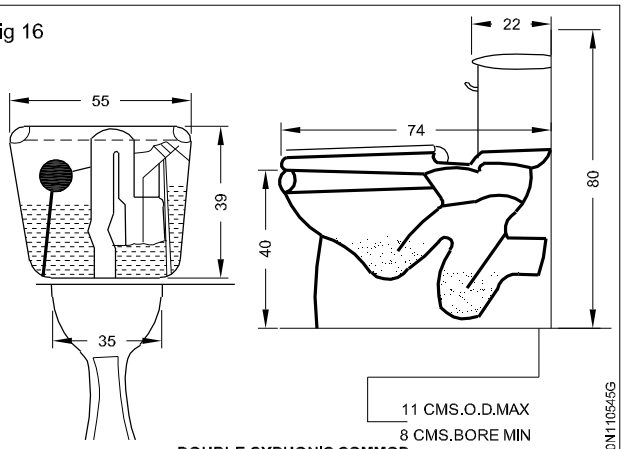
b On dimension of less than 50 mm ± 2 mm

c On all angles ± 3°

Fig 14 to 17 shows the section through a wash-down type water closet, which is most commonly used in high class

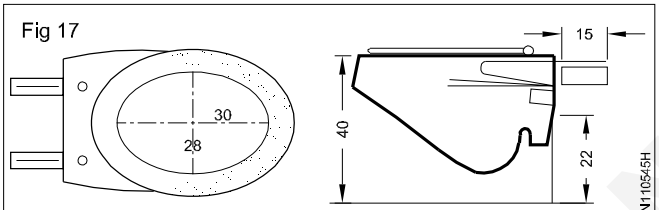
buildings. It is provided with a wide flushing rim and 5 cm trap. It is one-piece construction in which the pan and trap are not separate. It is provided with an inlet or supply horn for connecting to the flushing pipe. It may be provided with P and S trap as desired. These types of water closets require less space than squatting pattern type and can be flushed by low level cistern. Now-a-days symphonic water closets are very popular, with conceals flush tank (Fig 14a)

Fig 16



DOUBLE SYPHONIC COMMOD

Fig 17



WALL HUNG W.W.C.

either 'S' or 'P' outlet with at least 75 mm water seal. Where required the water closet shall have an antisiphonage 50 mm dia. vent horn on the outlet side of the trap. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 15 liters of water between the normal water level and the highest possible water level of the water closet as installed.

Description of concealed flushish cistern. (Fig 14 (a)

Concealed flushing system

The concealed flushing system in which the cistern is hidden mostly behind the walls and only the water closet is visible. It is concealed, which means it is hidden behind a cabinet or wall that can be accessed via a maintenance panel.

Benefits

Save space in the bathroom and good appearance.

Offer a hygienic option and is easier to clean

De merits:

They can be expensive

Only installed with European water closet.

Working of concealed flushing cistern

A concealed tank toilet is where the cistern or the top tank part of the toilet is not visible. The toilet bowl seems attached to the wall and only the flush buttons are visible. This cistern working has normal flushing cistern.

Specifications Seats and covers for water closet

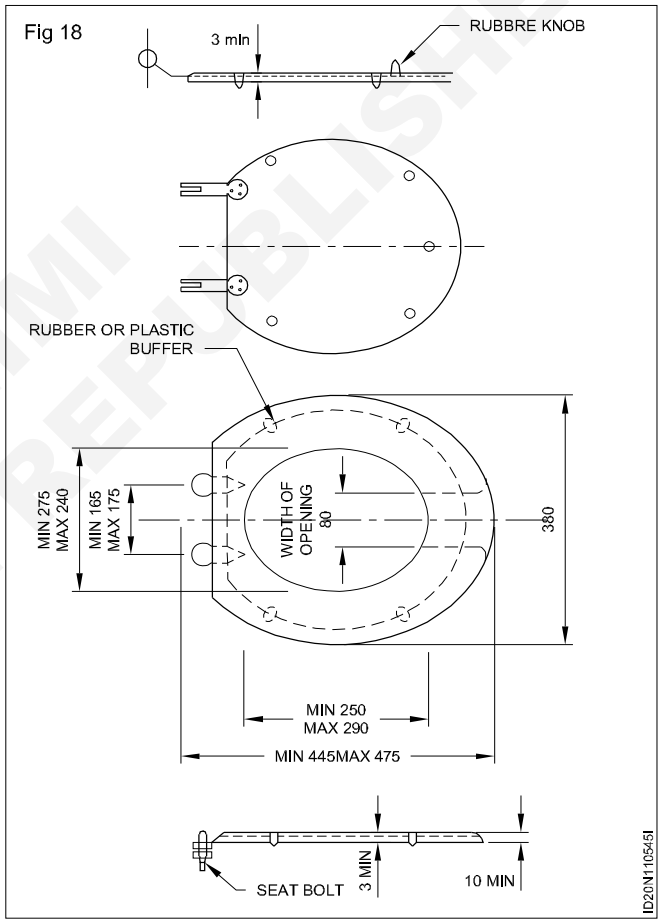
The seat and cover may be of wood or plastic, as specified. Unless and otherwise specified these shall be of closed pattern.

a Wooden seat and cover

These shall be of type I confirms to I.S. : 776 - 1962. These shall be made of timber, such as well seasoned teak wood or mahogany, as specified, and shall have C.P. brass hinges and rubber buffers.

b Plastic seat and cover (Fig 18)

Fig 18



These shall conform to I.S. : 2548 - 1967. These shall conform to I.S. : 2548 - 1967. These shall be made of moulded synthetic materials, which shall be tough and hard with high resistance to solvents and shall be free from blisters and other surface defects and shall have C.P. brass hinges and rubber buffers.

There shall be a 100 mm dia. white glazed vitreous China channel with stop and outlet pieces in front.

Urinals

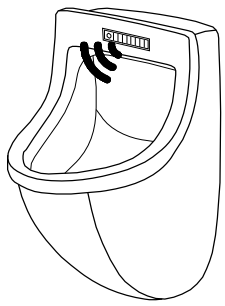
The following types of urinals are generally used.

- Flat back

- Corner type
- Half stall
- Senso type
- Stall
- Squating plate
- Water less urinal

Sensor type urinals (Fig 19) : Manufactures from white vitreous china clay. These urinals are fitted with sensors so that automatic flush tank will work only when it is used. Thus there is a lot of saving in water and at the same time immediately after use it is flushed automatically size 61 x 39 x 38cms. (Fig 19)

Fig 19



SENSOR URINAL

ID20N1110545J

Sensor system for urinals and wash basin sensor taps

Objective: At the end of the lesson you shall be able to
- **explain sensor system for urinals, wash basin, sensor taps and soap dispenser.**

Urinal sensor/ flusher

Definition : To keep your bathroom & restrooms Hygienic & safe, you need to use a good automatic urinal sensor and senor flusher. They are very effective & easy to use while giving you a very attractive appearance.

Touchless urinal sensor/sensor flusher is quite perfect for private bathrooms, public toilets, workplaces and malls.

These sensor urinals / sensor flushers have touch-free features which helps to maintain the hygiene in the surroundings. The best part is that these touch free urinals are found in different designs & shapes and it is backed with intelligent technology & Low power consumption.

They also tend to save water and uses the water only when required.

Also, you can purchase automatic urinal sensor at a very cost effective price.

- Stylish ceramic urinal in white color with embedded sensor for automatic flushing and toilet sensor flushing system
- Deodorize feature of 24 hours voluntarily flush if no use
- False flush protection with live indicator to represent sensing & flush ready modes
- Sense to respect feature to avoid splashing on second person in queue
- 100% hygiene touch free urinal sensor for washroom
- Best price of infrared urinal sensor in Delhi and whole India
- Automatic urinal sensor at high discounts & best price in Delhi, India - with Unmatched deal
- Proper cleanliness

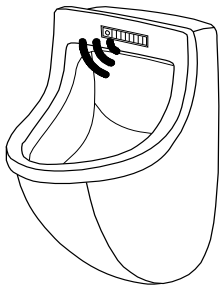
Advantages of getting automatic urinal sensor

- **Proper cleanliness :** An automatic urinal sensor ensures that everything gets cleaned automatically without using the hands. For instance, if a person forgets to flush the urinal manually, then auto flush sensor feature very well helps to take care of it.
- **Longer lifespan :** The urinal motion sensor are hands free and thus the mishandling & wear and tear is minimized. Hence, the chances of damage gets reduced.

  This arguably results in the longer lifespan of the urinal sensor for washroom.
- **Reduction in wastage of water:** One of the major advantage of urinal sensor is that they reduce the wastage of water as compared to manual urinals. Also, there would be delay between one flush to another which ensures that you are not flushing again and again.
- **Easy to use:** Automatic urinal sensor is quite easy to use and thus it is perfect for elderly or young children. The reason is that waste material gets flushed automatically while maintaining the utmost hygiene.

Different types of automatic urinal sensor (Figs 1 & 2)

Fig 1



SENSOR URINAL

ID20N1105461

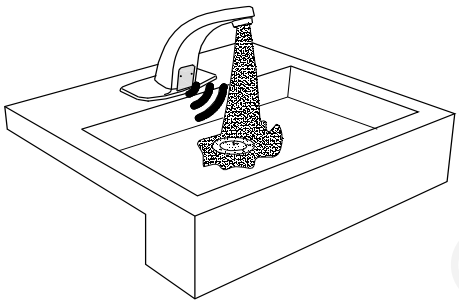
- Concealed urinal sensors
- Exposed urinal sensors
- Integrated urinal sensors

Neutral features of sensor taps (Fig 3) : Newbies will need a few seconds to realise how to use a touchless tap. A clear sign explaining that it is a motion sensor tap helps to cut down confusion. After such an initiation, visitors will know from then on that automatic faucets are a possibility in washrooms, like we all did with manual and push taps.

All faucet filters need to be checked regularly, including those inside the sensor tap system. Cleaning tap filters is fundamental before using the electronic tap for the first time and after a water cut.

Fig 2

Fig 3



SENSOR WASH BASIN

ID20N1105463

Since smart taps require power, they will run out of battery eventually. Most models in the market will let staff know the need for a replacement with LED warnings. There are different battery options, but they will last for at least 1 year.

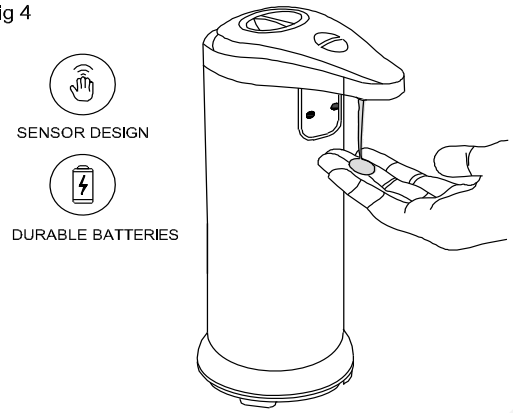
Advantages of getting automatic urinal sensor

- Water conservation
- Energy saving in the long term
- Reduce water bill amount
- Provide cleaner area in the bath room
- Provide dust free prevent cross contamination of users through tap.

Automatic soap dispenser (Fig 4) : An automatic soap dispenser is a device that dispenses a controlled amount of soap solution (or a similar liquid such as a hand sanitizer). They are often used in conjunction with automatic faucets in public restrooms. They function to conserve the amount of soap used and stem infectious disease transmission.

Application : The implementation of automatic washroom supplies has increased dramatically. An increasing number of public locations and private institutions have been incorporating touchless technology into their washrooms.

Fig 4



AUTOMATIC SOAP SENSOR

ID20N1105464

Mechanisms : When washing hands, the user's hands are placed under the nozzle and before the sensor. The activated sensor will further activate a pump that dispenses a premeasured amount of soap from the nozzle.

Radar-based sensor: This kind of sensor sends out bursts of microwave or ultrasound energy and waits for the energy to reflect back. In a stagnant situation, the energy will bounce back in a normal pattern. When hands are placed in the basin, the energy emitted from the sensor will bounce back irregularly which triggers the dispensation of soap. Modern sensors used in electronic faucets, electronic flush valves and electronic soap dispensers use Infrared light with wavelength in the range of 850 nm. The sensor employs an emitter and a collector. The emitter emits pulses of infrared light while the collector, which is positioned to face in the same direction as the emitter, "sits" dormant waiting to sense the emitted pulses. When no hands are present in front of the device, no reflection of light takes place, and therefore, no pulse is sensed. When hands are present in the path of the emitted light, a portions of the emitted infrared light is bounced back in the direction of the collector which then becomes excited by the light (in the event a photodiode is used) and generates voltage to switch the pump on. If a photo transistor is utilized, then the photo transistor, upon sensing the infrared pulse, will simply switch the pump on.

Photo sensor: This mechanism is composed of two parts, a source of focused light (usually a laser beam) and a light sensor. When the user's hands are placed in line of the beam of light, the pump mechanism is activated by the disruption that is sensed by the light sensor.

Passive infrared sensor: Infrared sensors detect infrared energy that is emitted by one's body heat. When hands are placed in the proximity of the sensor, the infrared energy quickly fluctuates. This fluctuation triggers the pump to activate and dispense the designated amount of soap.

Advantages

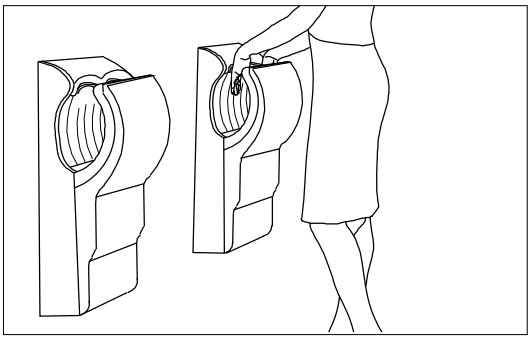
Touchless : The advancement of the automatic soap dispenser further creates an even more sterile environment. When various individuals use the pump, they will leave behind a variety of bacterial colonies.

Preset increments : Dispensers will only distribute a set amount of soap per motion activation. A predetermined amount to be dispensed can be set to a highly efficient quantity in which waste will be minimal.

Versatility: The mechanisms of the dispenser that work for soap may also work for other liquids: soap, hand sanitizer, lotion, laundry detergent etc. The wide range of possibilities extends the use of the dispenser to various other locations other than the bathroom.

Hand dryer (Fig 5): A hand dryer is an electric machine which might make use of a heating element and an air blower to dry the hands after hand washing. It is commonly used in public toilets as a cost-effective alternative to paper towels.

Fig 5



HAND DRYER

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It may either operate with the push of a button or automatically using a sensor.

Effect on environment: Due to the reduction in litter and waste in comparison with paper towels, which cannot be recycled, hand dryers are claimed to be better for the environment.

Hygiene and health: The World Health Organization (WHO) and the Centers for Disease Control and Prevention both stress the importance of frequent and thorough hand washing followed by their complete drying as a means to stop the spread of bacteria.

A study in 2020 found that hand dryers and paper towels were both found to be equally hygienic hand-drying solutions.

Water less urinals : Aqua free white vitreous chine clay. This can be put into use without water connections size available is 60 x 30 x 31.5cm. it is costly.

Wall flat back urinal/corner urinal (Fig 6, 7 & 8) : These are manufactured from white vitreous chine conforming to IS2556 (PVI). The urinals are one piece construction. These have two fixing holes of a minimum ∅ 6.5mm each side. It has a connect an outlet pipe. Inside surface of urinals are uniformly smooth.

Stall urinal slope (Fig 9) : The stall urinal and its screen are of white glazed fire clay and confirm to IS771 (Part 3 sec 2). It is 1140mm high 460mm wide with 400mm overall depth at the base. Screen are of size 1200mm 15cm wide (overall) and projects 50cm after embedding in the wall. Inside surface of stall and screen are regular and smooth-water spreaders as per IS2556 (PVIse6) is to provided. (Fig 9)

Fig 6

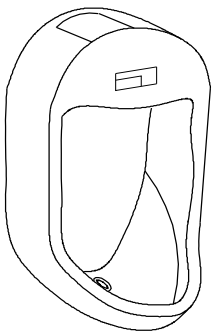

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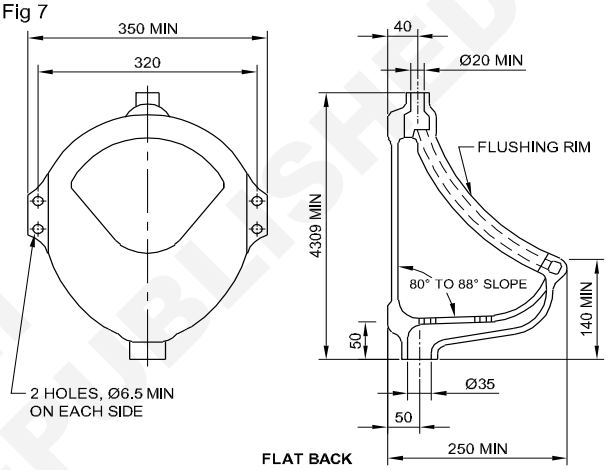
Fig 7



FLAT BACK

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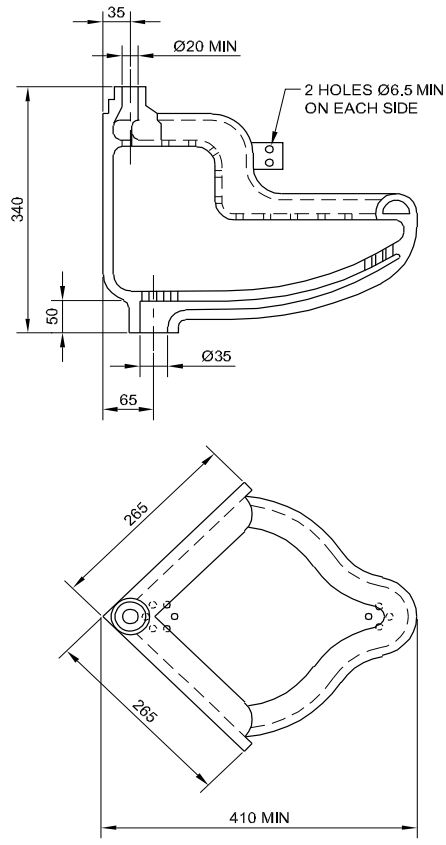
Fig 8



ANGLE BACK

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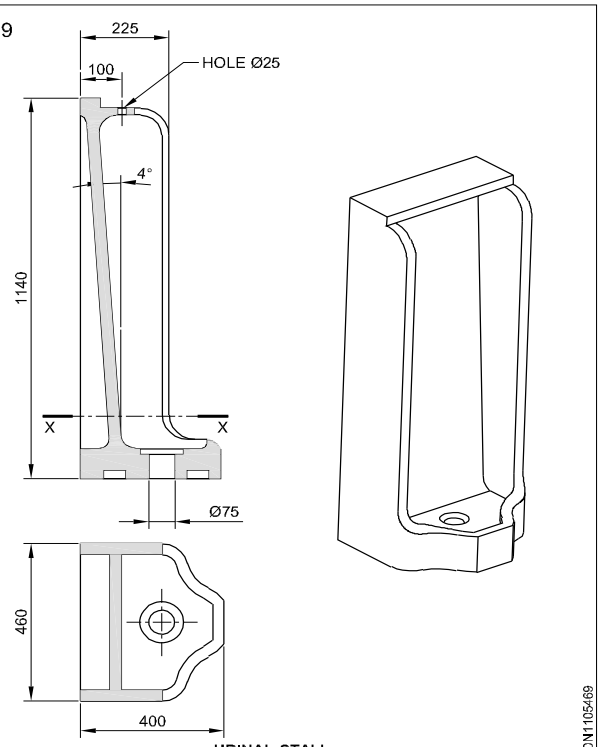
Fig 9

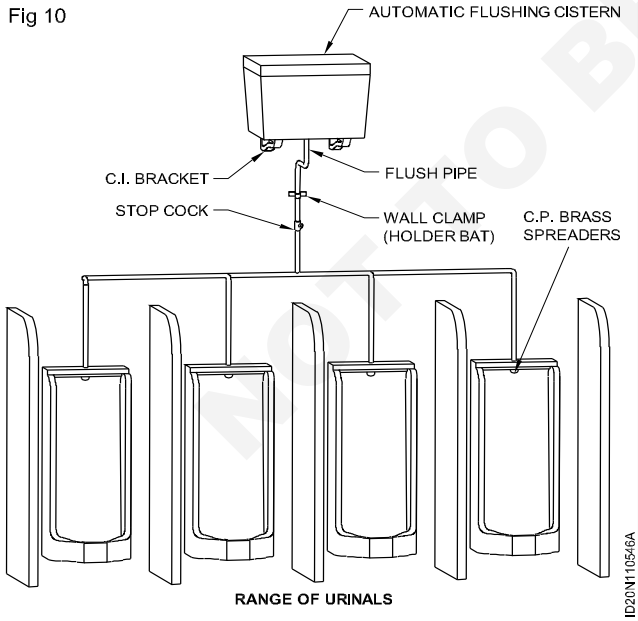


URINAL-STALL

Half stall urinal: These are to be manufactured as per IS2556 (PVI Sec2). They are onepiece construction with or without integral flushing box rim-water spreader shall to be provided if integral flushing rim is not provided.

Squating plate urinal (Fig 10 & 11) : These plates are of white vitreous china conforming IS2556 PI and Part VI sec 3. These are having internal flushing rim with front or side inlet. These are of onepiece construction - urinals are having integral longitudinal flushing pipe which can be connected to flush pipe.

Fig 10

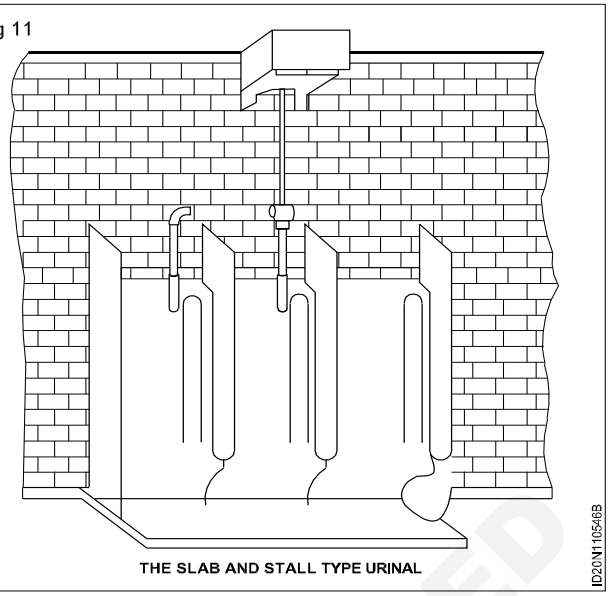


RANGE OF URINALS

100mm while glazed vitreous china channel with stop and outlet piece in front is also a part of this.

Automatic cistern for flushing are fixed at a height of 1900 from floor to bottom. If urinals are fixed in a row it shall be at 690mm centre to centre.

Fig 11



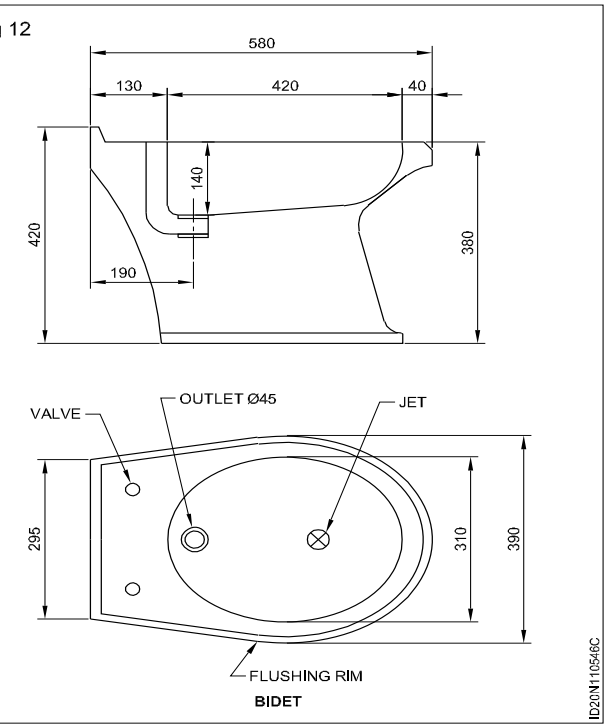
THE SLAB AND STALL TYPE URINAL

Specifications of urinals

Bowl type Urinals : Urinals basins shall be of flat back or corner wall type lipped in front. These shall be of white vitreous China conforming to I.S.: 2556 (Part I) - 1967 and I.S. : 2556 - (Part VI) Sec. I - 1974. The urinals shall be of onepiece construction. Each urinal shall be provided with not less than two fixing holes of a minimum dia of 6.5 mm on each side. Each urinal shall have an integral flushing rim of suitable type and inlet or supply horn for connecting the flush pipe.

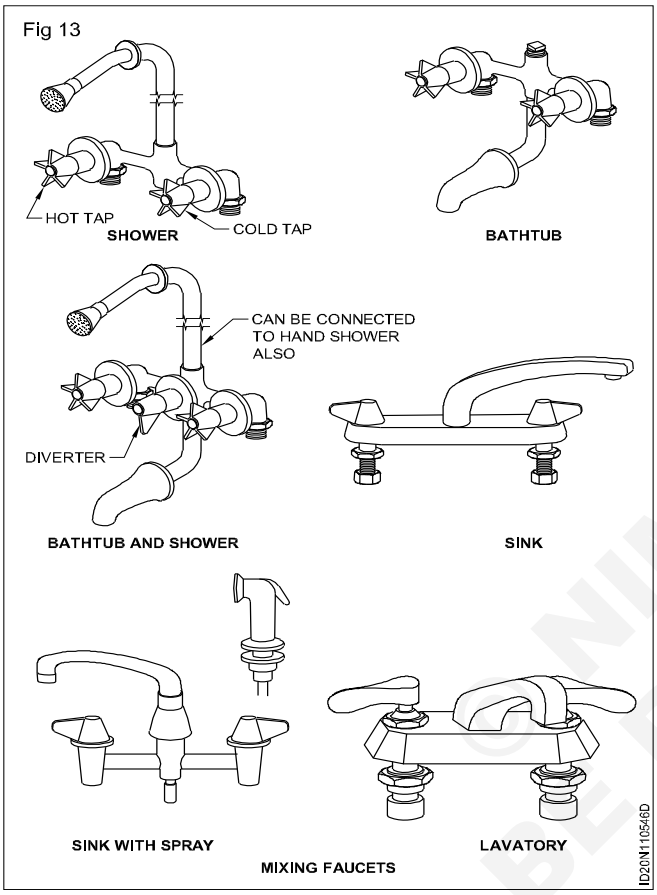
Bidet (Fig 12) : The bidet is pronounced as "beday". The bidet is designed for cleanliness of localized parts of the body especially of genitor urinary cleanliness. The bidet is equipped with valves for both hot and cold water and with popup waste plug, a flushing rim, an integral jet operated by means of valve. When the Jet is "ON" a stream of water flows upward from bottom section of bowl enabling cleaning.

Fig 12



BIDET

Mixing tap (Fig 13) : When hot and cold water supply is available the faucets used on lavatories, bath tubs, bidet and kitchen sink are to be mixing type. Instead of two separate units one for hot and cold water valves combined with a single spigot. This permits adjusting the temperature of the water to users' preference. Some of the various types of mixing faucets are shown in Figure. Hot water connection is given to the left side of the user and cold water on right side. Hot water taps are generally identified with red spot on top of tap.



Requirements for sanitary fittings

The requirements for sanitary fittings depends on the persons using them and the circumstances, type of building etc. For calculating the number of sanitary fittings required the following table 1 can be used.

General points to be observed when choosing sanitary

Five factors to consider choosing best sanitary ware for your bath room. To achieve that goal here are some tips that wise help you to choose the best sanitary ware for your bathroom that suits your needs.

1 **Color:** While choosing color you should know how to combine colours that complement each other. 76 yellow/ golden would be the accent color that you want, keeping every thing else white would be good but powder blue cabinets go well with it too. If you are not sure about this, it would be best to stick to white it's a safe

2 **Comfort:** Since you are going to spend money anyway, why not to invest on sanitary ware that make your life little comfortable. If you can afford it invest in bath tub and a shower that allows temperature adjustment.

3 **Ease of cleaning:** It would be convenient if all of your sanitary items in bathroom have a self cleaning feature. Always think how easy an item would be to clean before buying them. Otherwise you would end up swearing up and down while scrubbing the bath room.

4 **Size:** If your bathroom size is small so it would be better to off for sanitary wares which are in small size. Always plan the size of bathroom as per your requirements. Accordingly, choose the sanitary ware as per the space available.

5 **Resistance:** While choosing bathroom sanitaryware two major factors have to be put into consideration. These are strength and design. Toilet bowls and bathroom basins should be of good design and also be strong enough not to chip and break easily there should be no sharp edge and ensure that thay are well fitted.

Factors related with choosing right sanitary wares

1 **Importance of choosing right toilet basin:** Ensure that the toilet basin should be in the right shape, size and style which make great difference in the bath room.

2 You must consider the type of tap you choose for your toilet basin because it can affect the aesthetic of your sink and bathroom.

3 More commonly seen the deck mount offers easier installation and future maintenance. The other option which is wall mounted tap gives luxurious appeal. It is more space efficient especially for sweller home toilets.

4 Material of toilet basin depends upon the individual's requirement there are many materials used for toilet basin like marble, stone toilet, ceramic.

5 Marble/ stone toilets basins are strong and durable and easy to clean the ceramic toilet basin is economy and easy to clean.

6 Before buying toilet basin you must ensure that the type of mounting to be taken into consideration.

Introduction of natural and artificial light and types of lighting arrangements

Objectives: At the end of this lesson you shall be able to
- **explain about light**
- **state and explain different terms used in illumination.**

The electromagnetic spectrum: Light is a form of electromagnetic radiation. It is basically the same thing as the radiations used in radio, television, X-rays, gamma rays etc. Visible light is the radiation in that part of the spectrum between 380 and 760 nm, to which the human eye is sensitive. A nanometre is a wavelength of one millionth (10^{-6} mm) of a millimetre. Within these limits, differences in the wavelength produce the effect of colour, blue light being at the short-wave and red at the long-wave ends of the visible spectrum. Because the human eye is more sensitive to the yellow and green light in the middle of the spectrum, more power must be expended to produce the same effect from colours at the end of the spectrum. This is why the monochromatic low-pressure sodium lamps which emit all their visible energy in two narrow bands in the yellow region are more efficient in terms of light output than `Natural light' fluorescent tubes that imitate natural daylight pretty closely, and emit approximately equal packets of energy in each spectral band.

The areas of radiation on either side of the visible spectrum are important to the lamp maker. Wavelengths shorter than those of violet light are designated `ultraviolet' or UV, and have the property of exciting fluorescence in certain phosphors. That is, when irradiated with UV, they themselves produce visible light. Infra red radiation at the other end of the spectrum, produces a heating effect which may be considered simply as radiant heat. In the case of a filament lamp where light is produced by heating a coil of wire in the incandescence, far more infra red radiation is produced than the visible light, and this is radiated and may be reflected with the light.

Definitions : Before proceeding further, definitions of a few principle terms employed in connection with illumination are given below.

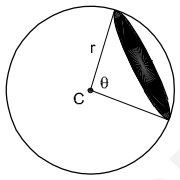
Luminous flux (F or Φ)**:** The flux of light emitted from a luminous body is the energy radiated per second in the form of light waves. The unit of luminous flux is `lumen'(lm).

Luminous intensity(I): The luminous intensity of a light source in a given direction is the luminous flux given out by the light source per unit solid angle. The angle subtended by an area r^2 on the surface of sphere of radius r, at the centre of sphere is unit solid angle. In SI, the unit of luminous intensity is the Candela.

Candela: This is the amount of light emitted in a given direction by a source of one candle power. SI base unit is Candela (Cd). 1 Candela = 0.982 international candles.

Lumen (lm)**:** It is the unit of luminous flux. This is defined as the amount of light contained in one steradian from a source of one Candela at its focus. (Fig 1)

Fig 1



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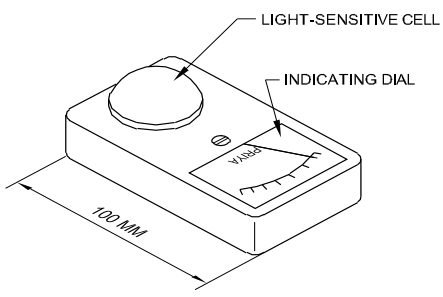
If the shaded area = r^2 and a source of one Candela is at the centre C, the light contained within the solid angle is one lumen.

The light output of electric lamp is measured in lumens and their luminous efficiency (efficacy) is expressed in lumens per watt (lm/w).

Illuminance or Illumination (E): Illuminance of a surface is defined as the luminous flux reaching it perpendicularly per unit area. The metric unit is the lumen m^2 or lux (lx).

The flow of light into a plane surface is called the `illuminance', and is expressed as the number of lumens arriving per unit area. The metric unit is the lux, i.e. one lumen per square metre. Lighting engineers use a pocket-size instrument called a `lightmeter' to measure illuminance; it is placed where the measurement is wanted, and the reading in lux is read off the scale (Fig 2). This is not the same sort of instrument as a photographic exposure meter, which measures brightness, not illuminance.

Fig 2



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TYPICAL POCKET-SIZE LIGHT-METER FOR MEASURING ILLUMINANCE.

Measured brightness is termed `luminance', and it should not be confused with `illuminance'. Its units are the Candela per square metre and the lumens emitted by a luminous surface of one square metre.

Two other terms that are easily confused with each other are `luminance' and `luminosity'. The first is measured brightness expressed in or Candelas per square metre, the second the apparent brightness as seen by the eye.

A simple example is the appearance of a motor car head lamps by day and by night. Their luminance is the same in both conditions but their luminosity is far greater at night than when it is seen in daylight.

Artificaial lighting

Nowadays, except where limited effect is needed, like during diwali or ritural worship, the source of artificial lighting is only electricity.

Aritificial lighting has to be provided : In areas where reommended illumination levels can not be obtained by daylighting, eg, areas without windows, or where natural daylight can not be allowed to enter for some reason, like, photographic darkrooms. Or at the times where natural daylight is not available, like night.

In areas which have insufficient level of illumination and required supplementary source of light, like basements. Or times when the level of daylight illumination is insufficient. Eg, at dawn and dusk.

In areas where visual taks demands a higher level of illumination, like at the drawing board.

Integration of lighting and air-condition systems : The return air from the air-conditioning systems passes through the sources of light and car remove a considerable amount of heat generated by them at source and only a fraction of dissipated in the inter thus reducing the on air-conditioning system. So the interation both is not only practical but also hight economical.

Artificial lighting to supplement day lighting : When daylighting provides low level of illumination, when it is required beyond hours or when conditions necessitate artificial lighting is required supplement daylighting.

Cool daylight fluorescent lamps are recommend supplementary lighting at a height o not less than 1.5to 2 m the work plane for a separate of 2 to 3 between the Also, the lamps to be preferably in the rear half off interior provide for the darker areas.

Lighting of various interiors : Every interior has its own lighting requirement. The size use, and people occupying it decide the lighting of interior.

Living room : A living room generally requires diffused liquid provide by down lighters for pleasant environment to site converse and watch for reading, a corner can be select and a standard lamp fixed, place diagonally behind book reader with a shade to focus light on the with light escaping in the environment.

Creation of mood is also very important dinning room. Wire there is a gathering, or unexpected visitors sudden celebration of any event. The light dimmers can be to use to increase or decrease light, and a spontaneous sing soiree, or the group of excess of visitors spilling into living room from the dining room for dining can enlivened by the dimmed light.

Kitchen : Fluorescent lamp fixed on top cooking platform in pelmet, the pelmet working as a shield against glare. best for a kitchen. An incandescent lamp will give, natural rendition of foodstuff, but more than the cleanliness has to be emphasised in a kitchen fluorescent lamp evokes that "neat and clear feeling.

Dinning table : A dress in tables should hang just above, or on a with the heads of diners to avoid shades. Longer table night require two lamps. Employment of incandescent lamps is recommended as it enhances the complexed of diners and colours of dishes

Dressing table : Dressing table should have light which reflects on the person in front of it and not on the mirror.

Bathroom : Bathroom requires general lighting for bath and washing, and specific light for dressing at washed, so lighting arrangement for this should also be

Office : Offices and commercial spaces are usually illumined by light engineers claiming to achieve only efficiency. This drab lighting design results in fatigue of the occupants. As an employee passes half of his active life in his workplace, it is important that it should have some of the comfort of a residence. That includes the cheerful ambience which light should provide.

Instead of false ceiling, light is integrated in the ceiling design, thus saving a lot of expenditure.

Now offices incorporate a lot of plants, paintings, graphics, sculpture and murals which require skillful accent lighting achieved through halogen. Spotlights and general lighting achieved through wall washers. Fluorescent lamp are employed to provide bluish white general lighting and yellowish incandescent lamps to provide specific lighting. Halogen spotlights also blend well with the background fluorescent light.

Restaurant/Night clubs : Most successful restaurant designs are built around a theme, and to augment, enhance and sustain them, and to create corresponding ambience custom built lighting is a must. Art nouveau and art deco movements produced unique examples of such designs and should be referred for inspiration. A novel architectural features and materials are employed in its interior, novel lighting designs should also be employed.

In most restaurants, and.in all night clubs, creation of intimacy through light is of prime importance. This is achieved with suspended dim incandescent table light which just lights the diner's face and table top, reducing the surrounding in background producing the effect that only those diners exist there.

Another very important factor is to show the compexion any features of diners and colours of food tiems favourably, which again is achieved through dim incandescent lamp.

Exhibition galleries : Lighting has to be tackled on two fronts; the interior it selef and the exhibits. An exhibition gallery is usually piece of art in itself and as such lighting design has to be custom made.

Two dimensional exhibits like painting, graphics must be spotlighted from top, and three dimensional exhibits should be lighted from side to modulate them and enhance their texture and colour.

A variety of lamps and fixtures can be installed on suspended grid system to make use of flexibility and adjustability provided by the system

Dance halls : Dance halls, ball rooms, discotheques, etc, are interiors where lighting is used at its dramatic best. These are also interiors where lighting is an integral pa t of the structure. All the new innovations find their place first in a dance hail, and only in dance halls all the elements of structure, like ceiling, walls, columns even floors are illuminated from inside.

Apart from general lighting, during the performance, the most of lighting system is controlled by manual/automatic dimmers.

Light & lighting

Objectives: At the end of this lesson you shall be able to
- **understand and lighting and its types**
- **patterns of light**
- **understand usage of light in different spaces.**

Three basic types of lighting are

i General lighting

ii Task lighting

iii Accent lighting

Light is measured in terms of:

Wattage: The amount of electricity consumed by a bulb.

Lumens: The amount of light that a bulb produced. **Foot candle:** The amount of lighting reaching a subject **Basic types of lamps**

Incandescent

1 Bulbs with tungsten filament.

2 Argon/nitrogen gas is used.

3 Lumensper watt energy consumed lowperformance.

4 Life 700 -1000 hours. (Can be used as a dimmer).

Halogen bulbs

1 Same principle as incandescent.

2 Bulbs glows when tungsten filament is heated.

3 Halogen gas is used

4 Life of the bulb is more.

5 More lumens per watt but more expensive

6 300W bulb can reach 300°C (Care taken) fire hazards

7 Relatively small in size

Gas discharge resources

i Low intensity discharge

a Low pressure mercury vapour

b Low pressure sodium vapour

ii High intensity discharge

a HPMV

b HPSV

c Metal halide

Strength of light : Different sources of light provide different strength of light and for different periods as we have discussed earlier. For instance, a fluorescent lamp of 40 watts gives two as much light as in, incandescent lamp of 40 watts and lasts longer. An open light gives about 25% more light than the concealed one. General lighting should be ranged considering all these points. Most important factors are to avoid glare and dimness.

Types of lighting and their shades/covers

Lighting can be kept open or concealed.

Open light

These are open lights:

1 Ceiling light

2 HAnging light

3 Bracket light

4 Pedestal light

5 Table light

6 Floor light

7 Indication light (bell, telephone)

Open lighting is normally used with shades to avoid glass and to give diffused light. Shades should coordinate with the decor and color of the interior. If they are made of cloth or glass, care should be taken to provide more space around the lamp. As far as possible, the cover should be of white or a tint to absorb lesser amounl light. Darker colours can be chosen if the required lei of illumination is not considerable.

Concealed lightings are more pleasing to the eye, tho they reduce illumination and produce considerableh which should be effectively removed. For this purpo minimum 2.5 cm space is left around them.

Types of lighting

Lighting can be divided into various catergories accorcing to various considerations

position-wall, bracket

movability - Fixed, portable

Adaptability - Tracking ,turning,swivel

Adjustability- Dimmable, undimmable

state- Open,concealed

purpose -General, specific , accent

Direction-Direct, indirect variations of these

Architectural- Cove, valance, recess.

Application-Wall-washer,ceilling-downlight

Lighting fixture:-

1 Architectural lighting

2 Portable lighting

1 Architectural lighting

a Ceilng mounted

b Wall mounted

a Ceilng mounted

1 Incandescent hanging or decorative pendants or chandeliers.

2 Incandescent recessed or surface mounted down lights

3 Track lights

4 Surface mounted or recessed mirror optics luminaries

5 Cove lighting

b Wall mounted

1 Wall brackets

2 wall mounted up lights

3 Valance lighting

4 Cornice lighing

5 cove lighting

2 Portable lighting

1 Shaded incandescent table of desk lamps

2 Globe lamps

3 Shaded incandescent floor lamps

4 Floor mounted up lights.

Characteristics of a good lighting system

Effeciency : % of total number of lumens incident on plans

Uniformity: Variation in light, execessive shadows or bright streaks has tiring effect on eyes% deviation from the average illumination level.

Diffusion: Indirect lighting light reflected on wide ceiling.

Eye protection: Glare of reflected glare should be avoids angle of light 65°from the vertical.(Not harmful)

1 Direct glare

2 Reflected glare

3 Colour rendering

4 Refectance

5 Light comfort

a Cove lighting

1 A cover or a pocket built into the ceiling (or walls).

2 light units usually fluorescent are concealed in the cove and provide indirect light .

b Wall mounted:

Wall brackets:

1 Use of pear shaped lamps (bulbs or tubes) or unishaded globes for direct light

2 Corridors or at stairs, bathrooms or dressing rooms

3 Bulb covered with a decorative feasted or opal glass, living rooms, bed rooms, halls etc,

Wall mounted uplights:(Scones)

1 Same as floor up lights provides indirect general lighting .

2 Rooms looks spacious and higher light

3 Used in classical rooms, highlighting cornices low light only.

Valance lighting

1 light souce is mounted so that the light is directed up towards the ceiling

2 some ovet the draperies of the wall.

3 Flowescent tubes installed behind the valance frame which are painted white to reflect the light.

4 Min 10'' Between valance ceiling.

cornice lighting

1 It gives general illustration.

2 placed behind a cornice at least 6'' in depth at the junction of ceiling of wall.

3 Fluorescent tubes used because been cooler

Ceiling mounted:

Hanging or pendants or chandeliers:

1 Several bulbs or single bulb hung.

2 Contemporary forms or historic designs.

3 provides general lighting both up and down.

4 Various shades of globes are used.

I Recessed, surface mounted down lights:

1 Designed to beam light downwards.

2 Lens above fitted to prevent direct glare of reflect light downwards.

3 Fixture availabel in 2 types gold and silver, surface finish

4 Silver does not effect the colour of light Gold gives a warm glow.

Track lights:

1 Elactricals track made of metal ceiling mounted or hong

2 lights can be adjusted given both spot of general lighting

3 Used: Showrooms, exhibition galleries of residential setting.

Surface mounted or recessed or mirror optics luminaris:

1 Architectural lighting devices widely used.

2 light can be delivered at work surface levels.

3 Used: Officers, factories of shops.

4 Glare control lensesor louvers are provided.

5 Louvers of parabolic cross sections do this with a minimum of light loss.

6 Hence lighting fixture also known as mirror -optical fitting .

Gas discharge sources:

Low intensity discharge source :

LPMV: Fluorescent tube light low intensity electric discharge .

1 Fluorescent power activated by UV energy generated by a mercury arc.

2 Transformer or ballast (Provides requored lamp voltage)

3 Enclosed in metal boxes

4 starter

5 Economical 1/3 to 1/5 power consumption.

6 Factoroes, offices,calss rooms, restaurants ,stores (low cost)

LPSY

1 Passage of electric discharge this sodium vapour.

2 Consist of U -shaped inner tube.

3 Gas used inert gas mixture+sodium metal.

4 Outer bulb is made to reflect the radiated heat.

High intensity Discharge Source :(HID)

HPMU: Light produced electric discharge mercuvapour at high pressure within an arc tube.

1 2 envelopes innet one quartz glass.

2 are tube contains nitrogen gas.

HPSV:

1 Light produce electric discharge sodium vapour high pressure within an arc tube.

2 2 envelopes, lamp made of .

Metal halide: (MHL)

1 To widen the spectrum of emitted light

2 To improve colour rendering of efficiency

3 Metal halide the zinc or cadmium iodides added to

Principles of lighting

We have already discussed the purpose of good lighting. Let us discuss how we achieve the aims set out there.

These include:

1 Planning of brightness/colour pattern

2 Effective use of light sources

3 Planing of visual comfort

4 Reducing the shortcomings of artificial light sources

5 Consideration of safety

6 Installing emergency lighting systems.

1 Planning of brighyness /colour pattern : The brightness and colour pattern within the working areas and the surroundings should be thoroughly planned to attract attention naturally to important areas, to show the details quickly and precisely, and to make the interior free of any hint of gloom of monotony,especially duing a gloomy weather like monsoon.

The brightness pattern within an interior comprises three parts:

1 The task itself.

2 Its imediate surroundings, and

3 General surrounding of wall/ceiling /floor/equipment/ furnishings.

In an interior, where visual demands might be low, but considering the welfare,safety, amenity and health of the occupants, a general level of brightness of 150 lux should be provided.

If the whole stretch of an interior is used as work area,the illumination provided should be of a reasonably uniform quality, and if possible, the ratio of minimum to maximum illuminance should not be less than 0.7

After determining the appropriate task brightness of atask, the brightness of its immediate and general suruounding should be decided. Here is a general guide for luminance (brighness) ratio within the normal field of vision.

Relation between	Luminance ratio
Task and its details for focus	2:1
Task and immediate surrounding	3:1
Task and general surroundings	10:1
Luminaries/windows and sizeable background	20:1
Task (like chandelier) and surrounding for glitter	40:1
Task and surrounding for hightlight	50:1

Effective use of light sources

in appropriate areas, directional lighting should be used to assit perception of detail and to render effective modeling.

The recommended valves of illumination for various tasks are given in the following table. Whether the source of lighting is daylight, electric light or a combination of both, the values are standard.

The different tasks and locations have been grouped as:

1 Industrial/process buildings

2 Office /schools/public building

3 Surgeries/hospitals

4 Hotels/restaurants/shops/homes

The illumination levels recommended should be maintained throughout on task or location.

These are not absoulute quantities but a guide to good practice. the horizontal plane for performing various tasks has been talen as 75 cm above the floor level. For unspecified task planes, the height is taken as 85 cm above the floor level.For the localised specific tasks, the value recommended is for the task only not for general lighting,which should be lower than the specific value.

Recommended values of illumination

Visual tasks	Illimination value in lux
General factory areas	
Cafeterias	150
Cloak rooms	100
Entrances/corridors/stairs	100
Factoruy outdoor areas	
Stockyards/main entrance/exit roads/car paks/internal factory roads	20

Lights - types - functions - showcase lighting

Objectives: At the end of this lesson you shall be able to
- **name the types of bulbs for illumination**
- **design illumination for direct and indirect lighting.**

Types of lamps used for illumination: The lamps used are:

- Incandescent lamps of many varieties
- Tube lights

Types of bulbs/incandescent lamps

- Glow lamps
- Luminous lamps
- Tree light lamps
- Movie flood lamps
- Silvered bowl lamps
- Reflector lamps
- Moonlight lamps
- Daylight lamps
- Photo flood lamps
- Photo flash lamps
- Projector lamps
- Halogen lamps.

Points to remember while designing illumination direct lighting and indirect lighting: Lighting for commercial purposes is divided into many parts such as built in direct lighting (Fig 1), indirect lighting (Fig 2), core lighting, spot lighting etc.

To achieve the above lighting there are ceiling fixtures, side wall fixtures, portable fixtures and other luminaries available.

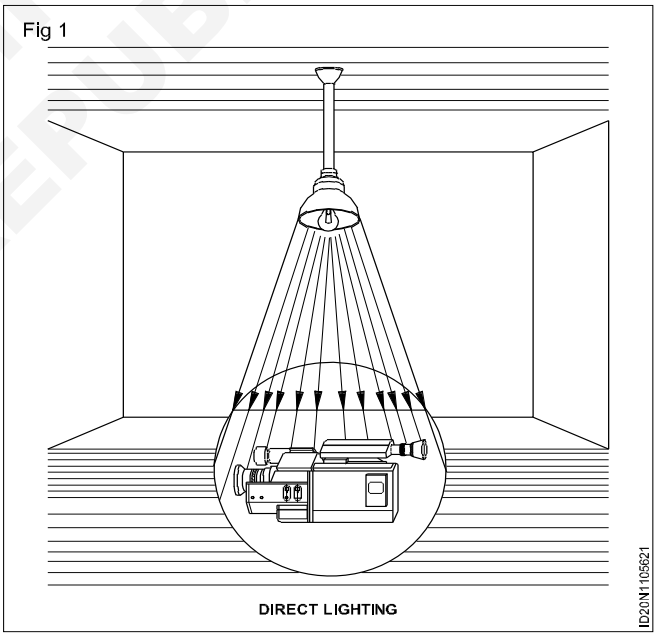
Many elements employed in lighting involves special dimensional or planning consideration other than proper spacing and capacity of outlet that save them.

Illumination is done by the architect, illumination engineer or a layman for producing the desired results with various degrees of excellence.

There are unlimited decorative possibilities and they can provide almost any desired illumination level without shade under complete control.

The appearance, character and efficiency are determined by the glass ware or translucent medium forming the surface of the panel. The choice of material for the panel, its colour and decoration are determined by the necessity for harmony with the rest of the structure. The desired luminous elements have either covering or lightly diffusing translucent material or an exposed uniformly illuminated diffusing background.

Fig 1

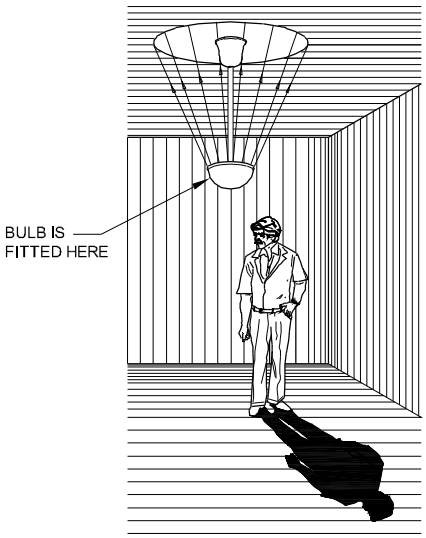


Though the efficient planning of a lighting installation is the job of the lighting engineers, the electrician is sometimes called in to advise on lighting requirements of small premises.

The number of lumens required for the working place is 150 lumens/m^2 . The lumens provided by the lamp must however be greater than this figure to allow for depreciation of the installation owing to dust and dirt on the lamps and their fittings.

Atleast 150 lumens per square metre should be provided for adequate visual performance on rough or unskilled work. Up to 1500 lumens per square metre should be provided for difficult or fine works.

Fig 2



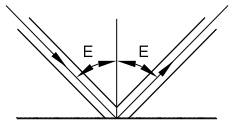
INDIRECT LIGHTING

Most sources radiate light in all direction and are too bright to be viewed comfortably. The light must therefore be controlled to direct it where it is required and to soften its brilliance.

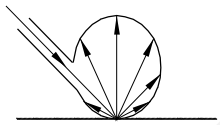
Reflection of light may be of three kinds.

- Specular reflection Fig 3(a)
- Diffuse reflection Fig 3(b)
- Spread reflection Fig 3(c)

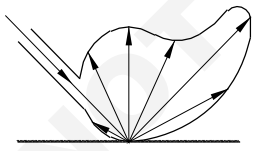
Fig 3



a) SPECULAR REFLECTION FROM A SMOOTH OR POLISHED SURFACE THE ANGLE OF INCIDENCE OF ANY LIGHT RAY EQUALS THE ANGLE OF REFLECTION.



b) DIFFUSE REFLECTION FROM A UNIFORMLY MATT SURFACE: THE BRIGHTNESS OF THE REFLECTION DOES NOT CHANGE WITH CHANGE OF VIEW POINT.



c) SPREAD REFLECTION FROM A SEMI-GLOSSY SURFACE (EGG-SHELL) FINISH

Specular reflection: When light strikes a mirror like surface it is reflected at the same angle and in the same plane as it strikes, for example a car lamp.

Diffuse reflection: Diffuse reflection is useless for the precise control of light, but it can be used to reflect light in a general direction.

Spread reflection: Unpolished metals and satin-finish mirrored surfaces have reflection characteristics between specular and diffuse. Vitreous and synthetic enamels are widely used for reflecting surfaces of light fittings. Vitreous enamels is the more hard working.

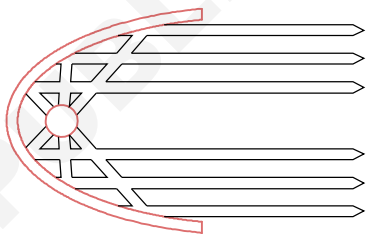
Types of reflectors: A lamp without any kind of reflector will radiate light in every direction. By placing the lamp within a reflector, you can control the light and direct it where you want it.

Dispersive type: The reflecting surface is either white enamelled or vitreous enamelled. The Viterous enamelled type is more expensive and less efficient optically but are more suitable for use in damp and corrosive atmosphere.

Mirror type reflector: These have highly polished surface for specular reflection. Silvered glass, Chromium plated; copper sheet anodized aluminium shades are typical example of this. This type are used in yard lighting

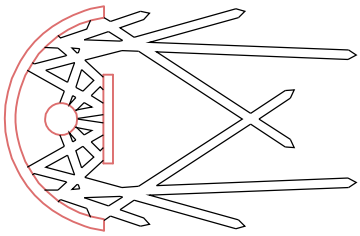
Parabolic and softlight reflector (Fig 4 & Fig 5)**:** A parabolic reflector produces a hard light and is most commonly used with tungsten lamps. A softlight reflector has shield in front of the bulb and so produces a diffused light. A spotlight enables you to vary the light beam. In each case, the light will be softer if the reflector surface is matted or dimpled rather than highly polished.

Fig 4



PARABOLIC REFLECTOR

Fig 5

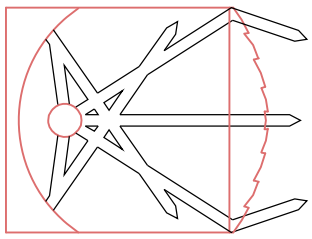


SOFTLIGHT REFLECTOR

Spotlighting (Figs 6 & 7)**:** Spotlighting is one way lighting, usually employing projectors with lenses but sometimes with reflectors only, and is used to give special illumination to a limited area as in theatre practice. The spotlights must be so located as to be out of the direct line of vision and produce no troublesome reflections or glare. Possible locations may gradually be found within chandeliers of special design, in ceiling beams or in columns or wall brackets.

Supplementary lighting: Severe visual tasks and modern merchandising methods require higher levels of illumination to eliminate eye strain or to highlight special displays that are practical or economical to obtain from a system of general lighting alone. Supplementary lighting as the name implies, should be employed in conjunction able.

Fig 6



SPOTLIGHT

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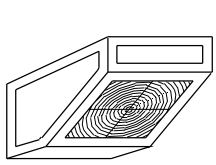
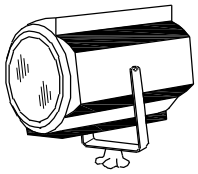
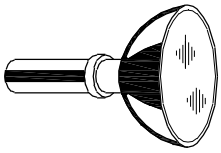
Fig 7



PRISMATIC LENS SPOTLIGHT



LENS SPOTLIGHT



WINDOW FLOOD LIGHT

TYPE OF SPOTLIGHT FIXTURES

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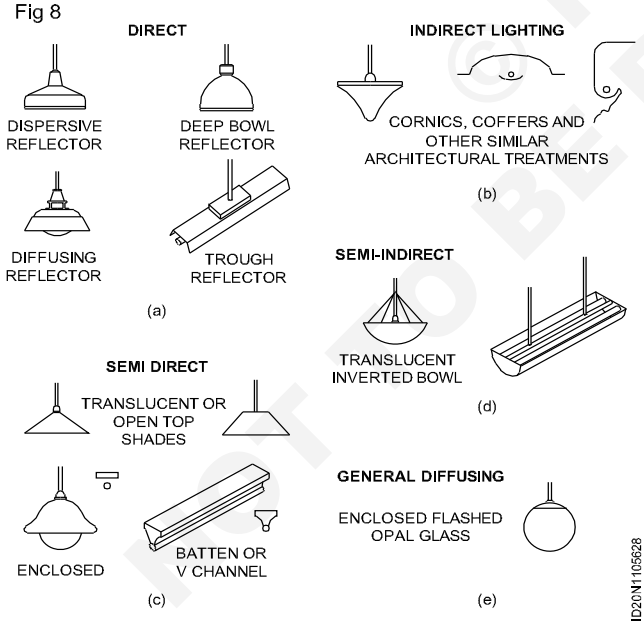
Light fitting, types and performance

Direct lighting type has largest efficiency from energy utilization point of view but glare is always present. Such systems are used for flood and Industrial lighting (Fig 8a).

Fig 8



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Indirect lighting type designed to avoid glare and recommended for specific purposes (Fig 8b).

Semi direct type designed to avoid glare and recommended for officies and other specific purposes (Fig 8c).

Semi indirect type designed to avoid glare and recommended for specific purposes (Fig 8d).

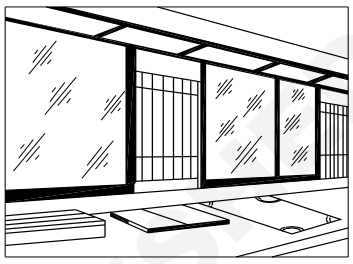
General diffusing type system has got low efficiency but are free from glare and has got uniform distribution of light. Fig 8(e)

Details of reflector's and their %age of light distribution is given in Table 1 for your reference.

Show case lighting: A number of commercial establishments use visual representation to their products. Some of the requirements are discussed below.

Counters and dealing shelves: In bank cages and ticket offices supplementary trough lighting equipment is usually located at the top of the cages to produce a band of light lengthwise on the counter. Troughs may be covered with diffusing glass or fitted with longitudinal louvers to shield the lamps. Sixty watt lamps on 15 to 18 inch centres will generally be adequate. (Fig 9)

Fig 9



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Small metal bracket type reflectors luminary or regular 25 or 40 watt tubular lamps effectively illuminate small vertical display racks, stands and cabinets. (Fig 10)

Fig 10

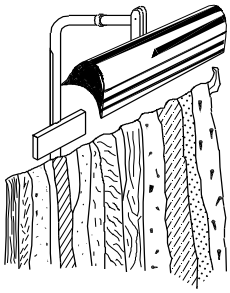

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Table 1

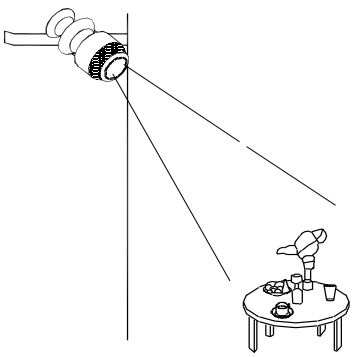
Lighting systems

Types of system	Amount of emergent light	
	Downward	Upward
Shaded or reflector system		
1 Direct	90 to 100%	0 to 10%
2 Semi direct	60 to 90%	10 to 40%
3 Semi indirect	10 to 40%	60 to 90%
4 Indirect	0 to 10%	90 to 100%
Diffused system		
1 General diffused	50%	50%
Above table is in line with CIE classification of general indoor lighting luminaries		

Small compact lens posts are available in both 250 and 400 watt size, mounted on columns or ceiling brackets, give sales emphasis to small counter or table displays.

Adjustable in spot size for 12 to 48 inches diameter spot at 10 ft. a 250 watt unit at 10 ft. will deliver 200 to 250 foot candles, with a 12 to 15 inches spot size: the 400 watt unit will give 350 to 400 foot candles. (Fig 11)

Fig 11



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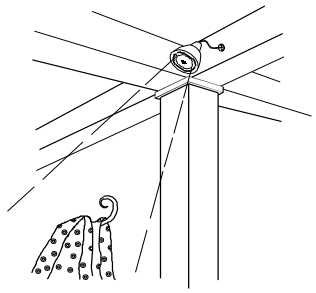
Louvered concentrating reflector spotlights available in 200 to 500 watt sizes give a less sharply defined beam than lens units. The spot size cannot be adjusted except by changing the projection distances. A 200 watt unit at 10 ft. will produce about 90 foot candles. (Fig 12)

Fig 12



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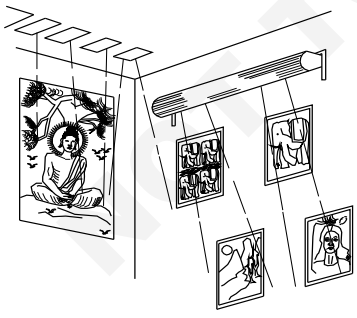
For extended vertical surface displays - rungs, tapestries, draperies, paintings - a series of 150 or 200 watt lens plate units at the ceiling is suitable for fixed display locations. Bracket type parabolic, polished metal troughs produce equivalent results and have some advantage in greater mobility. (Fig 13)

Fig 13



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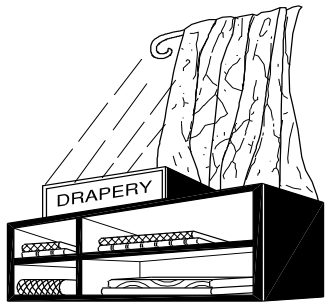
Floodlight type trough lighting for counter and shelf displays ranges from single lumiline reflectors for counter cards and small displays to extended shelf troughs as illustrated. Trough floodlights with changeable, luminous sign panels transform waste space into valuable display. (Fig 14)

For necessity and impulse items such as groceries, where attention rather than critical seeing is the requirement, less engineering refinement is needed in shelf lighting equipment. Concentrating trough reflectors which incorporate luminous panels for changeable advertising copy are satisfactory. Sockets 30 cms apart may be fitted with 40 to 100 watt lamps, as conditions dictate. (Fig 14)

Fig 14



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For lighting displays on columns or built-in shelving a metal nosing along the front edge of each shelf effectively conceals small 25 watt tubular lamps as shown in the sketch. Lamps should be spaced not more than 30 cms apart. Lumiline lamps are, of course, equally suitable in many cases.

Displays of glassware and bottled goods are highly attractive and colourful if lighted by transmitted light as shown in Fig 15. An opal glass panel, illuminated uniformly from behind the lamps spaced not more than 1½ times their distance at the back of the glass will provide a suitable luminous background.

Fig 15

ID20N110562F

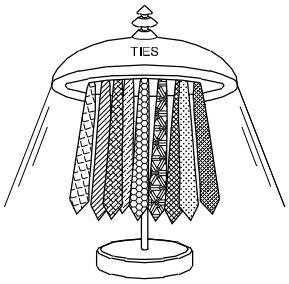
Circline tubes used for window show case: For circline tubes the ballasts are specially designed and are easily adaptable to assembly on the stem of portable lamps and in shallow wall and ceiling fixtures, and in some designs they can be mounted within the circle of the tube. Ballast equipments designed for use with the 8¼ inch 22 watt, 12-inch 32 watts. circle line include two single lamp ballasts, one with uncorrected power factor. The other with high power factor. Many of the portable lighting equipments - dressing table, desk lamp, vanity mirror, tie rack, display unit and boudoir lamps such as Fig 16 and 17 - in which the 8¼ inch circline will be used which have small thin bases and slender stems.

Illumination is done in showcases or window cases for attracting customers to the shop. When he looks at the goods he must get the proper colour of goods or fineness of detail or both by proper illumination.

There are varieties of goods which are being displayed in showcases of different colours, size, shape, fineness etc.

As per the qualities mentioned lighting in the showcase will differ. Different shades and colour layers will be used.

Fig 16



TIE RACK

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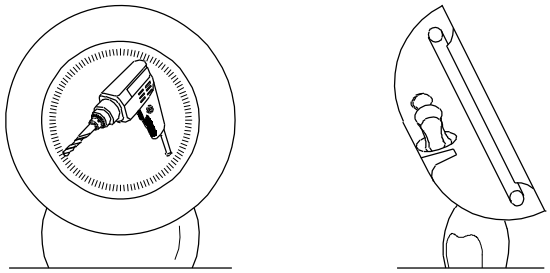
Fig 17



DISPLAY UNIT

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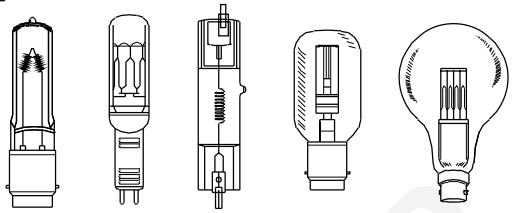
Merchandise will change from time to time and for this type, illumination will change from time to time. Hence there is a necessity to have more number of electrical points than normally required as and when necessary in any part of the showcase.

Precaution should be taken while putting the merchandise in showcases so that wiring will not be damaged. Also the wiring and merchandise should not get damaged due to the excessive heat of lamps.

Quartz lights (Halogen lamps) (Fig 18): Also known as Tungsten-Halogen or Quartz-Iodine, these lamps now dominate the movie making scene. They are smaller, lighter and more efficient than tungsten lights.

ll quartz glass tube filled with a halogen gas - usually iodine. The presence of the iodine guarantees that the bulb does not darken and that the light output and colour temperature remain constant. Most quartz lamps last as long as 250 hours and have a colour temperature rating of 3,200°K. Outputs vary from 150 to 350 watts for battery lights and from 200 to 10,000 watts for main power supply use. The quartz bulb itself should never be touched with a bare hand, even when unlit, as acid from the skin can cause premature failure of the bulb. Always handle the bulb with a small piece of tissue paper.

Fig 18



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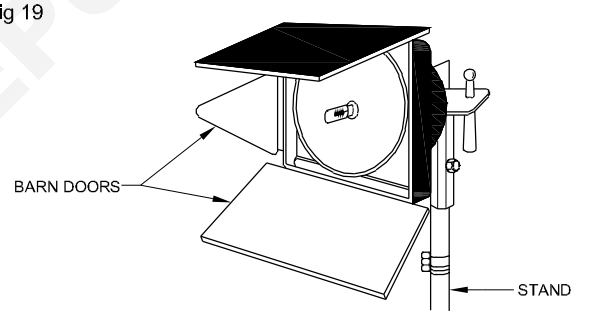
Quartz bulbs set in open reflectors are probably the most common quartz lights. They are available in a wide range of wattages, usually from 200 to 2,000 but also as high as 10,000 watts. On many models the light may be focused by moving the quartz bulb to and fro. Nowadays, many of the better lamps are made with fiberglass housings to reduce transmission of the bulbs' heat.

Basic quartz lighting kits usually consists of three lights, each of which might be 1,000 watts. They are often equipped with "barndoors" and stands. (Fig 19)

Fig 19



QUARTZ REFLECTOR LANE

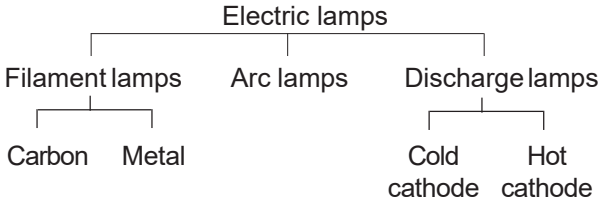
ID20N110562J

Lamps and electrical assessories

Objectives : At the end of this lesson you shall be able to
- **list out the types of lamps**
- **explain the different types of lamps**
- **explain the construction and working of tungsten filament lamp.**

Types of lamps : There are many types of electric lamps now available. They differ in construction and in the principle of operation. The lamps can be grouped on the principle of operation as follows.

Filament lamps fall into a group of light producing devices called `incandescents'. They give light as a result of heating the filament to a very high temperature. The definitions of the terms are given below.



Filament lamp: A lamp in which a metal, carbon or other filament is rendered incandescent by the passage of electric current.

Vacuum lamp: A filament lamp in which the filament operates in a vacuum.

Gas-filled lamp: A filament lamp in which the filament operates in an inert gas.

Halogen lamp: A tungsten filament lamp in which the tungsten filament operates in a relatively small space filled with an inert gas and halogen of iodine or bromine.

Arc lamp: An electric lamp in which the light is emitted by an arc.

Discharge lamp: An electric lamp in which the light is obtained by a discharge of electricity between two electrodes in gas or vapour.

Carbon filament lamp: The carbon filaments made today have limited application as resistance lamps (battery charging) and radiant heat apparatus. This lamp gives a reddish light and operates at a temperature about 2000°C. Above this limit, the carbon evaporates rapidly and blackens the glass bulb or envelope. The output from a carbon filament lamp is abot 3 lm/W (lumens per watt).

Tungsten filament lamp: This lamp consists essentially of a fine wire of the metal, tungsten (the filament) supported in a glass envelope and the air evacuated from the glass bulb - hence called a **vacuum lamp**.

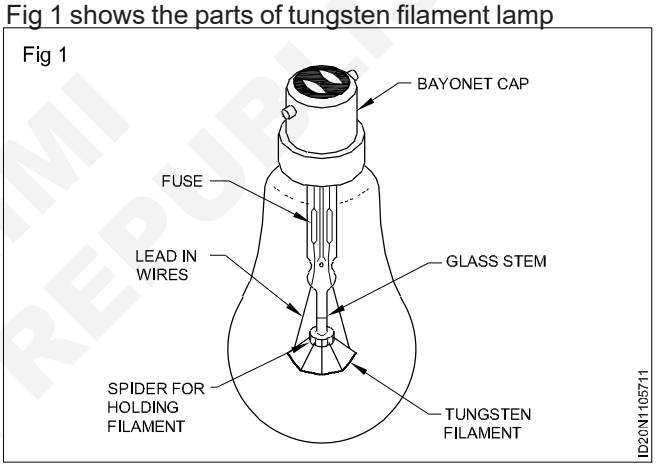
Filaments are now constructed of tungsten due to its exceptionally high melting point. It operates at a temperature of 2300° C and has an output of about 8 lm/W.

At temperatures above 2000°C, whilst the filament does not melt, it begins to break up and particles fly to the side of the lamp. This causes the glass bulb to become blackened. (Frequently observable in torch light bulbs.) The evaporation causes weak spots in the filament resulting in uneven resistance, which sets up hot spots and the filament burns out and breaks, i.e. fuses.

Filling up the bulb with an inert gas reduces the rate of evaporation. Argon and nitrogen are inert gases which do not support combustion. The operating temperature of a gas-filled lamp is about 2700°C. The output is in the region of 12 lm/W.

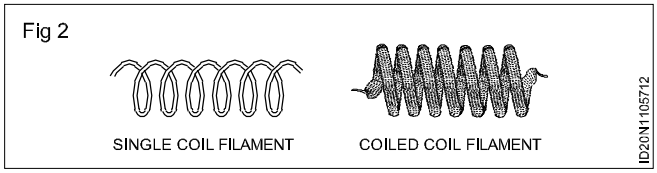
Fig 1 shows the parts of tungsten filament lamp

Fig 1



The two types of filaments (Fig 2) are

Fig 2



- single coil filament
- coiled coil filament.

The main advantage of a coiled coil lamp is the higher light output.

Most general lighting service (GLS) filament lamps used in homes have a bayonet cap (BC). Some small lamps used in special fittings have a `small' bayonet cap (SBC). Some GLS lamps have an Edison screw (ES) cap. There are also `small' Edison screw (SES) and `giant' Edison screw (GES) caps.

ES Caps are favoured for spot lights in which the lamp must be accurately positioned. Each type of lamp can be used only in an appropriate design of a lamp holder.

The rated life of GLS lamps is 1000 hours. This means that in any batch of lamps, 50 percent will have failed after 1000 hours of use. The life of an individual lamp in any batch may be greater or less than this average. The rated life is achieved in `normal conditions of use'. The normal conditions of use are

- operated cap up
- free from vibration
- not subjected to a voltage in excess of the rated voltage
- suitable light fittings.

Operating a filament lamp at a voltage higher than its rated voltage will reduce its life. Lower operating voltage will extend its life. At higher voltage, the filament gives a whiter and a more bluish light and operates at brighter and higher efficiency.

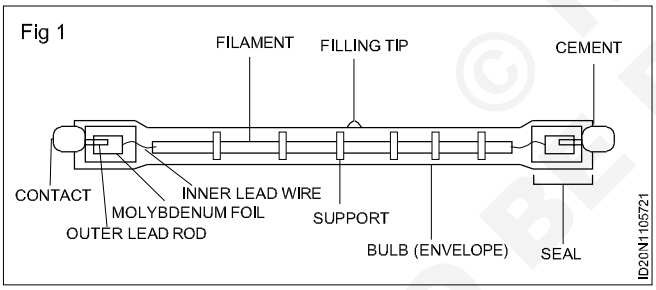
Halogen lamp

Objectives: At the end of this lesson you shall be able to
- **explain Halogen lamp construction**
- **describe the principle of tungsten halogen regenerative cycle process**

Construction

Halogen lamps are the most advanced and multi-purpose incandescent lamps. Although they belong to the incandescent family of lamps, they are designed to provide a superior quality of crisp white light, long life, high efficiency and constant lumen maintenance. Due to their reduced size, the halogen lamps allow for the most compact and stylish fixture designs. Halogen lamps operate on the tungsten halogen regenerative principle which eliminates filament evaporation and bulb blackening. As a result, the initial lumens and color temperature are maintained throughout the lamp life. The use of bromine, which is a transparent gas, increases efficiency by 28 -33 lumens/ watt as compared with iodine because there is less absorption of light by the filled gas (Fig 1).

Fig 1



Principle of tungsten halogen regenerative cycle process

1 If the lamp is turned on, tungsten particles evaporate from filament and attach on to bulb wall. At the same time, halogen is decomposed and becomes atomic halogen.

2 Atomic halogen is diffused on the bulb wall and combines with free tungsten particle to become transparent and volatile tungsten halide.

3 Due to the high temperature (over 500°F) on the bulb wall, tungsten halide is volatilized and circulated back to filament.

4 After tungsten halide is decomposed around the filament at a high temperature, halogen gas is released, ready to combine again, and tungsten is re-deposited on the filament, whereby the process is ready to begin again.

The halogen lamp's envelope is made of quartz glass because of the high operating temperature and pressure required to permit the halogen regenerative cycle process. Quartz also renders the lamp extremely resistant to heat impact. The small dimensions of halogen lamps allow accurate control over the light beam for a better focused and precise light.

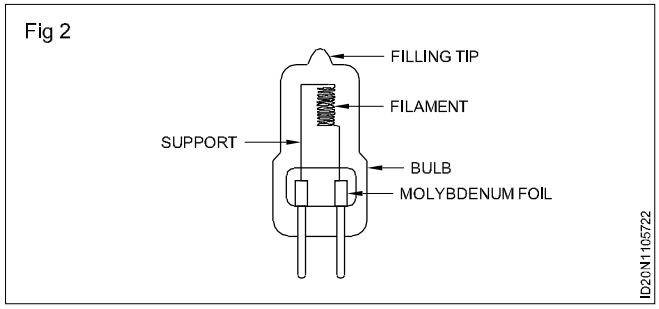
Tungsten Halogen Lamp

Halogen is the name given to group of gaseous elements like flourine, chlorine, bromine and Iodine.In incandescent lamp the life of filament is affected by evaporation of tungsten.

To prevent this a small amount of halogen gas (say iodine) is added to the argon gas filling of the lamp. Evaporated tungsten iodine is very volatile and suffers thermal diffusion in direction of filament and gets decomposed into tungsten and halogen.

Tungsten so relesed is deposited back on filament restoring its strength. Thus addition of halogen results in formation of a regenerative cycle and evaporation of tungsten is prevented. This also results in increased efficiency as tungsten filament can now be heated to much more temperature (Fig 2).

Fig 2



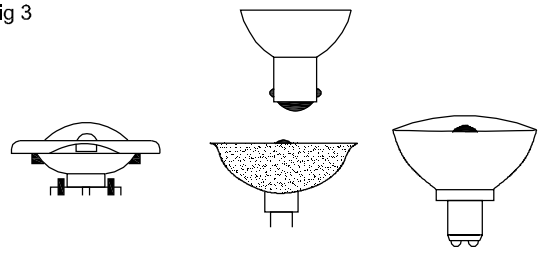
To maintain this regenerative cycle, it is necessary that the wall temperature is maintained high to 2500^{0}C. The lamp envelope is therefore made of quartz due to which it is possible to miniaturise, as filling gas can now be filled at high gas pressure.

The efficacy of this lamp is 50% more as compared to GLS for equal watage and life is just double. These lamps have better colour rendition. These are available in sizes of 500 W to 5kW. Halogen lamp with much better efficiency

and lesser sizes but having very less life are manufactured for TV photography and film camera purpose.

The Fig 3 shows the different shapes of halogen lamps.

Fig 3



LAMP SHAPES

ID20N1105723

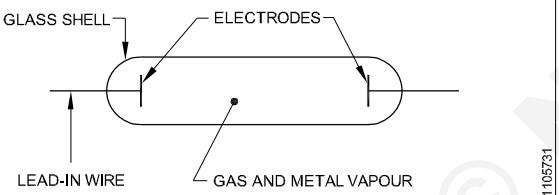
Fluorescent lamp

Objectives : At the end of this lesson you shall be able to

- **state the principle of discharge lamps**
- **describe the construction of single tube fluorescent lamp with its components**
- **state the function of each component in the circuit**
- **state probable causes for different problems in the circuit malfunctioning.**

Principle of a discharge lamp : The basic principle of a gas-discharge lamp is explained in Fig 1. Gases are normally poor conductors, especially at atmospheric and higher pressures, but application of suitable voltage (known as ignition voltage) between two electrodes in a sealed envelope containing gas at low pressure ionises the gas, and current passes from one electrode to the other through the gas medium.

Fig 1



GAS-DISCHARGE LAMP

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A glass shell with two electrodes apart is connected through lead in wires to the voltage source. The space within the shell is filled with low pressure vapour. When the voltage applied to the electrodes is increased to a certain value, the gas inside gets ionised and starts conducting.

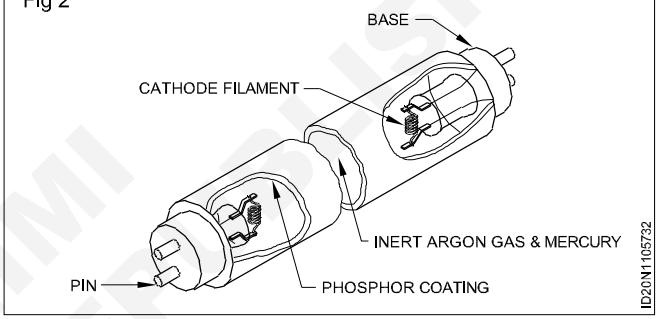
The current flow through the low pressure gas is called discharge. This causes the gas/vapour to emit radiation in the ultraviolet region. The UV radiation cannot be perceived by the human eye. Certain phosphors have the property of emitting light in the visible spectrum when it is exposed to UV rays.

Construction of fluorescent tubes: A fluorescent light bulb is basically a glass tube capped by two bases.(Fig 2) These bases are fitted with pins to carry current to internal components called cathodes. Contained inside the tube are minute droplets of mercury and an inert gas.

The inner surface of the tube is coated with a fluorescent powder or phoshphor. This phosphor emits light when exposed to ultra-violet rays. Cathodes or electrodes are made up of coiled tungsten filaments coated with a mixture of barium and strontium oxides.

Fluorescent tube: When the circuit is energised, a small current passes through the series reactor, the two tube filaments, and the glow-tube. At the instant when the circuit is energised, the current is very small because of the high resistance of the glow-tube.

Fig 2



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Because of the high resistance of the glow-tube, the current is small, and there is little voltage drop across the series reactor. Therefore, there is sufficient voltage at the glow-tube to produce a glow discharge between the U-shaped bimetallic strip to expand and close the contacts. Preheating takes place at both cathodes.

The current through the two filaments is relatively high but the series reactor limits the current to a safe value. In the period that the contacts of the glow-tube are closed, the temperature of the fluorescent tube electrodes increases rapidly.

However, when the contacts close in the glow-tube, the glow discharge is stopped, the bimetallic U-strip cools and the contacts open. At the instant these contacts open, an inductive voltage-kick generated by the series reactor coil starts conduction of current between the main electrodes of the fluorescent tube.

A stream of electrons flows between the filament electrodes. These electrons collide with the electrons of the argon and mercury vapour in the tube. The two gases radiate ultraviolet light. These rays bombard the phosphor coating on the tube wall. The phosphor-coating radiates visible light.

The fluorescent lamp continues to operate as long as the circuit is energised. The usual operating voltage for satisfactory operation is 110 to 125 volts AC. Once the circuit is in operation, the reactor limits the current to the rated value so that the fluorescent tube fluoresces at the proper light intensity.

Power factor correction capacitor: The reactor or voltage ballast in series with the fluorescent tube causes the power factor of fluorescent units to range between 50 and 60 percent lag. The power companies, therefore, have requested the various fluorescent lamp manufacturers to install capacitors in fluorescent lighting units. So that the operating power factor of most fluorescent lamp units is near 100 percent or unity.

Standard sizes of fluorescent lamps available in the market: The light output of a fluorescent lamp amounts to about 70 lumens per watt. The usual sizes are 10, 20, 40 and 80 watts; 1 foot (30 cm), 2 feet (60 cm), 4 feet (120 cm) and 5 feet (150 cm) respectively at 240 volts.

Comparison of a fluorescent lamp with incandescent lamps: Fluorescent lamps or tubes have several advantages over standard incadescent lamps. Their main advantage is that they can produce light at a much lower cost. Fluorescent tubes produce about four times as much light per watt of power than do incandescent lamps. This makes them much cheaper to operate. Glare level is low.

Fluorescent tubes produce less heat than incandescent lamps due to their higher light efficiency. If you touch a fluorescent tube after it has been `ON' for some time, you will note that it is cool to touch. Large incandescent bulbs will cause burns to anyone trying to remove them after they have been in operation for some time.

Under ordinary operating conditions, fluorescent lamps last five to fifteen times longer than standard incandescent lamps. However, the more often a fluorescent lamp is turned on and off, the shorter its life span. The major disadvantage of fluorescent lighting is the higher initial cost of the fixture. This extra cost is due to the auxiliary hardware required to operate the fluorescent lamp circuit. The disadvantage is the small wattage of these lamps require a large number of fittings.

Life of fluorescent lamps: Their normal life span is 7500 hours. They are affected by both high and low voltage, frequency of switching. The average life is for three burning hours per switching operation. The actual life may vary from 5000 to 10000 hours, depending upon the operating conditions. Light output is reduced by 15 to 20% after 4000 hours operation, and it is, therefore, a good practice to replace the fluorescent lamps after 4000 - 5000 hours of burning, on economic grounds.

High pressure mercury vapour lamp (H.P.M.V)

Objectives: At the end of this lesson you shall be able to
- **state the principle of discharge lamps**
- **describe the working of a `high pressure' mercury vapour lamp**
- **explain the different types of mercury vapour lamps**
- **identify the circuit elements in a mercury vapour lamp.**

Discharge lamps: When an arc is struck in gas or metallic vapour, it radiates energy in characteristic wave-bonds. For example, neon gives red light, sodium yellow and mercury vapour four distinct lines in the visible, and two in the ultraviolet region of the spectrum.

All modern discharge lamps operate in a translucent enclosure. The initial discharge is usually struck in argon or neon.

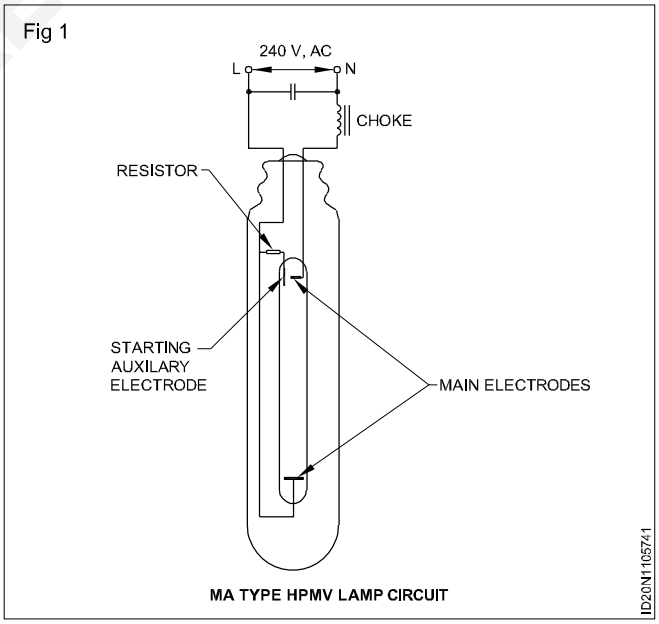
The discharge occurs in an inner tube enclosed in an outer evacuated tube. (Fig 1) The inner tube of glass or quartz contains mercury and a small amount of argon to assist in the starting of the discharge. The electrodes are rich in electron-emittting materials in order to permit ease in the release of electrons.

Working of HPMV lamps : The lamp operates at high pressure. To start the discharge, an auxiliary electrode is positioned quite close to the main electrode. The auxiliary electrode is connected to the lamp terminal through a high resistor.

The high resistor limits the current. When switched on, the normal mains voltage is not sufficient to start the discharge between the main electrodes but it can start over the very short distance between the main and auxiliary electrodes.

At the beginning, the discharge current passing through the high resistance causes a potential difference to develop between the starting electrode and one of the main electrode through the argon gas. The discharge now spreads rapidly until it takes place between the main electrodes.

Fig 1



MA TYPE HPMV LAMP CIRCUIT

The argon discharge then warms up the tube and vaporises the mercury. Soon the gas content is mainly mercury vapour and the argon has less and less effect. The discharge then takes place in the mercury vapour.

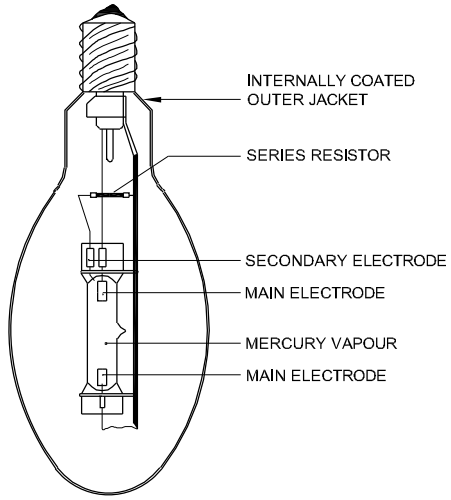
Types of HPMV lamps : Three different types of high pressure mercury vapour lamps are:

- MA type (MV lamp with auxiliary electrode)
- MAT type (MV lamp with tungsten filament)

• MB type. (MV lamp with auxiliary electrode and Bayonet cap)

MA type HPMV lamp: The discharge tube is made of borosilicate which is quite hard. The tube consisting of the main and auxiliary electrodes is sealed with an inside pressure of one and a half atmospheres. The lamp has a screw cap and is connected to the mains through the choke. (Fig 2) The lamp takes about 5 minutes to start giving full output.

Fig 2



MA TYPE HPMV LAMP

This lamp, once switched off, will not restart again until the pressure developed inside the tube falls back. It takes about 7 minutes to start again. There is no harm in keeping the switch on. The lamp should always be hung vertically, otherwise the inner tube will be damaged.

The efficiency is 45 lm/watt for 400 watts lamp.

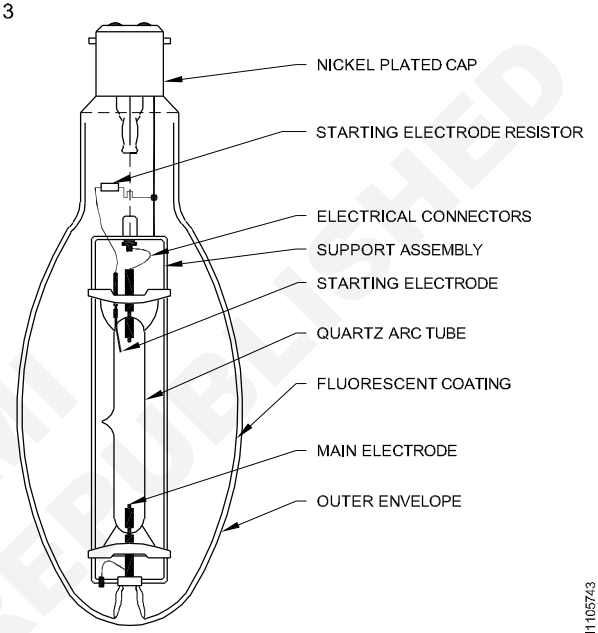
MAT type lamp: This type of lamp is almost similar to the MA type, but the outer glass envelope, instead of being empty, consists of a tungsten filament. The tungsten filament, similar to the one in an ordinary lamp, is in series with the discharge tube. It acts as a ballast. This lamp requires no external choke (or ballast) and capacitor.

When the lamp is switched on, it works as a filament lamp does and its full output is given by the outer tube. At the same time, the discharge tube starts warming up, and when a particular temperature is attained, a thermal switch operates. The thermal switch cuts off a part of the filament so that the voltage across the discharge tube increases.

The light output is a mixture of light produced by a filament lamp and a discharge lamp.

MB type lamp: This lamp operates at an extra high pressure of 5 to 10 atmospheres. The discharge tube of this type is of quartz, about 5 cm long and has three electrodes, two main and one auxiliary. This lamp has a 3-pin bayonet cap and it cannot be put into an ordinary holder as it requires a choke and capacitor. (Fig 3)

Fig 3



MB TYPE HPMV LAMP

The functioning of the tube is similar to that of a MA type lamp. Since a quartz tube can withstand high temeperature, it can be used in any position.

The wattages available are 80 watts 125 W, 250 W, 400 W, 700 W and 1000 watts operating in 230V/250V, 50 Hz main supply.

The efficiency is about 50 lm/W.

Sodium vapour lamp

Objectives: At the end of this lesson you shall be able to

- **state the sodium vapour lamp and its types**
- **describe the construction of low and high pressure sodium vapour lamp**
- **state the functions of the parts in the circuit**
- **specify the standard sizes of sodium vapour lamps available.**

Sodium vapour lamp and its types: Sodium vapour lamp is a cold cathode gas discharge lamp, which gives a yellow colour light. Sodium lamps are not suitable for locations where colour rendition is important, but due to their higher efficiency (110 lumens/watt), they are used for the lighting of streets, railways, storage yards etc. where human traffic is less and colour rendition unimportant.

Sodium lamps are particularly suitable in fog as their yellow light can penetrate fog better.

The average life of a sodium vapour lamp is well over 6000 hours. There are two types of Sodium Vapour lamps as given below:

- low pressure SV lamp

- high pressure SV lamp.

Construction

Low pressure sodium vapour lamp: In the sodium vapour lamps efficiency decreases rapidly as the current density is increased above a certain value. Consequently the lamp has to be operated at a low current density and this necessitates a large surface area of the tube.

This lamp possesses a brightness of 7.5 candle per sq.cm. Because of these points the length of this tube has to be very long. Moreover its efficiency is very sensitive to the change in tube temperature. For maximum efficiency the temperature of the lamp has to be maintained at about 220^0C. So the whole tube is placed in a detachable double walled vacuum jacket.

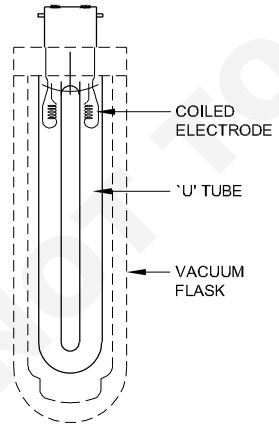
As stated above low pressure Sodium Vapour lamps require a long tube, but as there is limit to the practicable size of such a jacket of the vacuum flask type, the long lamp tube is bent to a `U' shape to suit the jacket.

The low pressure Sodium Vapour lamp possesses a `U' shaped glass tube internally coated with fluorescent powder, consisting of Sodium together with Neon and one percent of Argon, the function of the Argon being used to reduce the initializing voltage.

In a cold lamp the Sodium is in the form of solidified drops on the inner walls. The tube contains two Barium and Strontium coated, coiled Tungsten electrodes at both ends. The two ends of the electrodes are fixed to the bayonet cap. (Fig 1) Connection diagram is Fig 3.

High pressure sodium vapour lamp: A high pressure Sodium vapour lamp (Fig 2) operates at a much higher current which flows through a much shorter arc tube (discharge tube).

Fig 1



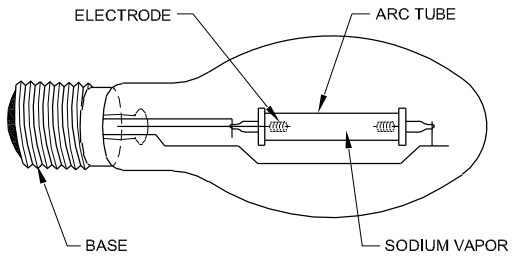
SODIUM DISCHARGE LAMP

ID20N1105751

This discharge tube is made of sintered aluminium ceramic discharge arc tube which is resistant to the hot ionised Sodium Vapour up to a temperature of about 1600^0C which transmits over 90% of visible radiation.

The discharge tube operates at a pressure of about half an atmosphere, and is enclosed in an evacuated hard glass envelope of elliptical shape to maintain the tube at the correct temperature. (Fig 3) The lamp gives a rich Golden light which enables colours to be easily distinguished. This discharge tube contains Sodium and Mercury, with Argon or xenon added at a low pressure for starting purposes at low pressure.

Fig 2



HPSV LAMP

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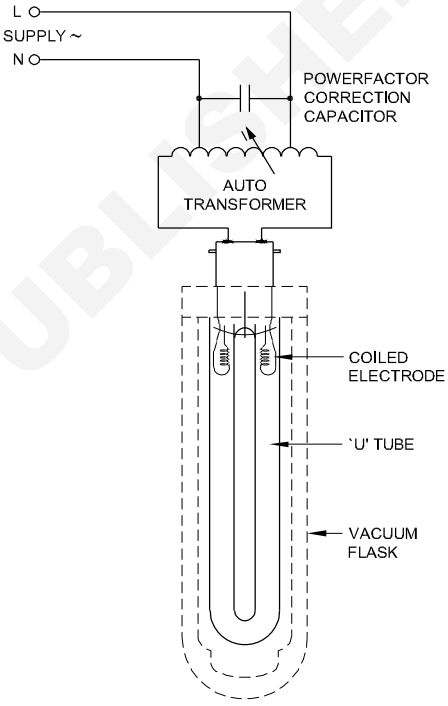
Fig 3



SODIUM DISCHARGE LAMP

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A voltage pulse of about 2.5 KV is required to initiate the discharge (Fig 4) in higher pressure Sodium Vapour lamp. This high voltage pulse is generated by high external ignitor or by built in thermal starter.

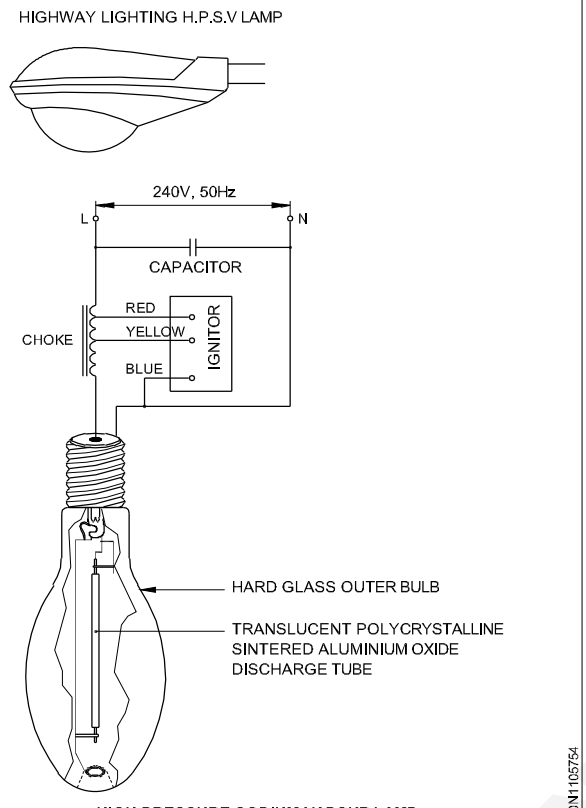
Leak transformer: The ignition voltage of sodium lamps varies from 400 to 600V. A `leak transformer' performs the dual role of providing the ignition voltage initially, and acting as a choke for limiting the current subsequently when the lamp starts conducting. The diagram of a leak transformer is shown in Fig 5.

The primary and the secondary windings are connected in series and placed around the centre limb of a 3-core yoke. Between the coils, a loose iron core is clamped in the yoke on either side, which acts as a shunt for the magnetic field.

Under no-load conditions, the resistance of the shunt is large due to air gaps, with the result the magnetic field moves through the limbs of the yoke, and the device acts

as an auto-transformer. But when the lamp ignites and consumes current, a part of the magnetic field leaks away through the shunt due to the counter-acting field of the secondary.

Fig 4



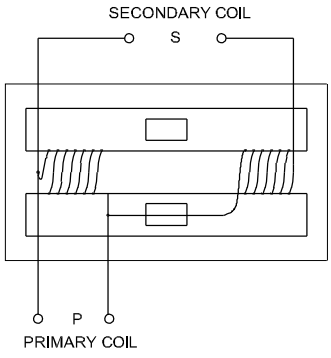
HIGH PRESSURE SODIUM VAPOUR LAMP

The device now acts as a choke coil reducing the voltage across the lamp electrodes to the required value.

Function of Sodium vapour lamp

Before the lamp starts, the sodium is usually in the form of a solid deposited on the sides of the tube walls. So in the initial stage when the potential is applied to the lamp it operates as a low pressure Neon lamp with pink colour (characteristics of the neon gas); but as the lamp

Fig 5



LEAK TRANSFORMER

warms up it vaporizes the sodium, and slowly it radiates out yellow light ,and after about ten minutes the lamp starts giving its full output.

Now the resistance of the lamp decreases and the current increases but the voltage drop across the high leakage transformer controls the current to safe values.

The lamp works at low voltage, and the working temperature is about 300^0C.

Operating position of sodium lamps: Sodium lamps of 45W and 60W may be operated in horizontal or any other position. The cap of the lamp should always be higher than the lamp itself, so that the Sodium does not settle behind the electrodes.

For Sodium lamps of should not exceed 20°; otherwise, the distribution of the sodium will be altered, affecting the life and performance of the lamp.

Life of sodium lamps: The average life of a sodium lamp is well over 6000 hours for three or more burning hours per switching operation. At the end of this period the light output will be less by about 15% due to ageing.

Tin-oxide sodium lamps (SOX Lamps): This lamp is an improvement over the ordinary sodium lamp the light output in its case is of the order of 150 lumens/watt.

Light Emitting Diodes (LEDs)

Objectives: At the end of this lesson you shall be able to
- **define the LED**
- **state the advantages of LEDs over-conventional bulbs**
- **explain the principle of working of LED**
- **state the popular types of LED.**

Light emitting diodes (LED) : In recent years, the use of filament lamps/bulbs which consume quite an amount of power, has less life became absolute as indicators of electric systems. One of the most common and popular of new devices in the optical electronics is the **Light Emitting Diode** abbreviated as **LED**. These LEDs are now used as indicators in almost all electrical and electronic circuits and equipments.

The advantages of LEDs over incandescent bulbs are listed below:

1 LEDs have no filaments to heat and so require less current to glow.

2 LEDs require lower voltage level (typically 1.2 to 2.5 V) than the conventional bulbs.

3 LEDs last much longer - upto several years.

4 Because there is no filament to heat up, LEDs are always cool.

5 LEDs can be switched ON and OFF at a much faster rate compared with conventional lamps.

Principle of working of LEDs

Although LED is also a type of diode, it cannot and should not be used for the purpose of rectifying AC to DC.A LED

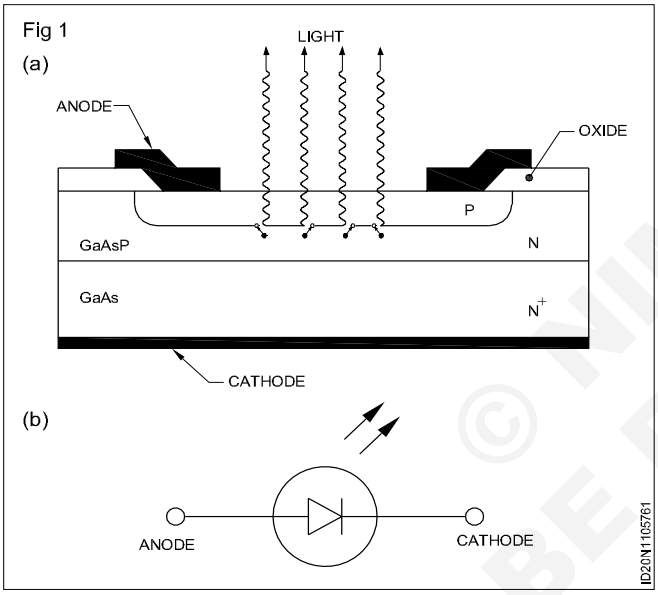
is a semi conductor device which emits visible ligt when it is property connected with the electric supply.

Recall that a general purpose diode or a rectifier diode conducts when energy is supplied to the electrons (Si=0.7V, Ge=0.3V) to cross the barrier junction. Each electron, after acquiring the supplied extra energy, crosses the junction and falls into the hole on the P side of the junction while the electron recombines with a hole, the electron gives up the extra energy by it. This extra energy is dissipated in the form of heat and light.

In general purpose diodes because the silicon material is not transparent(opaque), the light produced by the electrons does not escape to the outer environment. Hence, it is not visible. But LEDs are made using semi-transparent materials instead of silicon.

Because the material used in making LEDs is semi-transparent, some of the light produced by the electrons escapes to the surface of the diode, and, hence, is visible. (Fig 1a)

Fig 1



LEDs are typically doped with gallium arsenic, gallium phosphate or gallium arseno-phosphate. Different dopes cause the LED to emit light of different colours (wave-lengths) such as red, yellow, green, amber, or even invisible infrared light.

The schematic symbol of LED Non-integrated lamps is as shown in (Fig 1b). The arrows are used to indicate that light is radiated from the device.

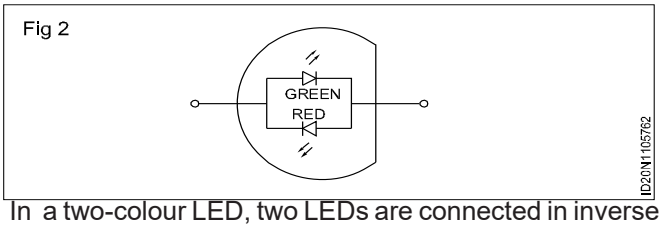
Types of LEDs

Single colour LEDs: Most of the commercially available and commonly used LEDs are single colour LEDs. These LEDs radiate one of the colours such as red, green, yellow or orange. Different coloured LEDs will have different forward voltages as given in the table below:

Colour of LED	Red Orange	Yellow	Green
Typical Forward Voltage drop	1.8V 2V	2.1V	2.2V

Two colour LEDs: These LEDs can give two colours. Actually, these are two LEDs put in a single package and connected . (Fig 2)

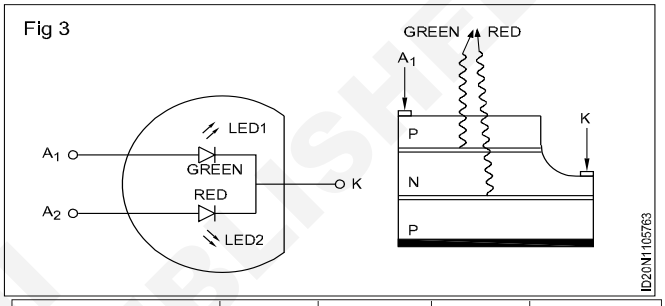
Fig 2



In a two-colour LED, two LEDs are connected in inverse parallel, so that one of the colour is emitted when the LED is biased in one direction and the other colour is emitted when the LED is biased in the other direction. These LEDs are more expensive than the single colour LEDs. These LEDs are useful to indicate +ve, –ve polarities, GO-NOGO indication, null detection etc.

Multicolour LEDs: These are special types of LEDs which can emit more than two colours. These LEDs comprises of a green and a red LED mounted in a three-pin common cathode package. (Fig 3)

Fig 3

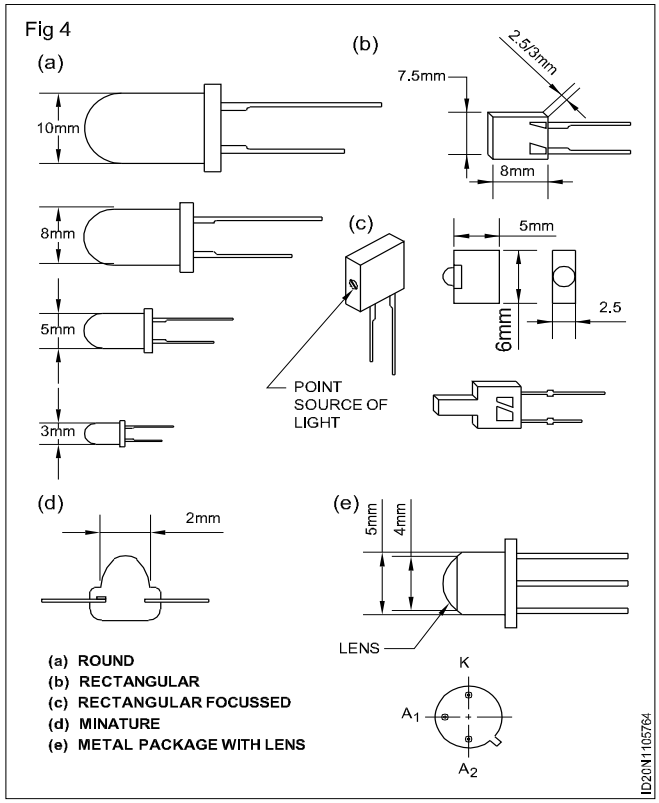


Output colour	Red	Orange	Yellow	Green
LED-1 current	0	5mA	10mA	15mA
LED-2 current	15mA	3mA	2mA	0

This LED will emit green or red colour by turning ON only one LED at a time. This LED will emit orange or yellow by turning on the two LEDs with different current ratios as shown in the table given.

Sizes and shapes of LEDs (Fig 4)

Fig 4



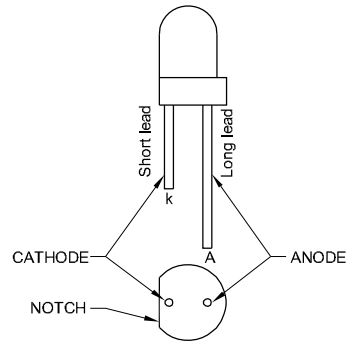
LEDs are available commercially in different shapes and sizes to suit varied commercial applications. Fig 4 shows some of the most popular shapes and sizes of LEDs.

The light output of LED may be guided as point-source or diffused. The point-source LED provides a small point of light while the diffused type has a lens which diffuses the light into a wide angle viewing area.

Terminals of LEDs

Since LEDs are basically diodes, they have anode and cathode terminals/leads as in any general purpose diode. Fig 5 shows the methods to identify the terminals of a LED.

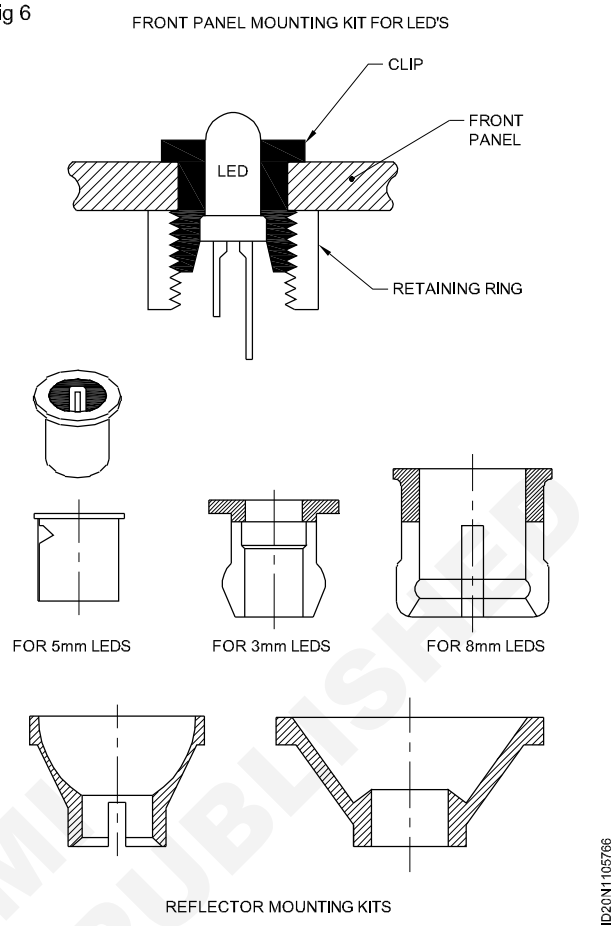
Fig 5



Mounting kits for LEDs (Fig 6)

Special mounting kits Fig 6, are available for fixing the LEDs on to the printed circuit boards and monitoring panels. These kits not only extend the life of the LED by way of protecting it from mechanical stress but also make the output of the LED clearly visible.

Fig 6



Electrical accessories

Objectives: At the end of this lesson you shall be able to

- **classify, specify, identify and state the uses of the accessories employed in domestic wiring**
- **state the IE rules related to safety and electric supply.**

Electrical accessories: An electrical domestic accessory is a basic part used in wiring either for protection and adjustment or for the control of the electrical circuits or for a combination of these functions.

Rating of accessories: The standard current ratings of the accessories are 6, 16 and 32 amps. The voltage rating is 240V AC as per B.I.S. 1293-1988.

Construction of accessories: These accessories shall be provided with complete enclosures which shall afford adequate protection against accidental contact with any live part the parts and the materials normally used are as shown in table 1.

Mounting of accessories: The accessories are designed to mount either on the surface or concealed (flush type).

Surface mounting type: Accessories are provided with a seating so that when mounted they project wholly above the surface on which they are mounted.

Flush-mounting type: These accessories are designed to mount behind or incorporated with a switch plate, the back of the plate being flush with the surface of the wall or switch box.

Table 1

Part	Materials
Base	Vitrified, ceramic material or non-ignitable moulded insulating material eg. Bakelite
Covers, cover plate actuating member (knob)	Tough non-jonitable insulating materials. Eg. Bakelite. (Knob may be of metal but should be insulated from the live parts.)
Springs	Corrosion-resistant metal.
Terminal's	Plated brass terminal posts and screws.
Attachment fitting screws and other non-current carrying parts	Mild steel, aluminium alloy or insulating material.

The electrical accessories used in wiring installation, are classified according to their uses.

– Controlling accessories

– Holding accessories
– Safety accessories
– Outlet accessories
– General accessories

Controlling accessories: The accessories which are used to control the circuits or an electrical point like switches are called `controlling accessories'. All the switches are specified in accordance with their function, place of use, type of mounting, current capacity and working voltage. For example - S.P.T. (Single pole tumbler) flush-mounted switch 6 amps 240 volts.

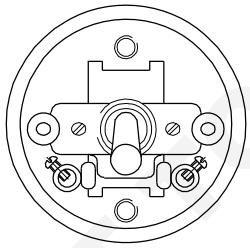
Types of switches according to their function and place of use

1 Single pole, one-way switch
2 Single pole, two-way switch
3 Intermediate switch
4 Bell-push or push-button switch
5 Pull or ceiling switch
6 Double pole switch (DP switches)
7 Iron clad double pole, (ICDP) switch.
8 Iron clad triple - pole (ICTP) switch.

Of the above 1,2,3,4 and 6 may be either surface mounting type or flush-mounting type.

Single pole, one-way switch: This is a two terminal device, capable of making and breaking a single circuit only. A knob is provided to make or break the circuit. It is used for controlling light or fan or 6 amps socket circuits. one way switch is as shown in Fig 1.

Fig 1



6 AMP SINGLE-WAY SURFACE MOUNTING SWITCH (COVER REMOVED)

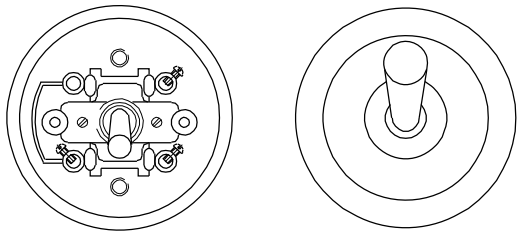
ID20N1105771

Single pole, two-way switch: This is a three terminal device capable of making or breaking two connections from a single position (Fig 2). These switches are used in staircase lighting where one lamp is controlled from two different places. Though four terminals could be seen, two are short circuited and only three terminals are available for connection.

However, both single way and two-way switches with their cover look alike (Fig 2b) but can be differentiated by looking at the bottom. Single way switches will have two terminal posts whereas two-way switches will have four terminal posts.

Intermediate switch: This is a four-terminal device capable of making or breaking two connections from two positions (Fig 3). This switch is used along with 2 way switches to control a lamp from three or more positions.

Fig 2



(a) 6 AMP 2-WAY SURFACE MOUNTING SWITCH (COVER REMOVED)

(b) A 2-WAY SWITCH WITH A METAL CAP

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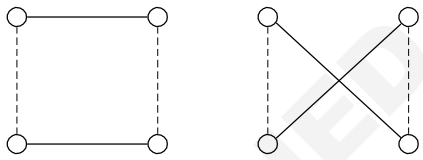
Fig 3



INTERMEDIATE SWITCH CONNECTIONS

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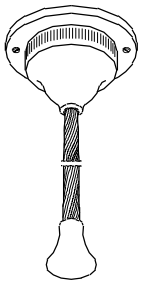
Bell-push or push-button switch: This is a two-terminal device having a spring-loaded button. When pushed it `makes' the circuit temporarily and attains `break' position when released.

Pull or ceiling switch (Pendent switch): This switch is normally a two-terminal device functioning as a one-way switch to make or break a circuit (Fig 4).

Fig 4



PULL SWITCH

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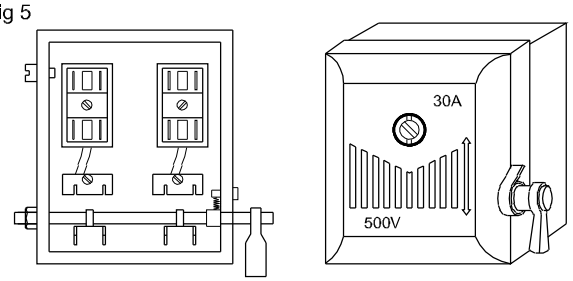
This switch is mounted on ceilings. As the user could operate the switch from a distance through the insulated cord, this could be used safely for operating water heaters in bathrooms or fan or lights in bedrooms.

Double pole switch (DP switch): This is a switch with two poles, the two poles being mechanically coupled together. It is operated with a knob. It is also provided with a fuse and a neutral link. These switches are used as main switches to control main or branch circuits in domestic installation.

Double pole iron clad (DPIC) main switch : This is shown in fig 5 which is mainly used for single phase domestic installation, to control the main supply. It controls phase and neutral of the supply simultaneously.

This switch consists of two fuse-carriers. The one in the phase circuit is wired with the fuse and the other in neutral is linked with a brass plate or thick copper wire. These switches should be earthed properly to safeguard the user. The current rating of the switch varies from 16 amps to 200 amperes.

Fig 5



DPIC MAIN SWITCH

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Specification of these switches should have:

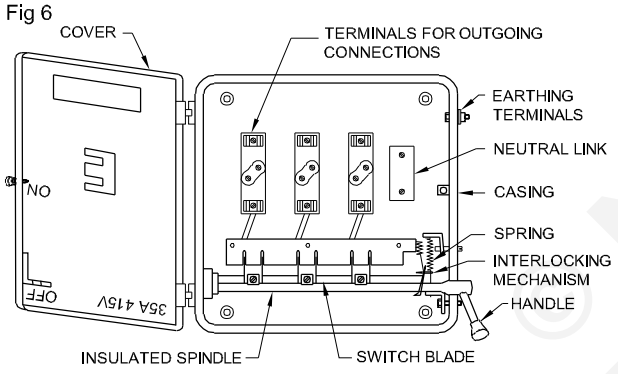
– current rating

– voltage rating

– type of enclosure (sheet steel or cast iron).

Triple (three) pole iron main switch: This is also referred to as TPIC switch and is used in large domestic installation and also in 3-phase power circuits, the switch consists of 3 fuse carriers, one for each phase. Neutral connection is also possible as some switches are provided with a neutral link inside the casing (Fig 6).

Fig 6



FUSED ICTP `N' SWITCH

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These switches need to be earthed through an earth terminal or screw provided in the outer casing.

The current rating of the switch varies from 16 to 400 amps. Specification of these switches should have

– current rating

– voltage rating

– type of enclosure (sheet steel or cast iron)

– whether with neutral link or otherwise

– rewirable type fuse carriers or HRC type fuse carriers.

Holding accessories

Lamp-holders : A lamp-holder is used to hold a lamp. Earlier, brass holders were most commonly used but nowadays these have been replaced by bakelite holders. These may contain solid or hollow spring contact terminals. Four types of lamp-holders are mainly available.

– Bayonet cap lamp-holders

– Screw type holders

– Edison screw type lamp-holders

– Goliath Edison screw type lamp-holders

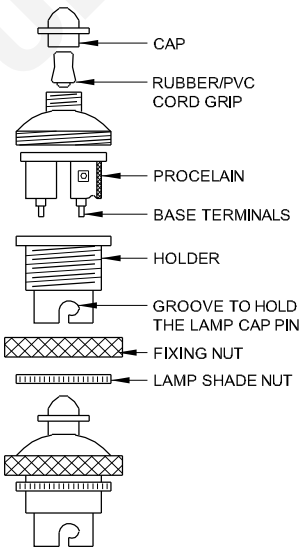
According to the Bureau of Indian Standard, 732, clause 5.8, all incandescent lamps, unless hung at a height of 2.5m (8ft), shall be provided with standard bayonet holders for lamps up to and including 200 watts. For lamp powers above 200 W and up to 300 watts Edison screw holders are to be used and for above 300 watts Goliath screw holders are to be used.

Bayonet cap (BC) lamp-holders: In this type,the bulb is fitted into the slot, and is held in position by means of two pins in the lamp cap. It has solid or hollow spring contact terminals, and the supply mains through the switch are connected to these contacts. In BC types there are two grooves on the circular construction of all types of holders.

The groove and the contact terminals are at right angle to each other. In this type of holders, the lamp is inserted, forced in, turned slightly and then left in position. These holders can be classified further as explained below.

Pendent lamp-holders: This holder (Fig 7) is used in places where the lamps are required in a hanging position. These holders are made of either brass or bakelite. An exploded view of this holder shows the parts of the holder. These holders are used along with ceiling roses for suspending the lamps from the ceiling.

Fig 7



EXPLODED VIEW OF PENDENT HOLDER

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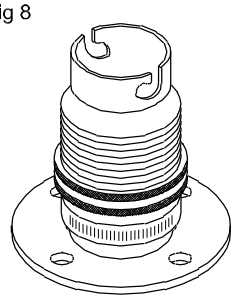
Batten lamp-holders: The straight batten holder (Fig 8a) is used on a flat surface on the round block, wooden board etc. These holders are made of either brass or bakelite.

Angle holders: The angle bottom holder, (Fig 8b) is to hold the lamp in a particular angle. These are made of either brass or bakelite. These are used for advertising boards, window display, kitchens etc.

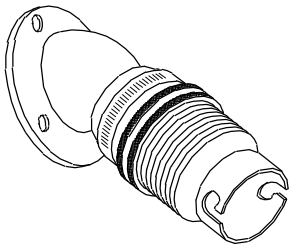
Bracket holders: This holder (Fig 9) is used with a bracket. These are made of brass and are used to give direct light to a particular place. Brass bracket holders need to be earthed as per BIS recommendations.

These are fixed on the bracket by the internal threading of the cap.

Fig 8



(a) BRASS BATTEN HOLDER



(b) ANGLE HOLDER

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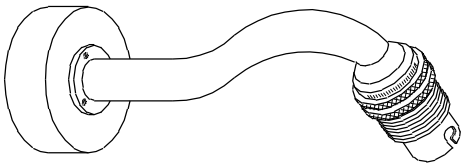
Fig 9



BRACKET HOLDERS

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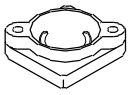
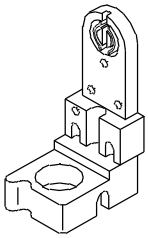
Tube light or fluorescent lamp-holders and starter-holders: Generally the fluorescent lamp-holders are of a bi-pin type (Fig 10).

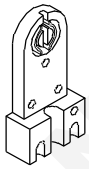
Fig 10



HOLDER FOR THE STARTER



COMBINED TUBE AND STARTER HOLDER



FLUORESCENT PIN TUBE HOLDER

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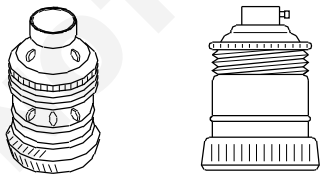
Edison screw-type lamp-holders: In this type, the holder is provided with inner screw threads and the lamp is fitted in it by screwing. It has a centre contact which is connected to the live wire and the screwed cap is connected to the neutral wire.

For lamps with wattage above 200W and not exceeding 300W, Edison screw-type holders are used. Edison screw (ES) lamp holders have spring-loaded central contact to ensure good contact (Fig 11).

Fig 11



EDISON SCREW TYPE HOLDER

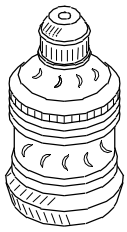
ID20N110577B

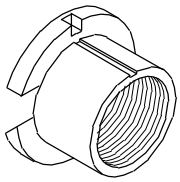
Goliath Edison screw (GES) type holders (Fig 12)**:** The cover of this type of holder is made of porcelain. Such holders are used in studios, headlights, floodlights, focussing lights etc.

These holders are used for more than 300W lamps.

Swivel lamp-holders: The swivel lamp-holder is designed for wide angle directional lighting which is used for the lighting of shop windows, showcases, etc. It consists of a ball and socket joint fitted between a back plate and the lamp-holders. It is available in bayonet cap type, small bayonet cap type and Edison screw type. All these type of holders are also available for wall fixing patterns or ceiling pattern (Fig 13).

Fig 12





GOLIATH EDISON SCREW LAMP HOLDER

ID20N110577C

Fig 13

ANGLE SWIVEL LAMP-HOLDER

ID20N110577D

Specification of a lamp-holder: While specifying the lamp-holders, the type of material used for construction, type of gripping, type of mounting, working current and voltages should also be specified.

Safety accessories: A fuse is a safety accessory. It is connected in series with the circuit and protects the electrical apparatus and equipment from damage, when excess current flows.

The kit-kat type fuse is commonly used in domestic installation.

Types of fuses

– Kit-kat type (Rewirable fuse)

– Iron-clad fuse cut out

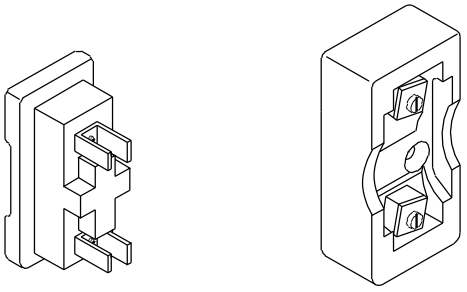
Kit -kat type fuse: This fuse consists of a porcelain base having two fixed contacts, for connecting the incoming and outgoing cables.

The line and load wires are connected in the base terminals and the carrier is provided with a fuse (Fig 14). The base is fixed but the carrier is removable.

Iron-clad fuse cut outs (Fig 15): These are kit-kat fuses in an iron cover. The iron cover has facility to be closed and sealed with a lead seal. This is used at the incoming side of the power supply and sealed by the supply authorities to ensure the line is not loaded beyond a certain prescribed current capacity.

Outlet accessories: These accessories are used to take the supply for the portable appliances like table fans, TV, electric irons etc.

Fig 14



FUSE CARRIER FUSE BASE

KIT-KAT FUSE

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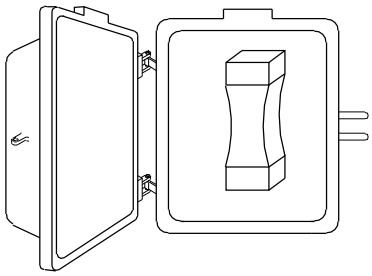
Fig 15



IRON CLAD CUT - OUT

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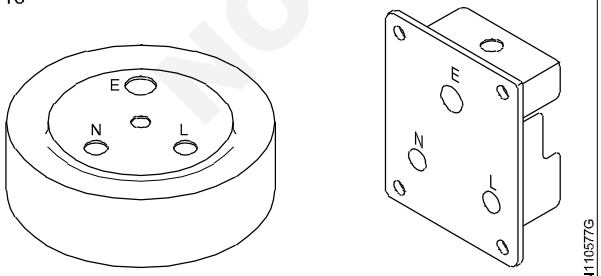
Socket outlet current rating: The standard ratings shall be 6, 16 and 32 amperes and 240 volts. The following types are normally used for domestic purposes. They have to be specified according to the mounting type, number of pins, current capacity and voltage.

Two-pin socket: This socket is rated as 6A, 250V, having only two pins without earth connection. These are suitable only for double insulated appliances (having PVC or insulated body).

Two-pin plug top: It is used for taking the supply from the socket. It has got two pins of the same size.

Three-pin socket: This type of socket is suitable for light and power circuits. These sockets are rated as 6A, 250V or 16A, 250V, and are available as surface-mounting type and flush type (Fig 16). There are three terminals marked as Line (L) Neutral (N) and Earth (E). The line terminal is always on the right hand side, the neutral terminal on the left hand side, and the top is the earth terminal which is larger in diameter. In all the cases, the earth wire must be connected to the earth terminal of the socket.

Fig 16



3-PIN 16 AMP SOCKET WITH TOP COVER FLUSH TYPE SOCKET

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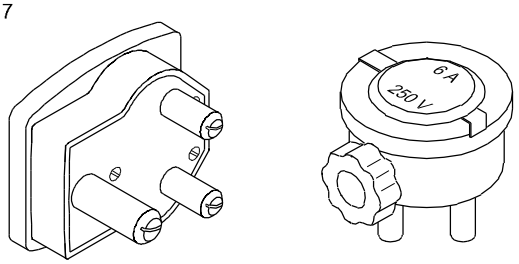
Three-pin plug top : It is used for taking the supply from the socket. It has three pins. Two are similar in size and the third one is bigger and longer which is for earth (Fig 17).

These are also rated as 6A,250V or 16A, 250V. These are made of bakelite, PVC materials.

Fig 17



THREE-PIN PLUG TOP

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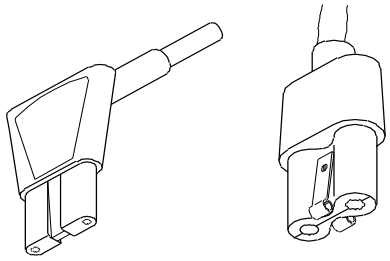
A socket which is controlled by a switch, is also available. Multi-pin sockets are also available which are suitable for 2 pins and 3 pins having 5 holes in one unit. Further multi-pin sockets for 3 pin of 6 amps and 16 amps are also available having 6 holes in one unit.

General accessories : Some accessories are used for general and special purposes such as:

- appliance connectors (or) iron connectors
- adapters
- ceiling roses
  - a two-plate
  - b three-plate
- connectors
- distribution board
- neutral links.

Appliance connectors or iron connectors : These are used as female connectors to supply current to electric kettles, electric iron, hotplate, heaters etc. It is made of bakelite or porcelain. The wires are connected with two brass terminals and the earth connection is provided with a twin nickel spring. The cable entry has a rubber protection tybe. These are rated as 16A, 250V (Fig 18).

Fig 18



FLAT CONNECTOR WITH SIDE ENTRY IRON CONNECTOR DIRECT ENTRY

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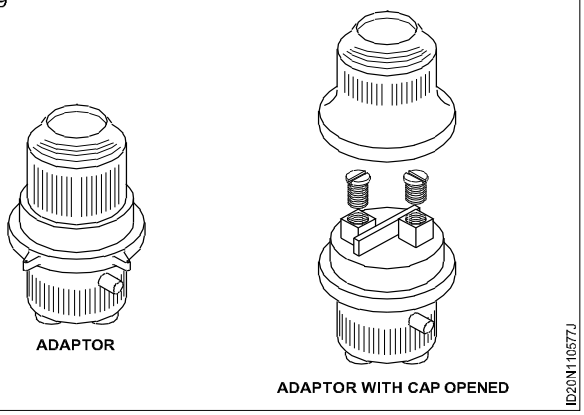
Adaptor (Fig 19)**:** They are used for taking supply from a lamp holder for small appliances. They are made out of bakelite. They are available in ratings up to 6 A 250 V.

Adaptors with multiple plugs are also available for taking supply to a number of appliances from a single point.

These adaptors should not be used in bathrooms or other damp places.

Ceiling roses: Ceiling roses are used to provide tapping points from the wiring for supplying power to fans, pendent-holders, tube lights etc. Normally flexible wires are used for tapping from the ceiling roses.

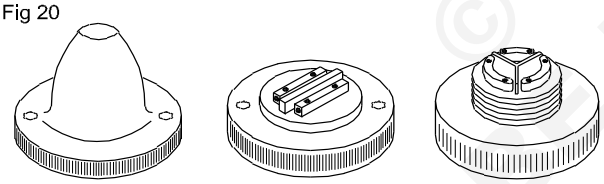
Fig 19



Ceiling roses have two parts, base and cover, both made of bakelite. The cover has a hole in the centre for the connecting wires to be taken out. There are threadings on the internal sides so that the cover may be fixed or tightened with the base. The base has terminals and holes for fixing on the block etc. and for wires to connect with the supply. Two types of ceiling roses are in use.

Two-plate ceiling rose (Fig 20 a & b)**:** This is made of bakelite and it has 2 terminals (phase & neutral) which are separated from each other by a bakelite bridge. Each of the terminal plates is provided with a metallic sleeve and a binding screw on one side through which the circuit wire from the back via the mounting block enters them. The other side of the terminal plate is provided with a washer and screw to tap wire connection. The two-plate ceiling rose is used for 6A, 250V current capacity. It is not used in circuits whose voltage exceeds 250V.

Fig 20

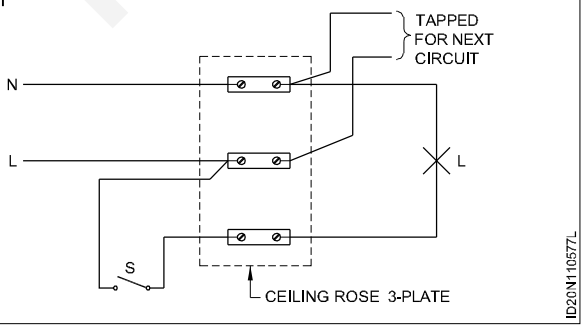


Three-plate ceiling rose: This type of ceiling rose has 3 terminals which are separated from each other by a bakelite bridge. It can be used for two purposes. (Fig 20 a & c)

– Bunch light control

– To provide tapping for phase wire (Fig 21).

Fig 21

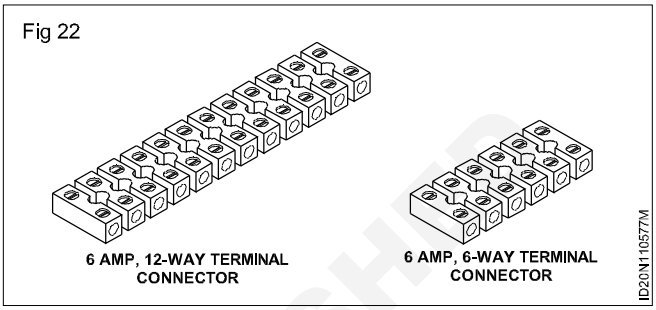


– Connecting earth wire in domestic wiring.

These ceiling roses are available in the rating of 6A, 250V. The covered 2 plate and 3 plate ceiling roses will look alike but could be identified by seeing the rear side.

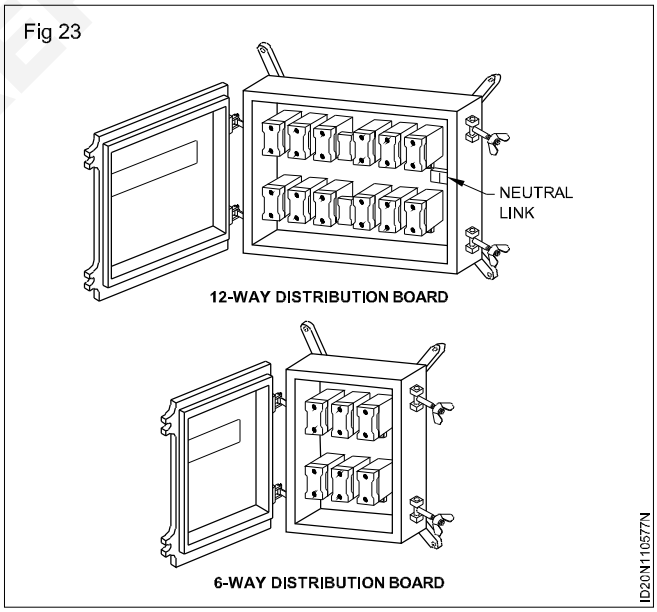
Connectors (Fig 22): Connectors are used to extend the length of the wire without joining. They are made of porcelain, bakelite or PVC based material. There is a brass sleeve with threading for small screws to tighten the wire in the sleeves. These are available in single way, two-way, three-way, six-way, 12-way types. These are rated according to the current and voltage capacity - 6A 250V, 16A 250V, 32A 250V, 16A 500V, 32A 500V etc.

Fig 22



Distribution board (Fig 23): These are used where the total load is high and is to be divided into a number of circuits. These are used where the load is more than 800W. The number of fuses in the board is according to the number of circuits, and a neutral link is also provided so that the neutral wire can be taken for different circuits. All these branch fuses are enclosed in a metal box. These boards are available as two-way, three-way, 4,6,12-way types.

Fig 23



Neutral link: In a three-phase system of wiring installations, the phases are controlled through switches, and the neutral is tapped through a link called neutral link. The neutral link consists of a terminal for incoming current and a multi-way outgoing circuit. The metal terminals are mounted on high grade vitreous porcelain base (Fig 24). The ratings are 16A, 32A, 63A, 100A neutral link.

Miniature circuit breaker (MCB)

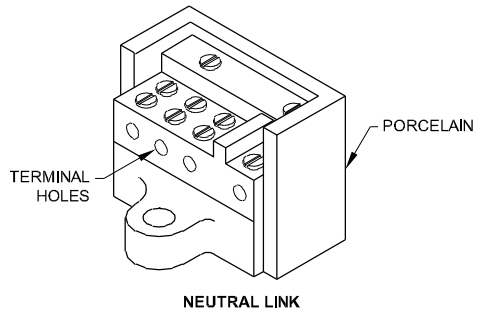
Nowadays instead of using fuses for individual circuit protection MCB are used. They are in fact sensitive and

easy to operate. The trip mechanism switches off the circuit when the circuit is overloaded. After removing the overload, the MCB could be switched on. On the other hand fuses once blown require replacement and replacing the fuse wire requires some skill and time.

Earth leakage circuit breaker (ELCB)

Earth leakage circuit breakers are the devices installed in the circuit to open the circuit in case of earth fault, leaky insulation and misuse, some of the supply companies insist that ELCB should be provided in each domestic circuit to protect men and material.

Fig 24

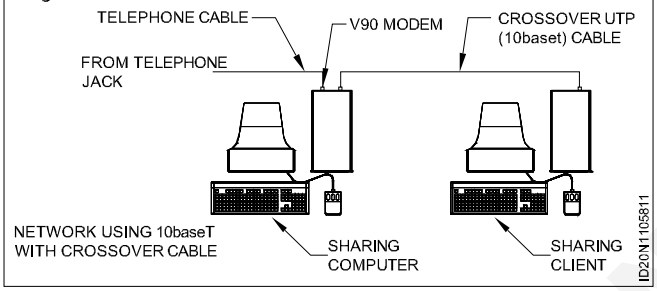


Introduction of LAN/CCTV/ Biometrics/ Speaker and smoke detector

Objectives: At the end of this lesson you shall be able to
- **state the meaning of LAN/ CCTV and uses**
- **state the meaning of biometrics/ speaker and smoke detector and uses .**

Local area net work (LAN) (Fig 1)

Fig 1



The LAN, or local area network is a group of two or more computers

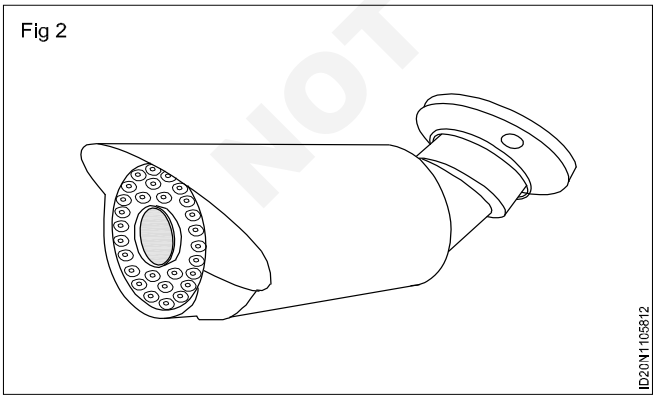
Physically close together that are linked to each other

LAN's can contain devices other then computers, for example printers, print servers, storage devices

First need to determine the type of connection method to use for your network. Choose your connection method followed (Fig 1) EthernetWirelessPhone-linePower lineDirect cable connection (only for two computer)

Closed circuit television (CCTV) (Fig 2)

Fig 2



Primarily for surveillance and security purpose

CCTV relies on strategic placement of cameras and private observation of the cameras input on monitors

The system is calles 'Closed-circuit' because the cameras, monitors and / or video recorders communicate across a proprietary coaxial cable run or wireless communication link

Modern CCTV displays can be light resolution color

CCTV is commonly used for a variety of purposes including

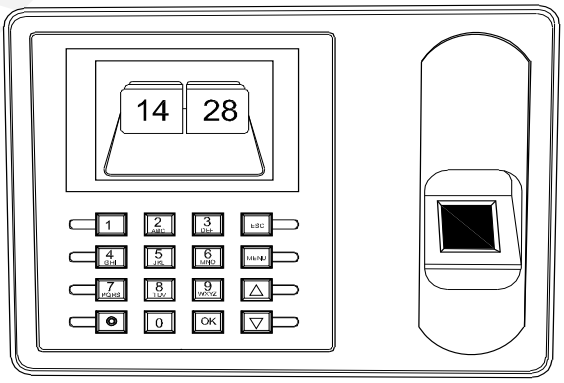
Maintaining per imeter security

Monitoring traffic

Obtaining a visual record of human activity

Biometrics (Fig 3)

Fig 3



Biometrics is the measurement and statistical analysis of people's unique physical and behavioral characteristics

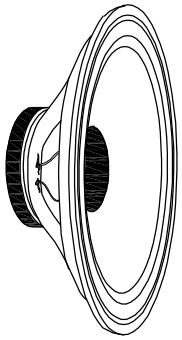
The technology is mainly used for identification and access control or for identifying individualy who are under surveillance

The basic premise of biometric authentication is that every person can be accurately identified

Biometric devices are reader or scanning device

Speaker (Fig 4) : A speaker is a term used to desceibe the user who is giving vocal commands to a software program

Fig 4



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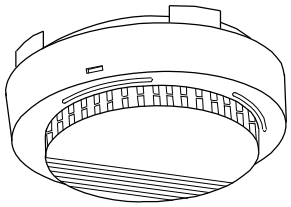
The computer speaker is an put hard ware device that connects to a computer to generate sound

Obviously the speaker and the listener are the two most important keys, as there would not be a communication exchange without them

The speaker is arguably the most important key as they are responsible for creating, a clear message that will be understood by their listenter

Smoke detector (Fig 5) : Smoke detector device used to warn occupants of a building the presence of a fire before it reaches a rapidly spreading stage and inhibits escape or attempts to extinguish it.

Fig 5



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Introduction of room Air conditioning and types,uses

Objectives: At the end of this lesson you shall be able to
- **state the meaning of 'Air conditioning'**
- **list the processess to be performed for air conditioning**
- **state the meaning of auotmatic air conditoning system, air conditoner and air conditioning unit**
- **state the principle of air conditioning**
- **state the types of airconditioning.**

Air conditioning: The factors like temperature,moisture air - moment, pollution (dust,toxic gases and bacteria) are affecting on the conditions of atmosphere and causing problems to human health and comfort. To overcome such problems, airconditioning plays a bital role.

Principle of air conditioning : Air conditioning can be defined as the regulation of all factors such as temperature,humidity, motion and dust simultaneously. Air can be suitability conditioned by applying the following processess on it.

- Filtering
- Cooling
- Circulation
- Humidifying
- dehumidifying
- Heating

Automatic air-conditioning system: It controls a specify field set of conditions by means of automatic controls and valves in order to maintain air conditioning

Air conditioner: It is a assembled equipment for the control of factors like temperature,humidity and motion etc.

Air conditioning unit: It is designed as a sepcified air treating combination in order to satisfy requirements such as ventilation, air circulation, air cleaning and heat transfer. It maintains specified temperature and humidity by means of controls.

Room Air conditioner: Room air conditioner is designed and assembled by a manufacturing company as a unit for mounting in a window through wall. It delivers conditioned air to an enclosed space without any ducts.

Types of Air conditioners

1 Window Air conditioning
2 Split Air conditioning
3 Centralised Air conditioning
4 Cassette Air conditioning

Window AC

Objectives: At the end of this lesson you shall be able to
- **list past air conditioning equipment**
- **list present air conditioning equipment**
- **list future air conditioning equipment**
- **explain the main components of window A/C**
- **describe mechanical parts (auxiliary)**
- **explain the function of all the electrical components of a window air conditioner.**

Past air - conditioning equipment: One's comport as well as the success of certain industrial operations dealing with hygroscopic materials and processes depending on temperature and humidity.

The First Mechanical atmosphere cooling and humidity control used cooled water; both to reduce temperature of the air and dehumidify it. Air was passed over water, cooled coils or through cooled water sprays.

It should be kept in mind that Air-conditioning is a use of refrigeration.

Present Air-conditioning equipment

Room Air conditioner: Room air conditioner is designed and assembled by a manufacturing company as a unit for mounting in a window through wall. It delivers conditioned air to an enclosed space without any ducts. The window AC is shown in (Fig 1).

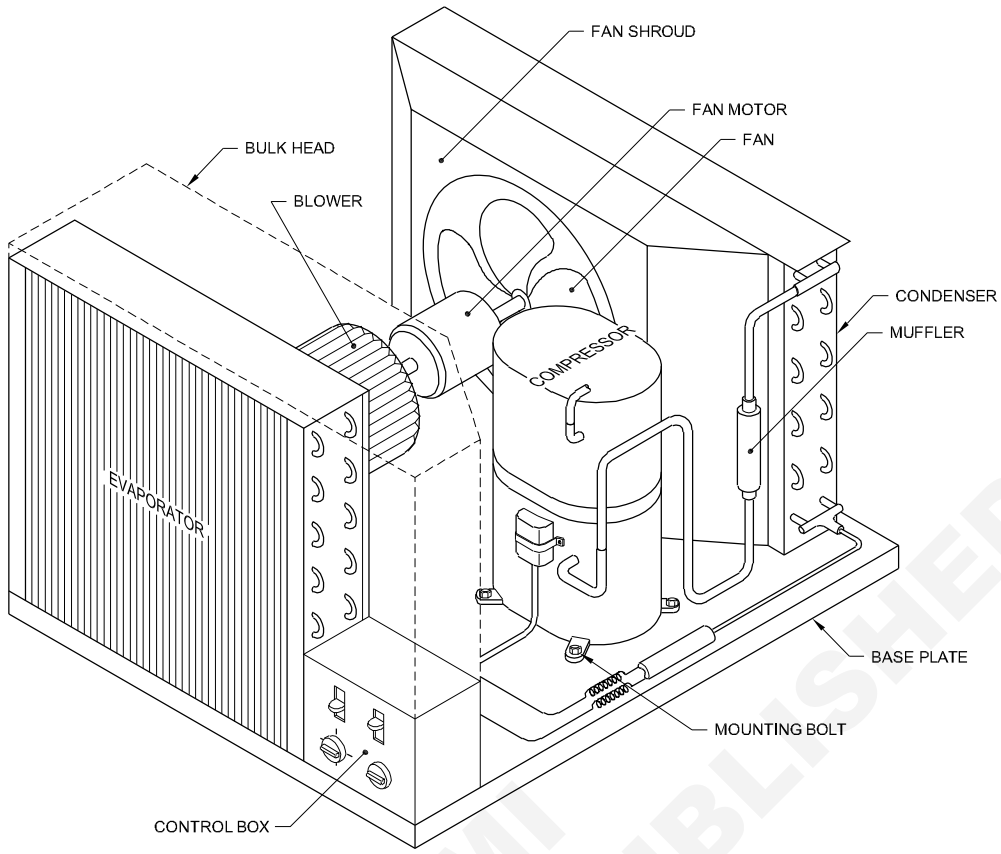
Air- conditioning fundamentals

Air conditioner : Air conditioning is defined as the process of treating air so as to control simultaneously its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space.

As defined the important actions involved in the operation of an air-conditioning system are:

- Temperature control temperature control for winter heating conditions requires automatic control of the heating source as a means of maintaining desired room temperature.

Fig 1



ROOM AIR-CONDITIONERS

- Temperature control for summer cooling conditions requires automatic control for summer cooling conditions requires automatic control of the refrigeration system to maintain the desired room temperature.

Humidity control for winter conditions usually requires automatic control addition of moisture to the heating system by humidifier.

Humidity control for summer conditions requires the automatic control of dehumidifiers usually this is above at the time the air to be cooled is passed over the cold evaporator surfaces.

Air filtering is the same for both summer and winter air conditions.

Air filtering equipment usually consists of very fine porous substances air is down through to remove contaminating particles, filters using oxide carbon and electrostatic precipitation may be added to the usual filtering mechanism to improve air cleaning. The air pollutants and methods used to remove them from the air are of different types.

Air Movement in an air conditioned area : Air movement is an important aspect in human comfort and as well as humidity aspect. If there is no air flow in an air conditioner on either side condenser/evaporator refrigeration cycle will not come into effect.

Air Movement will be constant, which make the unit viable, constant flow will be set according to the capacity of unit and the room by the related people who manufacture the unit.

According to capacity of the unit, the manufacturer will design and make according to their design which satisfy's the comfort part of human body/persons in the cooled area.

The chilling effect of air in a mixture of wind velocity and the relative humidity. Normally air movement is an important condition affecting the comfort cycle. If the air moves too fast, persons feel uncomfortable, if the air movement is too low the air becomes state and lacks oxygen (contamination).

Air movement in an air conditioned area

As you all know the air inside the room (which is air conditioned) will flow within the area. The same air is sucked through (evaporator inlet area) and is flown back to the same room only. Since the filter is provided in the evaporator inlet, the air inside the room is filtered for dust, moisture if any.

Normally it is designed that the cold air flow upto 15 feet length in a disbursed manner to the entire area at upwards as the air cooled normally lowers due to lower density and is sucked back to the filtered area (evaporator).

As per design, the normal capacity of area covering the room will be around 15' x 15', for better cooling effect false ceiling of the room is quite obvious. According to the capacity of the unit manufacturers providing air velocity is given below.

(As per design data) **Table 1**

Air flow	1 ton	1.5ton	2 ton
Rate (CFM)	400	480	620

This will vary from time to time and varies with the manufacturers.

Main components of window A/C

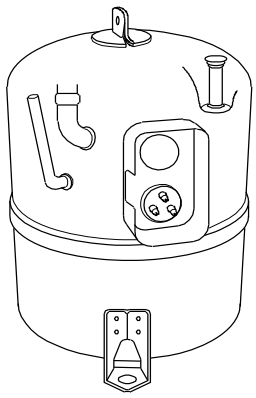
Room Air conditioner: Room air conditioner is designed and assembled by a manufacturing company as a unit for mounting in a window through wall. It delivers conditioned air to an enclosed space without any ducts.

The main components of window A/c are as follows.

– Compressor
– Condenser
– Filter drier
– Capillary tube
– Evaporator

Compressor: The compressor is the heart of the refrigeration system. It circulates the refrigerant around the system. It sucks the low pressure and low temperature refrigerant vapour, compress it. The vapour turns to high pressure and high temperature vapour and to condenser by discharge line. (Fig 2)

Fig 2



COMPRESSOR

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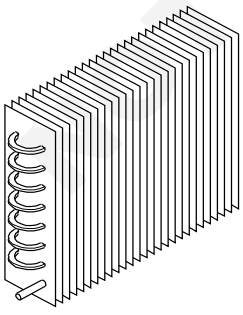
Condenser: Condenser is a heat transferring device to change the gas or vapour discharged by compressor to liquid to ready for the use in the evaporator. (Fig 3)

Fig 3



CONDENSER

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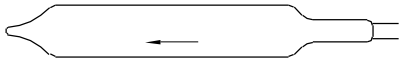
Filter drier: It is fitted in liquid line before capillary. It strain the dust and dirt. Absorb moisture in the system. It is filled with silica gel to absorb moisture. (Fig 4)

Capillary tube: It is a metering device in domestic refrigerators and air conditioners. The capillary tube consists of small diameter copper tube. The length of which depends upon the size of condensing unit and the kind of refrigerant used. (Fig 5)

Fig 4



FILTER DRIER

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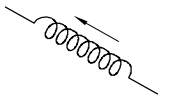
Fig 5



CAPILLARY TUBE

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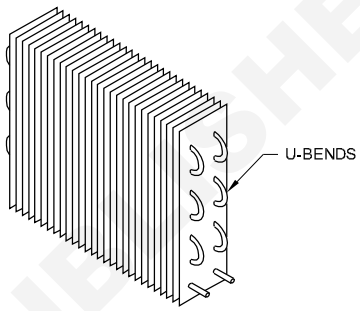
Evaporator: Any heat transfer surface area in which a refrigerant vapourizing for the purpose of removing heat from the medium being cooled. (Fig 6)

Fig 6



EVAPORATOR

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Mechanical part (Auxiliaries)

Front grill (Fig 7) : The front grill will be made of superior quality plastic. The internal construction is divided into two sections, one is the inlet air to be looked from room to evaporators through filter and the outer is evaporator cooled air to room.

Outer cover : The outer cover is made of mild steel sheet and pointed with water proof point some manufactures make it of aluminium, the cover covers the entire components of the air conditioner and protects it from rain water dust and all natural damages, it is secured tightly to the window wooden frame with screws. It protects the A/c unit from falling behind.

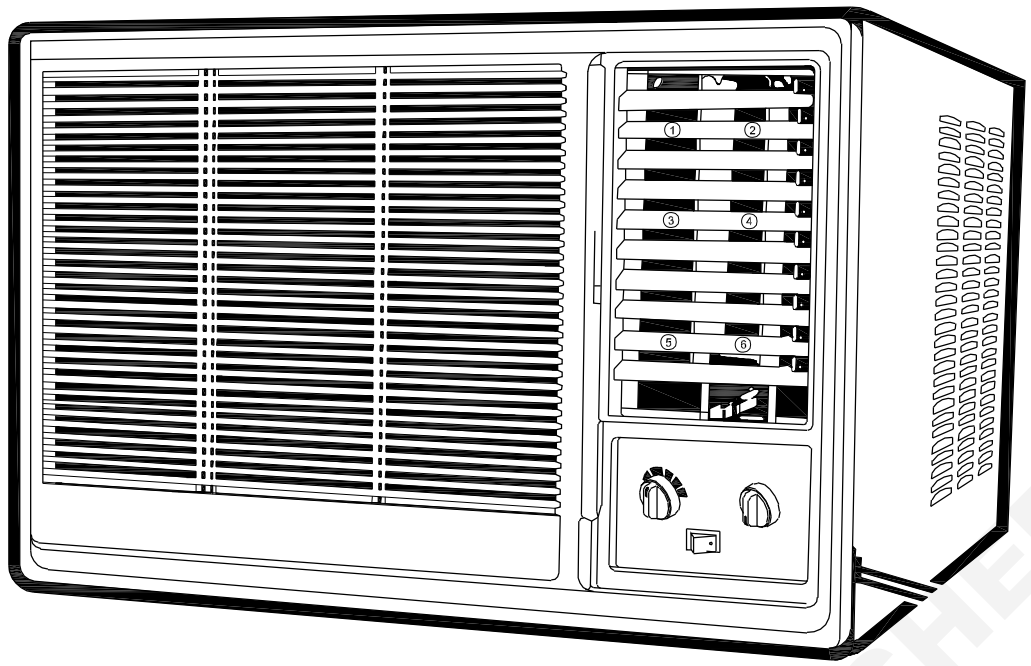
The outer cover has louvers on both sides through the louvers opening the condenser fan sucks atmospheric air and throws it on the condenser heated surface this air Pick's up heat from the condenser and goes out of the condenser fans to the atmosphere, enabling the gas to be liquefied.

Electrical components of window air-conditioner

Selector switch: The air conditioning controlled by the selector switch ON and OFF, low fan, high fan, low cool and high cool can be selected as requirement. (Fig 8)

Thermostat: It controls the room temperature by ON and OFF the compressor. The thermostat starts the compressor when the room becomes warm and reaches a predetermined setting. This setting is called 'cut-in' temperature.

Fig 7



AIR FLOW CHECK POINTS

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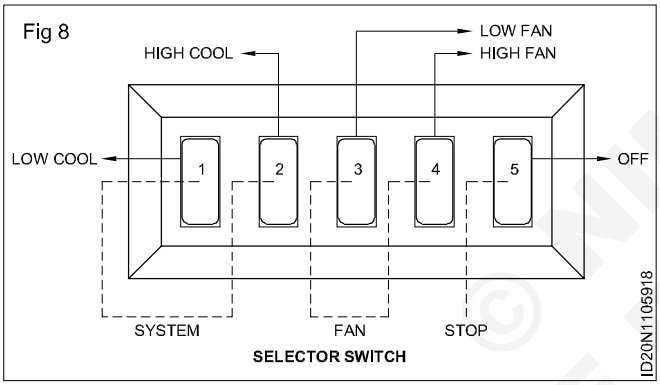
Fig 8



SELECTOR SWITCH

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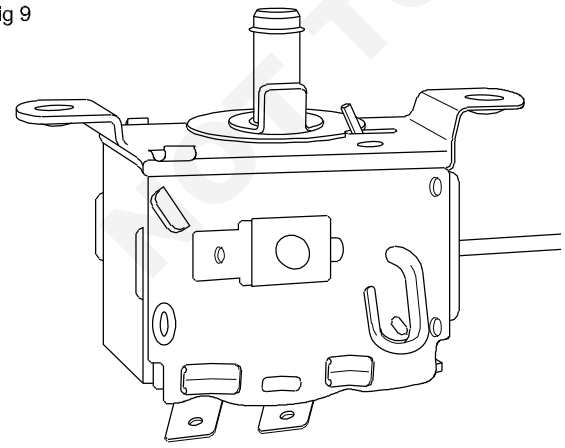
As the compressor runs, the A/C unit cools the room. When the room temperature reaches the desired temperature low or 'cut-out' the thermostat disconnects the compressor from the circuit. The compressor stops. (Fig 9)

Fig 9

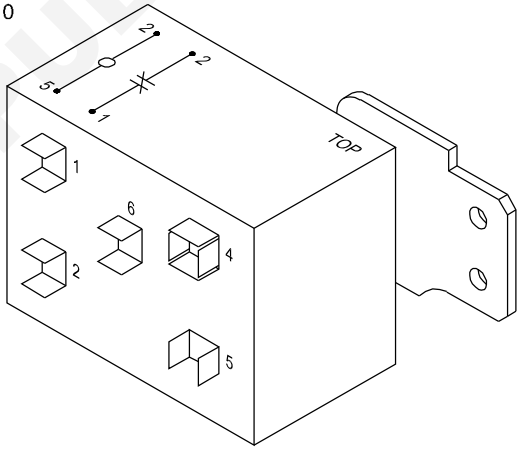


THERMOSTAT

ID20N1105919

Relay: The relay coil is in series with the motor (compressor) running winding. The high current draw on starting causes the relay contacts to close. Connecting to starting capacitor to the compressor start winding circuit, speed increases, relay contact open. (Fig 10)

Fig 10

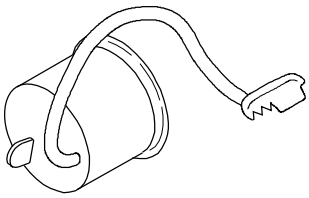


RELAY

ID20N1105591A

O.L.P: The OLP contains a resistor wired in series with the running current. If the current draw too high (overload), the resistor will heat up and cause a bimetal contact to break the circuit. (Fig 11)

Fig 11



OVERLOAD PROTECTOR

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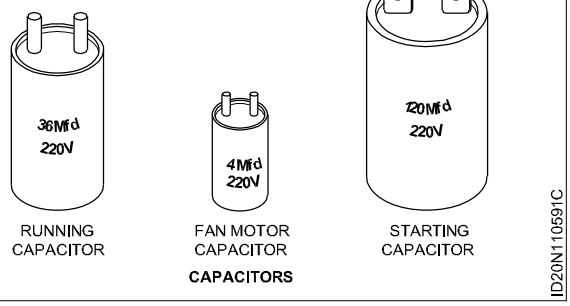
Capacitors: The capacitors have two ratings. The microfarad (μfd) rating and a voltage rating. Starting capacitors are the electrolytic type and are used in the motor start winding circuit to affect on increase in starting torque. (Fig 12)

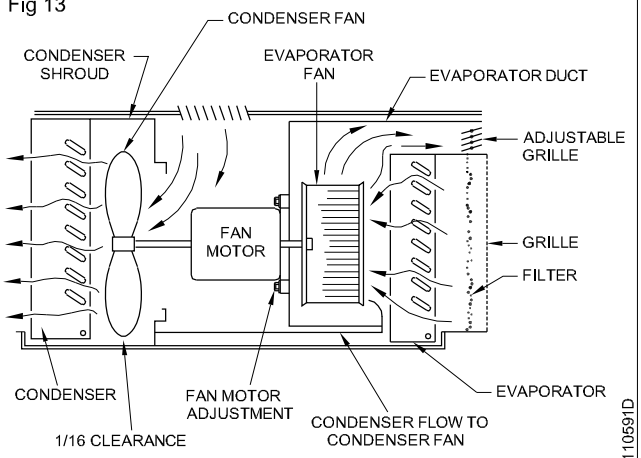
Fig 12



Running capacitors are much lower in microfarad(µfd) rating than starting capacitors of comparable size. The running capacitor remains in the motor start winding circuit at all times during compressor operation.

The fan motor used in window model air-conditioner's are designed with a single shaft that extends both side (one through shaft) as shown in Fig 13 one side the condenser fan blade will be fixed on the other side the evaporator fan will be fixed.

Fig 13



Window AC - Installation method

Objectives: At the end of this lesson, you shall be able to
- **select installing location**
- **inspect and check electrical power and temperature.**

There are different types of room air conditioner unit and there are various methods used;

– Window module air-conditioner

– Split type air conditioner

In Window module air conditioner are two types;

– Top air through

– Side air through

Window AC cooling capacity for 1 ton 12000 BTU per hour. This will cool room of size 1000 sq.ft which is of height 10" x length 10" x breadth 10".

Need of power supply for window AC is 220V. If it is less, stabilizer to be used. For 1 ton AC, 3 KVA stabilizer to be used. Fan motor take 0.5 amp, this fan motor got double shaft for fan blade and blower. Compressor take 8.2 amp to 13 amp. (some make of compressor take more amps.)

– HP of the 1 ton window AC for motor 1/16 same AC 1/32 HP using

– HP of the 1 ton window AC compressor 0.75

– HP for 1.5 ton AC compressor 1 HP

Refrigerant use in window AC F22 (Freon 22) or F12. Window model AC comes in various sizes. 47 cm height, width 72 cm and breadth 65 cm. See table for size of window AC.

Some window model AC comes with small heater also. Window AC in all module and all make coming with 2 Nos small door (2" x 2" door) for 1 door open. Fresh air will bring into AC room other door open (exhaust door) smoke and other bad smell will go out through this door. In latest model window AC does not come with heater, for that fresh air comes into room use.

In all make window AC 2 types of thermostat switch in use for control room temperature, one is remote electric switch other one mechanical switch. In window module there are 3 system is working when AC is using

– Air flow system (circulating room air through blower)

– Refrigerating system make room air get chill working by compressor

– For both 1 and 2 used electrical system.

Totally window AC make very comfort in room by making defrost temperature from outside to room inside at same time room air will be filled by air filter and make fresh. The window AC room temperature will be 70°F and grill temperature come 58°F.

– Control of window AC

– cooling control - thermostat

– selecting fan speed - selector switch

– wet and fresh air control

Latest remote control come for all this above control (electronic controls)

Installation precaution : Window type conditioner is so valuable and the improper installation of it will cause a lot of damage! Please associate the professional technician to install the unit and don't install it by yourself. Otherwise, we are not responsible for the damage like this.

Cooling capacity of window AC

Ton of AC	Compressor	Kilo Calorie	Fan motor HP	Room temperature
0.5	0.75	6000 BTU/Hr		72°F
1.0	1.5	12000BTU/Hr		72°F
1.5	2.0	18000BTU/Hr		72°F
2.0	2.5	24000 BTU/Hr		72°F

For 1 ton Window AC

Name of window AC	Height	Length	Breadth	Grill temp.	Room temp.
Usha AC	47 cm	70 cm	55 cm	58°F	72°F
Feddars AC	45 cm	68 cm	52 cm	56°F	70°F
Kelvinator AC	48 cm	72 cm	55 cm	58°F	72°F
GE AC	48 cm	72 cm	55 cm	58°F	72°F
Voltas AC	47 cm	70 cm	52 cm	56°F	70°F

Location

- The condensation water must be drained away conveniently.
- Install air conditioner unit far away TV set or radio etc, to avoid disturbing video or voice.
- In salt and coastal area or place where is near thermal springs and polluted by sulphurous gas, or other special areas, please contact the seller before use.
- Avoid a place where is possible for inflammable gas to leak out.
- Avoid other heat sources or direct sunlight.
- Avoid a place where is easy for children to touch.
- Don't use the unit in the immediate surroundings of a laundry, a bath, a shower or a swimming pool.
- For window type air conditioner with remote control, install in a location where is strong electromagnetic disturbance, you should contact the seller in advance to avoid the malfunction in use.

How to install

- Choose a location where there are no any obstacle surrounding the unit, and the plug is accessible.
- Prepare the installation hole slightly bigger than unit size.
- Choose the installation space according to the following diagram.

The distance of obstructions from window unit inside should be upper 300mm, lower 1500mm, left 500mm, right 500mm, front 1500mm.

Drain water : Drain pan and drain hose to be installed before using. Drain hose is not included in the products. You need to purchase it locally to satisfy your particular needs. Use the following procedure to install drain pan and drain hose.

- Slide out the chassis from the cabinet.
- Install the drain pan to the corner of the cabinet with 2 screws.
- Connect the drain hose to the outlet on the drain pan bottom.
- Slide the chassis into its original place in the cabinet.

To get the maximum cooling efficiency, the air conditioner is designed to splash the condensation water on the condenser coil. If the splashing sound annoy you, you can remove the rubber plug from the chassis to lower the noise, which also cause a bit loss of performance.

Installation procedure

1 Remove the sticker from the front panel.

2 Put the unit into the installation hole.(Figs 1 & 2)

- When installing the unit, it should be slanted down to the back to avoid the enlargement of noise or vibration. (Slant between 6-10mm) (Shown at right figure)
- The installation place should be strong enough to avoid the enlargement of noise or vibration.

3 Fill up sews in the cabinet with sponge or foam. (Fig 3)

Fig 1

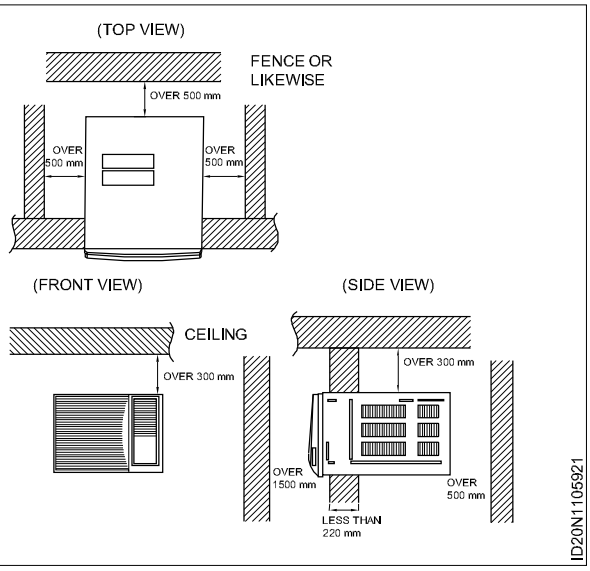


Fig 2

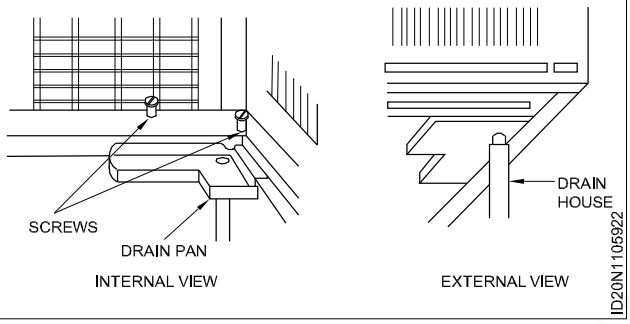
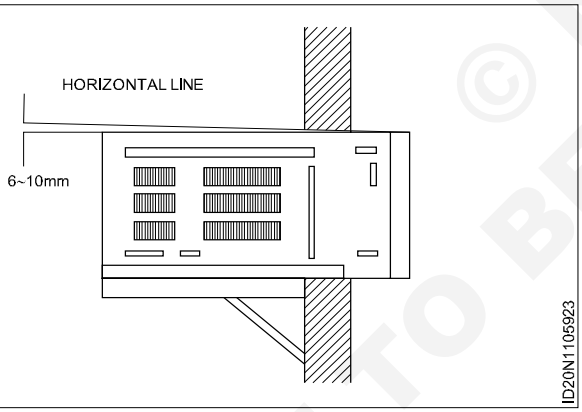


Fig 3



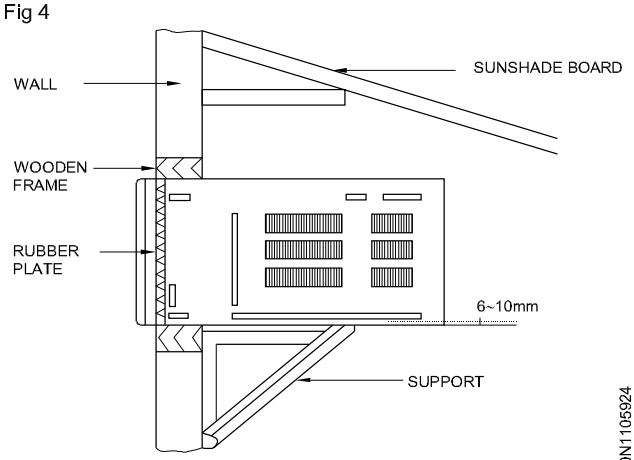
Installation assistance

- Use iron support. The installation hole should be strong enough to support the air conditioner. If it cannot, iron support has to be used outdoors. Iron support should be fixed on the building (shown at right figure)
- Use sunshade board. Air conditioner should avoid anything to be dropped into it and avoid direct sunshine. If there is no cover on it. You should contact the seller for installing the sunshade board. When installing the sunshade board, don't let it block the air inlet at the side grille. (Fig 4)

Notes for installation

Remove : Before removing air conditioner to the other place, you should contact the seller firstly.

Fig 4



Then it must be done under the direction of the professional technician. In addition, the charge of this must be paid.

Noise

Install in a location where is firm enough to avoid the enlargement of noise and vibration.

Don't put anything in front of the outlet of outdoor unit to avoid increasing noise.

Be sure that hot air no noise will not inconvenience neighbours.

Please contact the seller as soon as there is strange noise during operation.

Please use the safety support.

Electric wiring

Must connect with ground reliably.

The exclusive circuit must be used. But removable socket can't be used because poor contact of it can cause over heat or fire.

Don't pull the power cord strongly.

In fixed circuit, there must be electricity leakage protection switch and leakage current is less than 30mA.

Connecting method between air conditioners and power cord and interconnecting method of each individual element with one another should accord with wiring diagram on the unit.

The air conditioner should be installed in accordance with national wiring regulation.

An all-pole disconnection switch having a contact separation of at least 3mm in all poles should be connected in fixed wiring.

Air switch (thermal-magnetic breaker) should be installed in the circuit.

If the supply cord is damaged, it must be replaced by the manufacturer or your dealer or a qualified person to avoid a hazard.

All the electrical work must be done according to the local wiring regulations.

Split Air conditioner

Objectives: At the end of this lesson you shall be able to
- **explain the types of split air conditioner**
- **describe the details about the compounds**
- **study ventilation of room conditioner drain**
- **explain about remote control**
- **advantages of split air conditioner.**

Split air-conditioners have become very popular because of (Fig 1)

1 They are an alternative for air-conditioning of partition rooms, where window model air-conditioners cannot be used.

2 They are very silent in operation.

3 The room side units can be selected to match the interior decorations of the rooms.

Types of split air-conditioners

1 Direct room mounted split unit : The evaporator unit can be installed in different models, like floor mounting, wall mounting and ceiling mounting. The condensing unit is kept outside in a suitable location.

2 Duct able split unit : In this type the evaporator is normally mounted above false ceiling space and the cold air is supplied through ducting and delivered through the terminals (outlets) located at selected places.

3 Multi split unit : This system offers the feature of having individual room temperature control. Multi split units have been developed to cool two or three rooms simultaneously by having as many individual compressors and separate refrigerant circuits.

Condenser : The function of the condenser is to remove heat from the superheated high pressure refrigerant vapour and to condense the vapour into a sub-cooled high pressure refrigerant liquid. The cooling medium for domestic air-conditioner is air (Fig 2).

Expansion devices : An expansion device is a link between condenser and evaporator. Capillary tube is an expansion device in domestic split units. Capillary tube allows the equalisation of suction and discharge side pressure during off cycle, it can be used with compressor working on CSR and PSC circuit, compressor motors which provide low starting torque.

Liquid line drier filter : The function of a liquid line drier filter is to absorb moisture in the system. It also filters the foreign particles such as copper burr, dirt, dust, etc. This protects the expansion device from getting blocked due to ice (moisture) or other particles. It also protects the compressor from damage due to metal burr or dust etc.

Evaporator

The function of evaporator is to remove heat from the area to be cooled and to maintain it at desired temperature. Various types of constructions of the evaporator are in use in hermetic systems.

Liquid suction heat exchanger

In a liquid suction heat exchanger the low temperature return gas picks up the heat from the higher temperature liquid, thereby increasing the sub-cooling and decreasing the flashing. This is expected to increase the capacity of the system. During this process super heat at compressor suction increases, also increasing the specific volume of gas.

Suction line accumulator

A suction line accumulator prevents liquid refrigerant from entering the compressor under low load condition.

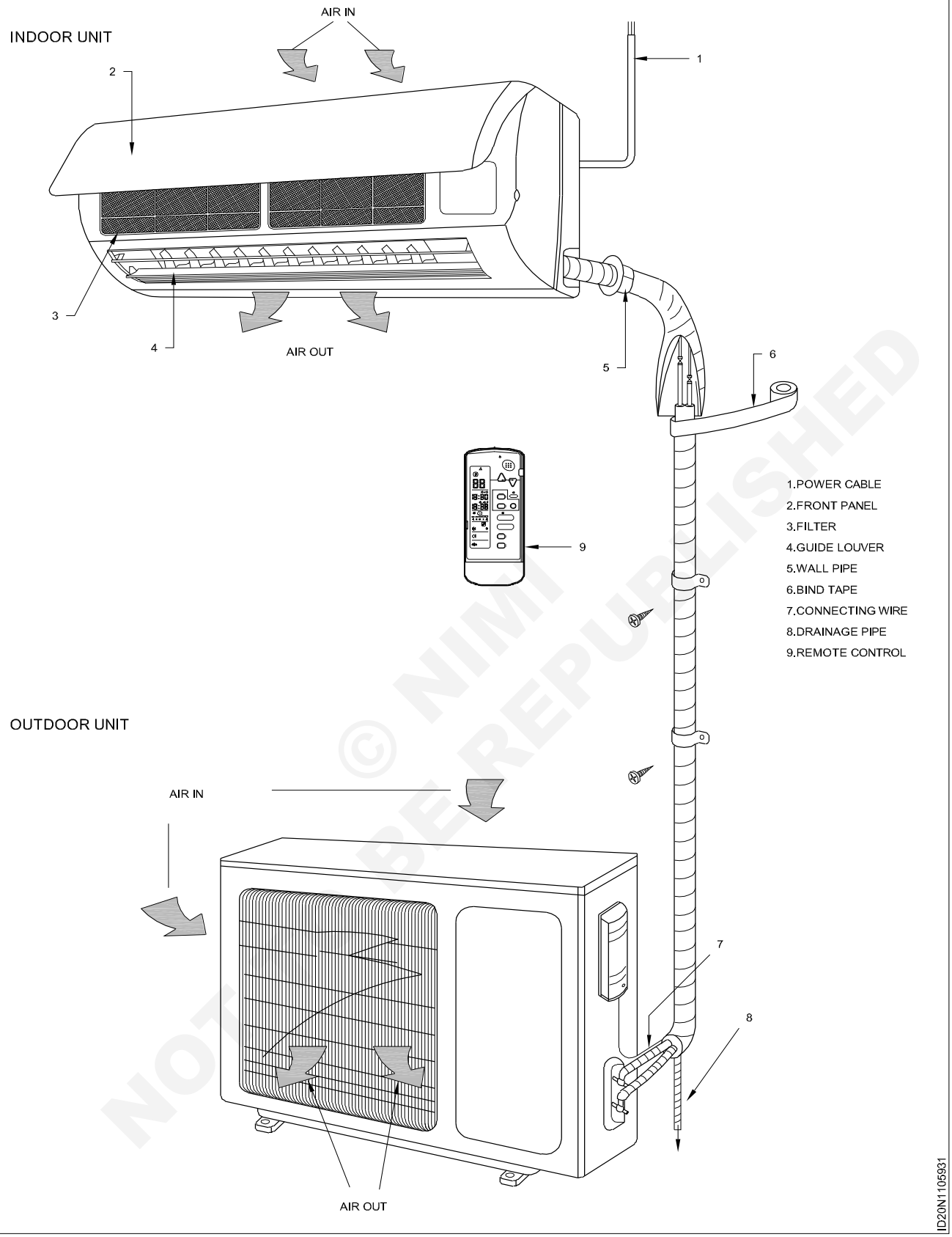
Fan, Fan motor, Blower

The function of the fan, the fan motor and the blower is to provide the required amount of air flow on the condenser and the evaporator as per the design. The selection of these components is very important because any change in air flow over the fan cooled condenser or evaporator has a large effect on the capacity of these coils.

TECHNICAL SPECIFICATIONS OF SPLIT AIR-CONDITIONER

Cooling capacity	T.R	1.0	1.5	2.0
	BTU/Hr.	12000	18000	24000
	Kcal/Hr.	3000	4500	6000
Power supply	Volt Phase Cycle	230 1 50	230 1 50	230 1 50
Power input	Watts	1140	1850	2470
Running current	Amps	6.0	8.5	11.0
Energy Efficient Ratio	BTU/W	10.5	9.7	9.7
Air circulation at high speed	M^3/min. CFM	10M^3/min. 350	13 450	15 525
Temperature control		Thermosensor	Theromostat	
Condenser & evaporator fan motor/capacitor	H.P Mfd	1/6 2.5	1/5 2.5	1/4 4
Compressor	Type	Rotary Reciprocating	Rotary Reciprocating	Reciprocating
Refrigerant		R22	R22	R22
Cooling unit fan speed-mode		3	3	3

Fig 1

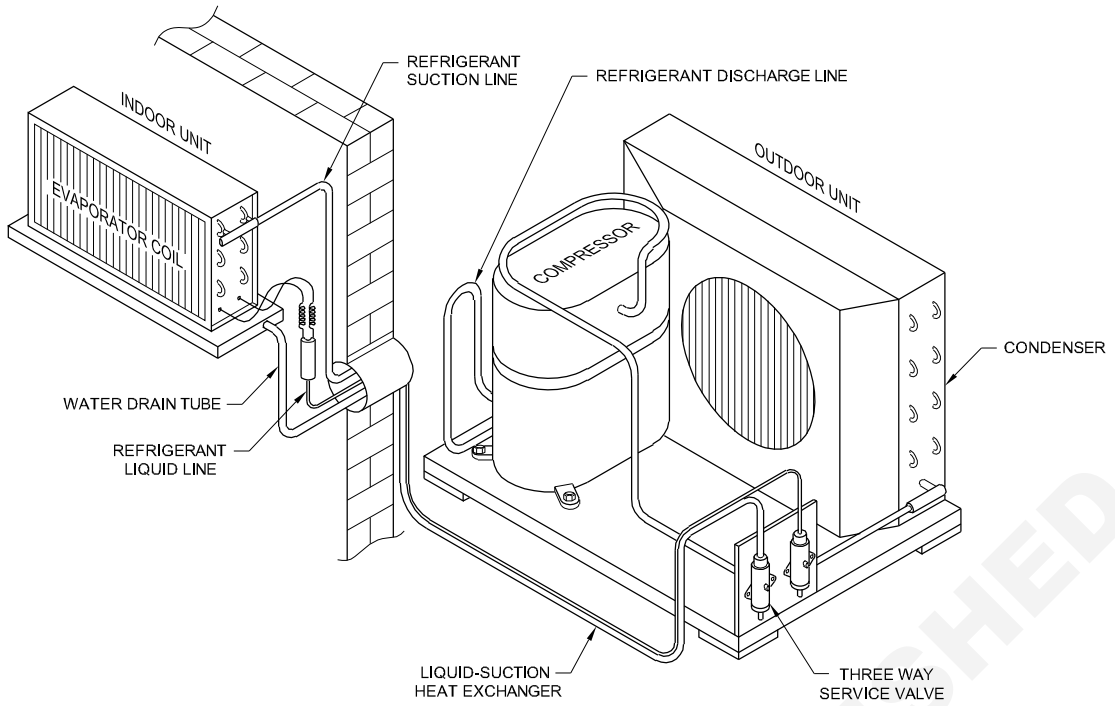


Refrigerant tubing : In split air conditioner the evaporator unit and condensing unit are connected by refrigerant tubings.

The condensing unit shall be kept as near as possible to minimise the pressure drop in the connecting tubings, bends, etc. Mounting the condensing unit at a higher level than the evaporator unit should be avoided, if other options are available, to make the oil return to compressor easier.

The distance between the units shall be normally horizontal distance: 40 ft. (12 meters) vertical distance - 20 ft. (6 meters.)

Fig 2



PARTS OF A SPLIT AIR CONDITIONER

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The oil charged in all air-conditioner model compressors will be sufficient to operate upto 40 ft. long tubing (12 meters). When a typical installation for a much longer tubing than 40 ft. the compressor has to be charged with a specific quantity of extra oil as 90 ml. for every 10 ft. length after crossing the initial 40 ft. distance. The suction line shall be well insulated.

Suggested tube sizes for room mounted/ductable split A/Cs.

Ventilation of room : Cooling unit of the split unit is mounted directly inside the room, normally do not have any built-in provision to supply fresh outside air for ventilation of the room. In certain applications while using split units, the need and quantity of fresh outside air required may be considered and suitable external provisions may be made.

Drainage of condensate water : When the air around the evaporator is cooled, the moisture in the air accumulates as water under the evaporator. This water referred to as 'Condensate' is collected in a pan under the evaporator and must be removed from the conditioned space. Therefore, wherever indoor units are mounted, there must be a gently sloping drain tube to carry this condensate water away from the room. If the water is not drained properly, it may collect in the drain pan until it overflows and drops into the room.

Remote Controller (Fig 3)

Functions

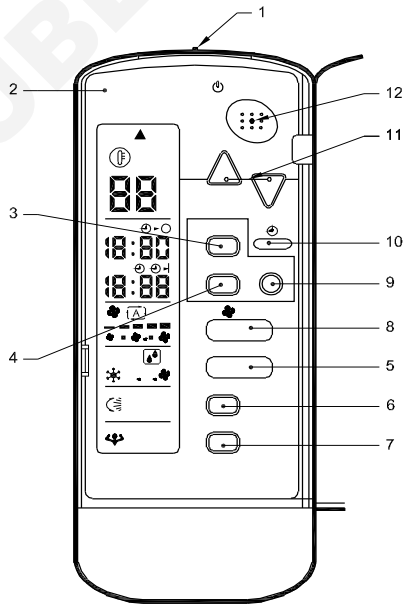
Transmitter

Sends signals to the indoor unit

Display: Displays the current settings. Each section is shown with all its displays ON for the purpose of explanation.

OFF timer operation: Timer functions are useful for automatically switching the air conditioner OFF. Press

Fig 3



1. TRANSMITTER
2. DISPLAY
3. OFF TIMER BUTTON
4. ON TIMER BUTTON
5. MODE SELECTOR BUTTON
6. SWING BUTTON
7. POWERFUL BUTTON
8. FAN SETTING BUTTON
9. TIMER CANCEL BUTTON
10. CLOCK BUTTON
11. TEMPERATURE/TIME ADJUSTMENT BUTTONS
12. ON/OFF BUTTON

REMOTE CONTROLLER

ID20N1105933

OFF timer while the air conditioner is operating 0:00 is displayed. Press up or down button and set the time. Press off timer once again. The timer lamp lights up.

ON timer operation: Check that the clock is correct. If not, set the clock to the present time. Press the ON timer button while the air conditioner is not in operation. The time is displayed. Press up or down buttons and set the time. Press ON timer again. To cancel the timer, press cancel, then the timer lamp goes off.

Capacity	Suction line		Liquid line
	Up flow	Down/Hori. flow	
1.0 TR	1/2" OD	5/8" OD	5/16" OD
1.5 TR	1/2" OD	5/8" OD	3/8" OD
1.7 TR	1/2" OD	3/4" OD	3/8" OD
2.0 TR	5/8" OD	3/4" OD	3/8" OD
3.0 TR	3/4" OD	7/8" OD	3/8" OD
3.75 TR	3/4" OD	$1\frac{1}{8}$" OD	1/2" OD
5.0 TR	7/8" OD	$1\frac{1}{8}$" OD	1/2" OD

Compressor motor circuits & accessories

Capacity	Compressor motor circuit	Run capacitor	Start capacitor
1 TR	PSC/CSR	25 mfd	60/80 mfd
1.5 TR	PSC/CSR	36 mfd	80/100 mfd
2.0 TR	PSC/CSR	45 mfd	150/200 mfd

Mode selector button: Select a mode. Each pressing of the button advances the mode setting in sequence.

Swing: This can adjust the air flow direction. Every time the button is pressed the indicating lights appears or disappears to stop the flap at an angle, press the swing button and no display.

Powerful operation: Powerful operation quickly maximizes the cooling effect in any operation mode. Get the maximum capacity with this operation.

Fan setting: Selects the air flow rate setting.

Timer cancel: Cancels the timer setting.

Clock: It is for setting the clock. To set the clock press up or down button.

Temperature/time adjustment: Change the temperature or time setting.

ON/OFF: To start operation press it once and to stop it press again.

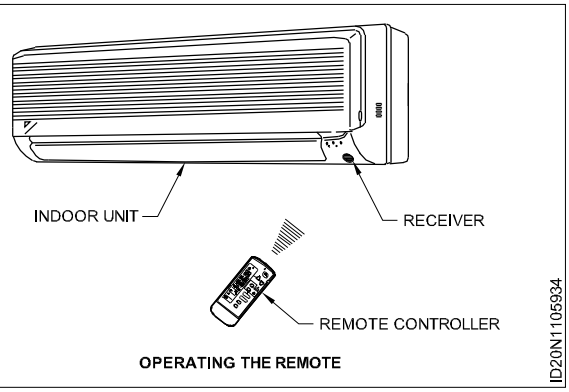
To use the remote controller, aim the transmitter at the indoor unit (See Fig 4). If there is anything to block signals between the unit and the remote controller, the unit will not operate.

Caution: Do not drop the remote controller. Do not get it wet.

Only the split A/C cooling coil and blower will work inside the room, so the cool in the room feel very comfortable and will not be any noise.

The mounting of split A/C cooling coil is very easy with 2 clamp, where the window model A/C cannot be used. The split A/C can be fitted easily and the room can be decorated neatly.

Fig 4



OPERATING THE REMOTE

Split A/C are available in 3 types:

1 Floor model 2 Wall mounting and

3 Ceiling mounting.

Important points for installation : The condensing unit can be fitted over evaporator. Also it can be mounted at the higher / lower (or) same level of the cooling coil.

Condensing unit to be kept very close to the cooling coil for minimising the gas quantity. The length of the pipe line also can be reduced.

The condensing unit should not be fixed above evaporator. Because there is no oil separator in sealed system for bringing back oil which travel in evaporator.

On condensing unit, sheet (shading) is provided for sun stroke.

Take care to avoid the air short cycling, otherwise compressor will trip with high condensation by OLP.

Specifications of split A/C

There are 3 types:

1 Direct mounted split A/C

2 Ductable split A/C

3 Multisplit

The outer unit of split A/C fan motor have single shaft with a capacity of 1/5 HP at 220V.

The indoor unit of cooling coil fan motor have double shaft with capacity of 1/32 HP at 220V.

There are 3 system in split A/C

1 Air flow system

2 Refrigeration system

3 Electrical system.

The Split A/C inner unit is covered with plastic and air louver for air direction.

The speed of fan motor is 800 rpm at 220V, 5 amps. for both indoor and outdoor unit.

The cooling capacity of 1 ton = 12000 BTU and for 1.5 ton is 18000 BTU. The compressor takes 8 to 9 amp. in full load at 220 volt. Refrigerant charge in split A/C is R 22.

Advantages of the split A/C units

In the recent years the split systems have been very popular because of their designs and latest developments etc. There are many advantages using the split units as follows:

i They are an alternative for air-conditioning partition rooms (various rooms) where window models cannot be used or over cost.

ii They are very silent in operation.

iii The room side units can be tailor made or specifically selected to match the interior decorations of the room.

There are some disadvantages too which are,

i Cost will be more.

ii Extra care should be taken.

iii Servicing of both the units will be done periodically.

iv Wear and tear of the unit (outdoor unit) will be more as the unit is positioned to open atmosphere.

Various models of split units in use:

1	Outdoor unit with one fan motor/one compressor	> <	One indoor unit
2	One outdoor unit different rooms)	> <	Two indoor unit (for the one fan motor and two compressors
3	One outdoor unit/ two fan motor and two or three compressor (two fan motors connected in series) (Mostly ductable type)	> <	Two or Three indoor unit (For different rooms) Rest line given respectively.

Central AC Plant

Objectives: At the end of this lesson you shall be able to
- **identify various components**
- **study of construction and working principle.**
- **explain mechanical parts used in central AC plant**
- **explain electrical parts used in central AC plant.**

Mechanical parts : Vapour comparison refrigerator cycle is used in central air conditioning plant. The main components are compressor, condenser, liquid processor, drier, expansion valve, evaporator and accumulator.

Compressor : Compressor is the heart part of the vapour compression cycle in central air conditioning. Generally open type reciprocating or sealed type. Another compressor is screw 2 type is used is air conditioning systems. Now a day scroll type compressor is using in air conditioning. The centrifugal compressor is used in commercial central air conditioning plant.

Condenser : Water cooled condenser is generally used in central air conditioning plant. But some small central air conditioning system using air cooled condenser. In water cooled condenser, cooling tower is required to cool the condensing water. The water cooled condenser are shall and tube type, shall and coil type and plate heat exchanger type.

Liquid receiver : Liquid receiver is fitted at the out let of the condenser. The function of liquid receiver is collect liquid refrigerant coming from condenser and supply to the expansion valve. Pump down process can done in liquid receiver.

Drier strainer : It is located in the liquid line to prevent moisture and dust particles.

Expansion valve : For reducing the pressure and amount of liquid refrigerant into the evaporator a refrigerant control device is located at the in let of the evaporator coil. The expansion valve using in central air conditioning plants are thermostatic expansion valve, electronic expansion valve and float valve controls.

Evaporator : Evaporator coil is fitted at the outlet of the expansion valve. The evaporator coil are direct or indirect type.

Air Handling Unit (AHU) : AHU is the part of central air conditioning plant. It consists of air fitter, blower, cooling coil inlet and outlet air flow.

Ducts : Ducts are used to carry air from one place to another place. The different ducts in air conditioning systems are supply duct, return ducted fresh air duct.

Electrical parts

The main electrical parts used in central air conditioning plant are as follows:

1 Motor 3 phase for operating compressor

2 Motor for cooling tower fan

3 Motor condenser water pump

4 Motor for blower

5 Low pressure cut out

6 High pressure cut out

7 Oil pressure cut out

8 Crank cast oil heater

9 Thermostat switch

10 Solenoid valve

11 Starter for motor

12 Over load protector

13 Single phase preventer

Central / Industrial airconditioning system

Objectives : At the end of this lesson you shall be able to
- **describe about air conditioning system & central airconditioning**
- **describe air conditioning principle**
- **types of A.C. system, chiller**
- **describe about AHU, humidification, & de-humidification**
- **define air washer.**

Central air conditioning system & industrial air conditioning system is large plant & machineries. It is different than domestic freezer and air conditioner. As though the principle & working are similar to the small plant. Basically the plant room is separate, normally it is in basement or ground floor of the multistoried building. All the major components like compressor, condenser, chiller, water pumps, and controlling devices installed at plant room except the air handling unit & cooling towers. A.H.V. placed in every floor of the buildings in suitable position. The chilled water through insulated pipe line circulated to A.H.V. by centrifugal pump.

In case of die system the refrigerant circulates directly to weather maker (AHU) through refrigerant control from the liquid line of condenser.

The chilled air circulated from air handler to conditioned space through insulated air duct.

The cooling tower generally provides at the roof or any open airy space. The pipe line provides from condenser to cooling tower to circulate the water.

Central / Industrial A.C. system

What is airconditioning?

Air conditioning is defined as a process which cools (or heats), cleans, circulates, freshens air and controls its moisture content simultaneously.

Most often airconditioning is about removing heat. Now that we have defined airconditioning let us get us know the nature of 'Heat'. There are two types of 'Heat': Sensible Heat and Latent Heat.

'Sensible Heat' is any heat that raises the temperature but not the moisture content of the substance. This is our regular and familiar every day heat. Because it raises the temperature it can be detected by the senses, and this in fact, is why it is called Sensible Heat.

'Latent Heat' is the tricky one. When we talk of Latent Heat we mean 'Latent Heat of Vaporisation'. It is that heat required to transform a liquid to vapour. Take water for example. Water can be heated to its boiling point of 100 °C. If more heat is added at this point the temperature of the water does not increase. The water continues to boil and becomes steam. So where does all the heat go? Well, the heat goes into changing the water into steam. The latent heat of vaporisation in this instance is the heat required to change water from liquid at 100 °C to vapour at the same temperature.

Latent heat plays an important part in refrigeration and air conditioning. It explains the principle of refrigeration and also is a component of Heat Load, of which we will learn more along the way. Human beings generate latent heat by way of moisture (perspiration) on their skin. The perspiration requires to be dried, therefore a change of its state from liquid to vapour is required. Fresh air which is added into the air system, very often brings in plenty of moisture with it. Removal of this additional moisture also involves latent heat removal.

A portion of the airconditioning heat load is therefore in the form of latent heat. For example in an office 10% of the airconditioning heat load could be in the form of latent heat. This goes up to around 25% in a restaurant and around 33% in a movie theatre.

How is cooling made possible?

Now that we have discussed "Heat" let us talk about the principle at work in airconditioning. The core concept to understand is Evaporation. Remember how could you skin felt when dabbed by liquid spirit at a doctor's clinic before an injection? It felt could because the spirit evaporated (changed from liquid state to the vapour state) very rapidly. And when it evaporated it needed heat to change its state. Where did this heat come from? It came from the liquid itself, and your skin, with which it was in contact.

In the refrigeration cycle this principle is put to work by causing a liquid Refrigerant* to evaporate in a cooling coil (evaporator). This refrigerant is a specially chosen substance which has the property of evaporation at a very low temperatures. (For example, the commonly used refrigerant, R-22, would start evaporating at *40 °C even under normal atmospheric pressure). The cooling coil, in which the refrigerant evaporates, is in contact with the air (or water in chilled water systems) surrounding it, thereby cooling that as well. Once this air (or water) is then directed to the spaces which require cooling.

A refrigerant is a gas with special characteristics that make it suitable for Refrigeration. It is possible to liquefy it even in ambient temperatures when the pressure is raised. R-22 is the most commonly used refrigerant in airconditioning. Recent studies indicate that Refrigerants when leaked into the atmosphere cause damage to the ozone layer. By international consensus today's refrigerants may be replaced by new ozone friendly refrigerants over the next three or four decades.

Equipment used to produce cooling

Now that we have seen the process by which cooling takes places, and examined the nature of heat and humidity, let us briefly look at the main equipment used to produce the effects we require.

The compressor: Under atmospheric temperature and pressure the refrigerant is in gaseous form. We learnt that

cooling takes places when liquids evaporate to become gas. Therefore we must first transform the refrigerant gas into liquid form. Most gases can be made into the liquid form by raising its pressure (and cooling it, which is handled by the condenser). The equipment that increases the pressure of the gas by compressing it, is called the Compressor.

The condenser: During compression however the refrigerant becomes hot. This is because of two reasons:

a Because of the work done on it (remember how warm the hand pump became when pumping air into your bicycle tyres?) and

b Because the refrigerant is converted from gas to liquid releasing its latent heat.

This heat has to be removed to enable the gas to condense into a liquid easily. The equipment that removes the heat is called the Condenser.

The evaporator ('Cooling Coil' to most of us): From the condenser we now have the liquid refrigerant ready to go to work. This refrigenra can remove heat from the space when it starts evaporating. The liquid refrigerant from the condenser is injected through a metering device* called the capillary or expansion valve into the cooling coil which is bundle of tubes.

Inside the cooling coil the pressure is low because of the metering / throttling device on one side and the compressor suction on the other side. In the low pressure, the liquid refrigerant starts evaporating rapidly. While evaporating needs sensible heat to transform itself from the liquid to the gas state. So it soaks up heat from the surrounding tubes, and from the air, with which the tubes are in contact. This is what causes the cooling.

End of cycle and beginning of the next one: Having done this, the refrigerant is back into the gaseous form. It is sucked into the compressor where it will be compressor again for the next refrigeration cycle.

In the water cooled systems, the heat from the conditioned area is transferred to the cold refrigerant warming it up. This warm refrigerant transfers the heat to water in the Water Cooled Condenser thereby warming the water. This warm water in turn transfers the heat to the atmosphere through the cooling tower.

Types of airconditioning systems

Over the years, Airconditioning Systems have evolved to suit different needs. The emergence of new technologies, environmental conditions and the availability of space have all played a part in shaping the airconditioning systems of today. Though many types of airconditioning systems are available it is convenient to first classify them broadly as follows:

Basic branches of airconditioning

The basic branches of airconditioning are Central AC systems and Non-Central AC products Central AC systems can then be divided into Ductable Packaged Airconditioners and Central Plants, while Non-Central AC products can be divided into Window ACs and Split ACs. Further subdivisions appear in subsequent pages.

Airconditioning falls into two broad segments.

Central AC systems and **non-central AC products**

By Non-Central AC Products we mean those airconditioners that do not use any air ducting to cool the conditioned space. Window mounted 'Room Airconditioners' and the 'Non-Ducted Split Airconditioners' fall into this category. These products are suitable where air throw is limited to around 4 metres (13 feet) and small spaces are involved. Where large spaces are involved, multiple units are used to distribute the air.

Alternatively in order to distribute the air uniformly using less units, **Central AC systems** are preferred.

Central AC systems can be further subdivided into **Ductable Packaged Airconditioners** and **Central Plants.** The term 'Ductable' implies and airconditioning system suitable for ducting. The design engineers may prefer to minimise ducting by employing Fan Coil Units instead.

Cassette mounted split AC

Objectives: At the end of this lesson you shall be able to
- **describe of cassette A/C**
- **explain the parts of cassette A/C**
- **select the location of indoor and outdoor units.**

Ceiling cassette A/C units are mounted as name suggests, in ceiling. This is most effective in a suspended (or) floating ceiling where there is room to accommodate the units. Since cold air falls towards the floor. It contains adjustable thermostats and variable speed fans, purification filters can also be used with then to filter the air of pollutants and other harmful particulate meaning the A/C can pull double duty as an air purifier.

The ceiling cassette A/C unit needs to have to be professionally installed. Lines need to be run from the condenser outside the building to the cassette in the ceiling, no more than 50 feet away.

Selection of location of indoor and outdoor units

Ensure the installation complies with the installation minimum dimensions and meets the minimum and maximum connecting piping length and maximum change in elevation.

Air inlet and outlet should be clear of obstructions, ensuring proper airflow throughout the room.

Condensate can be easily and safely drained.

All connections can be easily made to outdoor unit.

Indoor unit is out of reach of children.

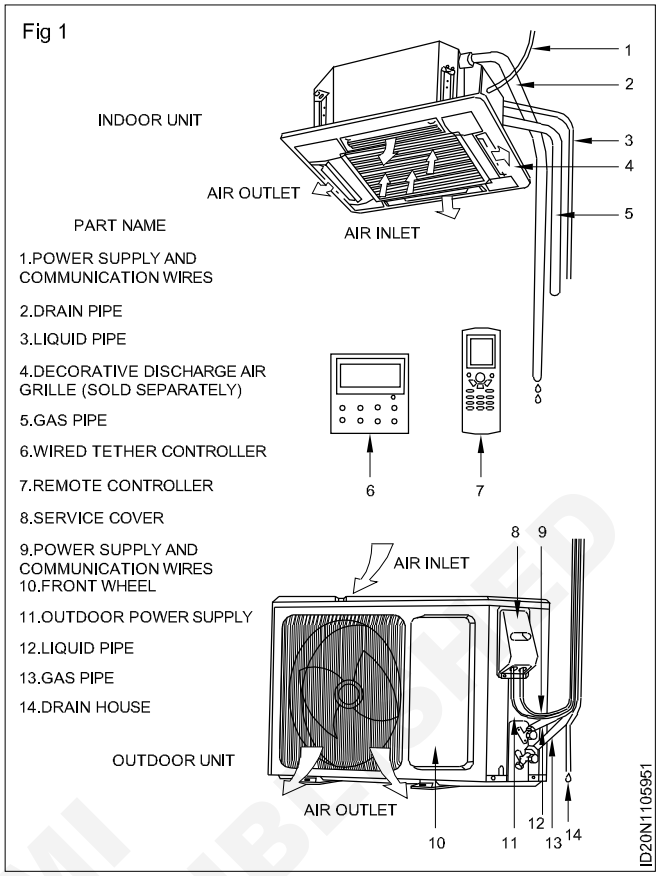
A structure strong enough to withstand four (4) times the full weight and vibration of the unit.

Filter can be easily accessed for cleaning.

Leave enough free space to allow for routine maintenance.

Do not install in a laundry room or by a swimming pool due to chemicals corroding cassette coil.

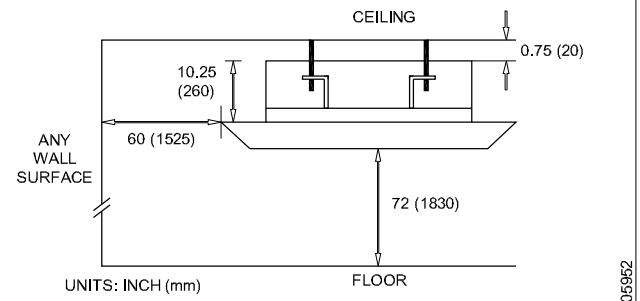
Fig 1



PART NAME

1.POWER SUPPLY AND COMMUNICATION WIRES
2.DRAIN PIPE
3.LIQUID PIPE
4.DECORATIVE DISCHARGE AIR GRILLE (SOLD SEPARATELY)
5.GAS PIPE
6.WIRED TETHER CONTROLLER
7.REMOTE CONTROLLER
8.SERVICE COVER
9.POWER SUPPLY AND COMMUNICATION WIRES
10.FRONT WHEEL
11.OUTDOOR POWER SUPPLY
12.LIQUID PIPE
13.GAS PIPE
14.DRAIN HOUSE

Fig 2



MINIMUM INDOOR CLEARANCES

System Requirements

Pipe Size in (mm)

Unit Size (BtuH)	Liquid Line	Suction/Gas Line	Net/ Gross Weight
12,000	1/4 (6)	3/8 (9.5)	44/51 lbs
18,000	1/4 (6)	1/ (12)	48/55 lbs
24,000	3/8 (9.5)	5/8 (16)	64/84 lbs

Nomenclature

Examples: CAS18HP230V1AC

CAS **18** **HP** **230V** **1** **A** **C**

Series Designation
CAS - Ceiling Cassette

Cooling Capacity
12 - 12,000 BTUH
18 - 18,000 BTUH
24 - 24,000 BTUH

Model Type
AC - Cooling Only
HP - Heat Pump
HC - Heat/Cool

Product Type
S - System
O - Outdoor units
H - Indoor High Wall
D - Indoor Duct
C - Indoor Cassette
F - Indoor Floor / Ceiling

Revision Level

Style/Color Designation

Electrical Rating
230V - 208/230V 60Hz 1PH
115V - 115V 60 Hz 1 PH

Problem	Cause/Solution
	• Relocate or remove heat sources from the room.
Water leaking from the indoor unit into the room	**Cause:** While it is normal for the system to generate condensate water in cooling mode, it is designed to drain this water via condensate drain system to a safe location.
following:	**Solution:** If water is leaking into the room, it may indicate one of the
	• The indoor unit is not level right to left. Level indoor unit
	• The condensate drain pipe is restricted or plugged. All restrictions must be removed to allow continuous drainage by gravity.
	• If problem persists, contact a qualified service professional for assistance
The unit will not deliver air	**Cause:** There are a number of system functions that will prevent air flow.
	Solution: Check for the following:
	• In heating mode, the indoor fan may not start for three minutes if the room

Planning of commercial interiors

Objective: At the end of this lesson you shall be able to
- **understand the planning of commercial buildings.**

Planning of commercial building

1 Introduction

The classifications of buildings based on predominant function or purpose and correctors of its own. Following are the brief description of public buildings.

Agricultural buildings

Buildings associated with agricultural activities including bulk storage of products (e.g. shearing shed, grain silo, animal production units, dairy and milk booth etc.)

Business areas buildings

Buildings primarily occupied with the business trade, including buildings used primarily in wholesale and retail trades, office, shops markets, plazas and transport activities etc.

Educational building

Buildings used in the provision for supporting of educational services, including group accommodation buildings (e.g. hostels, classrooms, school, collage, university, library, institute, laboratories, canteen, dormitories etc).

Entertainment and recreational buildings

Buildings used for warehousing and the production and assembly activities of industrial establishments. It includes the factories and plants, production units and assembly processes of goods and end users.

Hospitality building

Buildings used in the provision for medical services, and includes categories on hospitals and other health care buildings (e.g. nursing homes, clinics, medicals and health centers and their respective laboratories).

Offices buildings

Buildings primarily used in the provision of professional services or public administration (e.g. offices, banks, insurance or finance buildings, post office, police station, telephone departments and courts etc).

Religious buildings

Buildings associated with worship, or in support of programs sponsored by religious bodies (e.g mosque, church, temple, church hall etc).

Short-term accommodation buildings

Buildings primarily providing short-term accommodation, includes the hotels predominantly accommodation, motels, boatel, boarding houses, guesthouses, lodges etc.

Transports buildings

Buildings primarily used in the provision of transport services, Passenger transport buildings (e.g. railway stations, bus stand, airports, garage, passenger terminals, car parking and docks etc.)

2 Watch man\guard room

This is a small room provided at the main entrance of the building and with a minimum size of 2.0 m x 2.0 m.

3 Public telephone

Public telephone in a building may be provided in the form of small booth measuring about 1.5 m x 1.5 m near the reception\entrance of the building.

4 Parking area

Parking space is an essential part of any public building. Its size may depend upon its function and no of user.

S.No.	Vehicle	Area required
1	Car	15 to 20 sqm
2	Two wheeler	2.0 to 3.0 sqm
3	Bi-cycles	1.0 to 1.25 sqm

The passage between adjacent blocks for car should not less than 2.2 m.

5 Reception

Entrance: Every public building requires some space at the entrance, which is called reception lounges or lobby. The size of reception lounge may very slightly with the no of persons entering at one time. Following sizes may be adopted for entrance hall or reception lounges.

3.0 m x 6.0 m, 4.0 m x 5.0 m, 6.0 m x 7.0 m, 8.0 x 10.0 m

6 Circulation area; circulation in a building is of two types

Horizontal circulation which includes passage, corridors, verandah and lobby etc.

Vertical circulation includes stair, lifts, and elevators.

Following size may be adopted;

Passage/corridor	1.2 m to 1.5 m
Verandah/lobby	2.0 m to 3.5 m
Stairs:	
Width	1.2 m minimum
Riser	150 mm to 170 mm
Tread	300 to 325 mm

Landing 1.2 m to 1.75 m

Headroom 2.0 m

7 Lifts

For residential buildings the speed of lift should not be more than 0.5 m\s and in public building this speed of lift may very from 0.25 m/s to 2.5 m/s depending upon the function of the building.

Religious buildings

Buildings associated with worship, or in support of programs sponsored by religious bodies to mosque, church, temple, church hall etc.

8 Sanitary block

This includes bathroom, water closets, urinals, wash hand basins.

Following size may be adopted

Bath room	1.2 m x 2.0 m
Water closet (wc)	0.9 m x 1.2 m
Urinals	0.75 m x 0.9 m
Passage width	1.0 m to 1.5 m

9 Open space (set back) for school building

S. No.	Size of plots (sqm)	Front (m)	Back (m)	Left side (m)	Right size (m)
1	Up to 500	6.0	3.0	3.0	-
2	501 to 1000	9.0	3.0	3.0	3.0
3	1000 to 2000	9.0	4.0	3.0	3.0
4	2001 to 4000	9.0	4.5	3.0	3.0
5	More than 4000	9.0	6.0	4.8	4.5

10 Open space (set back) for hospital building (up to 10 m height)

S. No.	Size of plots (sqm)	Front (m)	Back (m)	Left size (m)	Right size (m)
1	500 to 1000	6.0	4.5	3.0	-
2	1000 and above	9.0	9.0	3.0	3.0

Minimum width of plot 15 m.

11 Open space (set back) for hotel building (up to 10 m height)

S. No.	Size of plots (sqm)	Front (m)	Back (m)	Left side (m)	Right size (m)
1	Up to 500	4.5	3.0	3.0	3.0
2	501 to 1000	6.0	3.0	3.0	3.0
3	More than 1000	9.0	3.0	3.0	3.0

12 Open space (set back) for other public building

S. No.	Size of plots (sqm)	Front (m)	Back (m)	Left side (m)	Right size (m)
1.	Up to 200	4.5	3.0	-	-
2.	201 to 500	6.0	3.0	3.0	3.0
3.	More than 500	9.0	3.0	3.0	3.0

13 Data for public building

The data for various buildings is given below. The dimensions are given are for guidance and may be changed suitably according to the requirements.

14 Educational buildings

It include primary school, secondary school, colleges and institutes.

Classrooms

Students below 10 years	1.0 to 1.25 sqm/student
Students above 10 years	1.25 to 1.50 sqm/student

General sizes for classroom may be taken as 4.3 m x 6.0 m, 5.0 m x 6.5 m, 6.0 m x 8.0 m, and 7.0 m x 10.0 m.

Drawing studio/hall	3.0 to 3.75 sqm/student
Laboratories	3.0 to 4.0 sqm/student

Introduction of office building and design guidelines/office space standard

Objectives: At the end of this lesson you shall be able to
- **understand the planning of office designs**
- **explain interior of offices lawyer office, administration room**
- **hotel waiting lounge.**

Introduction : The amount of office space built during the past few decades can be measured in the hundreds of billions of square feet. Within these buildings, workers spend nearly half of their working hours and a one third of their entire lives.

Over the life span of a typical office building, the same spaces may be occupied by a succession of different tenants, each with their own programmatic requirements. Consequently, interior spaces may be recycled and redesigned many times, simply to accommodate the changing needs of new corporate users. In many instances redesign may be necessitated solely by the effect of technological change on the methodology of transacting business. Moreover, the escalating costs of land acquisition and construction and the increasing scarcity of urban building sites make it essential that he redesign reflects an efficient, cost-effective utilization of space, as well as one that is responsive to the human factors involved. It is necessary, therefore, for the designer to be familiar not only with the general planning criteria associated with office design, but with the architectural detailing of some of the typical interior elements contained within these spaces.

Accordingly, this section includes general planning criteria and examples of actual working drawings of typical interior conditions, prepared by various design professionals. The details alluded to include such items as trading desks, elevated computer floors, and library furniture, built-in storage cabinets, work counters, wall paneling, vanities, reception desks, and conference room elements. Also included are illustrations and dimensional data pertaining to typical office furniture, equipment, and electronic media storage.

Factors determine the designing of an architecture office (Fig 1)

Fig 1

- First you should find a suitable open office space available for rent
- The importance of light, light is an architect's best friend
- Make it aesthetically pleasing
- Prevent termite infestation
- Get inspired
- Other posts you might enjoy

Lawyer office (Fig 2) : When we design a lawyer office interior advocate want a books storage space so first we plan book shelves on the top and bottom we design the file storage. The colour of lawyers chamber design is cream, white, off white. Law office table have storage and table top is white. The way your law office looks will have a direct impact on how clients feel when they enter your office. It will directly influence their first impression of you before you even say a word. There are lot of elements from general office furnishing and interior design that can apply to your lawyer office design.

Fig 2

Basic principle for your lawyer office design: Your work space should always look aesthetically pleasing, especially if it is a place that many people are going in and out of it. The law office should be designed with the client in mind.

These design tips can make your law office a professional setting, making sure that your clients feel welcome and comfortable pay attention to your decor. The décor will have the biggest impact on the way that client feel when they enter your law office.

In a law office people are usually emotional so it is crucial that you make your space a place where they feel welcome and clam

- Display pictures of your friends and family. Personal pictures will make clients feel a personal connection to you and will feel more comfortable in your office.
- Place plants around the room: plants can make a law office feel like home than a work space. It is important that clients feel at home, during a stressful and overwhelming time. Plants provide fresh air to space. Making it feel less stuffy and more inviting.
- Don't choose a dark color palette choosing dark color will not make clients feel welcome. These dark color

may even add to your clients anxiety. So it is better to choose light color.

- Hang your degrees and certificates, this is an easy way to show you are qualified without having to say a word.
- Incorporate a impressive book shelf you can display the books you have read that pertain to your area of law. It also knowledgeable in your area of practice.
- **Hang art work:** Art work brightens up the office while making it abstract art is a good choice for lawyer's office design.
- **Use rich textures:** Leather, wood and woven textiles can help communicate a sense of gravitas to your clients. They will feel like you take the job very seriously.
- **Install the appropriate lighting:** Lighting has a direct effects on how a person feels in a space. If the lighting is wrong he or she may feel anxious, interrogated, confused, even tired. So plan what kind of lighting will benefit your space. Utilize lighting that will make clients comfortable and ensure that they are not distracted, Install glass walls or windows throughout the rest of the office. Glass gives the illusion that there is more space eliminating any feeling of constriction consider getting rid of things that you no larger need. File things away in hidden storage space with clear lables.

Administration room (Fig 3)

Fig 3

- Health benefit of having the right office furniture. Choosing the right furniture is the most important responsibility of employer. Your work force will be spending lot of time to sit at their desk working. So bad quality office furniture can lead to health complications.
- **Open up the space:** No matter how big or small the space you are working with is you can always make the most of it by introducing more open plan layout. It also offers employees more room to collaborate. This helps you work towards building a more efficient work force with employees. They have more freedom and space to communicate with and work as a team.
- **Introduce more light:** There is no better work space than a bright airy environment. Natural light make people happier and more productive. The natural light in the office ditching the shades and creating an overall more inviting environment. Reduce the need for artificial lighting can also help to lower energy cost in the long run.
- **Consider glass office partitions:** One of the best ways to keep an office up to date with the modern world is by introducing more glass. We have seen the huge modern glass fronted sky scrapers in city centres, many offices around the world picking up on this trend and realizing that more glass is the better. Modern offices maximum the amount of natural lighting by providing to solid walls and doors the glass partition does not disrupt the design of office.
- **Create breakout spaces:** Most modern offices are more than simply a room filled with desk and computers. They allow the workers time to break away from the office environment and have a different space to allow their creative thoughts to flow. The great thing about break out spaces to the freedom to design them, however you want them to look.
- **Sit and stand:** Sitting for long hours in the office will lead to common medical problems. So to over come this problem many employers have introduced more standing options in the work place.
- **Brand the office space:** Branding is the key factor determine modern offices. Branding the office can be just as important as branding your stationary.
- There is no need to shy away from having a blown up logo printed on to a wall or frosted on to a pane of glass.
- **Invest in good quality furniture:** Utilise your majority of your budget to invest in good quality office furniture that will last long. This prevents you to replace office furniture frequently.
- **Add mood boosting elements:** It is important to ensure that the office is a place they want to be spending their time. So it is an employers interest to help achieve this mood boosting elements. Such as plants natural features, interesting art, office pets and other elements can all help to add to atmosphere in the office and boost the mood of employees.
- **Organisation is key:** If you have small space to work with keep it minimal. Utilise the space to include storage space to hide any clutter to avoid it looking over crowded. There are some great modern storage and shelving solutions that can be installed to organize any mess and act as a display unit for key items.
- **Focus on the finishing touches:** Some times it really the smaller things that make the biggest difference for example. If you are heading towards a more minimal, clean look. It might just be those few colorful plant pots cleverly displayed on shelving cubicles that really add the finishing touch. Weather you are about to under go an entire office refurbishment or making some minor improvements. It is important to remember that the office reflects company, image and can have big influence on the productivity of the employee and impressions on visitors. So get creative and have fun with it.

Hotel waiting lounge (Fig 4) : First impressions matters. Here how to design the perfect reception area for your office in order to meet your clients expectation. It is your first opportunity to make a real life impression on your clients.

So it is most important to create a memorable one. Here are some tips on how to design the perfect reception area for your office in order to meet your clients expectation.

Fig 4

Seating: It is better to ask these question to yourself.

Are the chairs comfortable? A little bit of cusion goes a long way when a client is waiting.

Are there enough chairs? Plan for more than what may need to ensure a guest is never left standing.

Are there chairs available for clients of all sizes? Consider adding chairs with the arms to give every one comfort.

Are your seat fabrics clean and or easy to clean? There is nothing less professional than big stains vinyl or tight weave fabrics can save the day.

Reception area: Your reception desk is the focal point of your waiting area. The desk should give your staff enough space to efficiently complete their work.

If your receptionist need to complete private phone calls. A floor to ceiling glass divider to be installed to keep the conversation confidential. The half height divider around the desk always for limited privacy. But keeps the space more open and inviting. If your receptionist need to use a copier, filing cabinet or other office supplies regularly. Organising needed equipment near the reception space ensure that your staff person is never too far away to miss some ones arrival.

Colours: Using of different colors which affect you. Bold reds, oranges and yellows may feel agitating. This space is not your personal favorites but more about reflecting trust and professionalism. Try choosing softer more neutral colours and injecting some personality through wall art pillows or rugs.

Lighting: Keep shades or windows blinds to a minimum. If you are in a darker space choose soft lighting from table lamps or wall fixtures over head florescent bulbs, feel sterile and unwelcoming try LED lighting for a more natural feel. Overall be sure there is plenty of light in your space for it to feel warm, clean and for your waiting client to be able to easily read and feel relaxed.

Accessories: Take a walk through your space and make small bunches that would add comfort for your client. Consider a coat rack or space to hang jackets or wet umbrellas. Ensure that there are enough surfaces like end tables or coffee tables for your clients. Keep up the welcoming atmosphere with bottled water, mints, tissues and fresh reading materials. Use air fresheners or fresh flowers sparingly to avoid allergic reactions from guests frame a handful of awards or media clippings about your work and hang them in an accessible location.

Technology: Sitting in a reception area with nothing to do is not only boring. It is unproductive consider setting up a computer terminal or granting guest Wi-Fi access to allow clients to quickly check e-mail or read the headlines. A mounted television is a great option. If your office can expect to have children in your reception area consider creating a small activity area just for them, and their parents.

Minimum square footage standards for the open and screened workstation

The non automated task: Square footage workstation standards for the non automated task are developed primarily according to task profile, equipment, conferencing, and privacy requirements.

Open: No requirement of equipment or task for privacy, concentration.

Screened: Privacy required for reading, working, thinking, calculating, meetings, confidential phone calls, elimination of visual and acoustical distractions.

General offices and multiple workstations (Fig 5)

Fig 5 Depending upon function, the sizes of individual and multiple workstations vary dramatically. Size of work surface, length and depth of return, chair size, and circulation patterns all influence the gross square footage requirements.

Office spaces (Figs 6 to 11)

The offices illustrated in figs 6 to 11 reflect middle to senior management functional, as well as status, requirements. Each office layout should be carefully reviewed with the client to ensure that all programmatic functions have been met, offices of this size do not easily accommodate an independent conference function.

Conference rooms - sizes

Planning data: Table sizes and seating capacities

Round conference tables offer the advantages of intimacy. “equality”, and compactness. On the other hand, if status is an issue, diovisual wall, this table shape can be less than satisfactory. The same problems can arise with a square conference table. In both instances, however, the total seating around each table shape must be viewed in the context of chair size, chair spacing, and tasks to be performed at the table. (Figs 12 & 13)

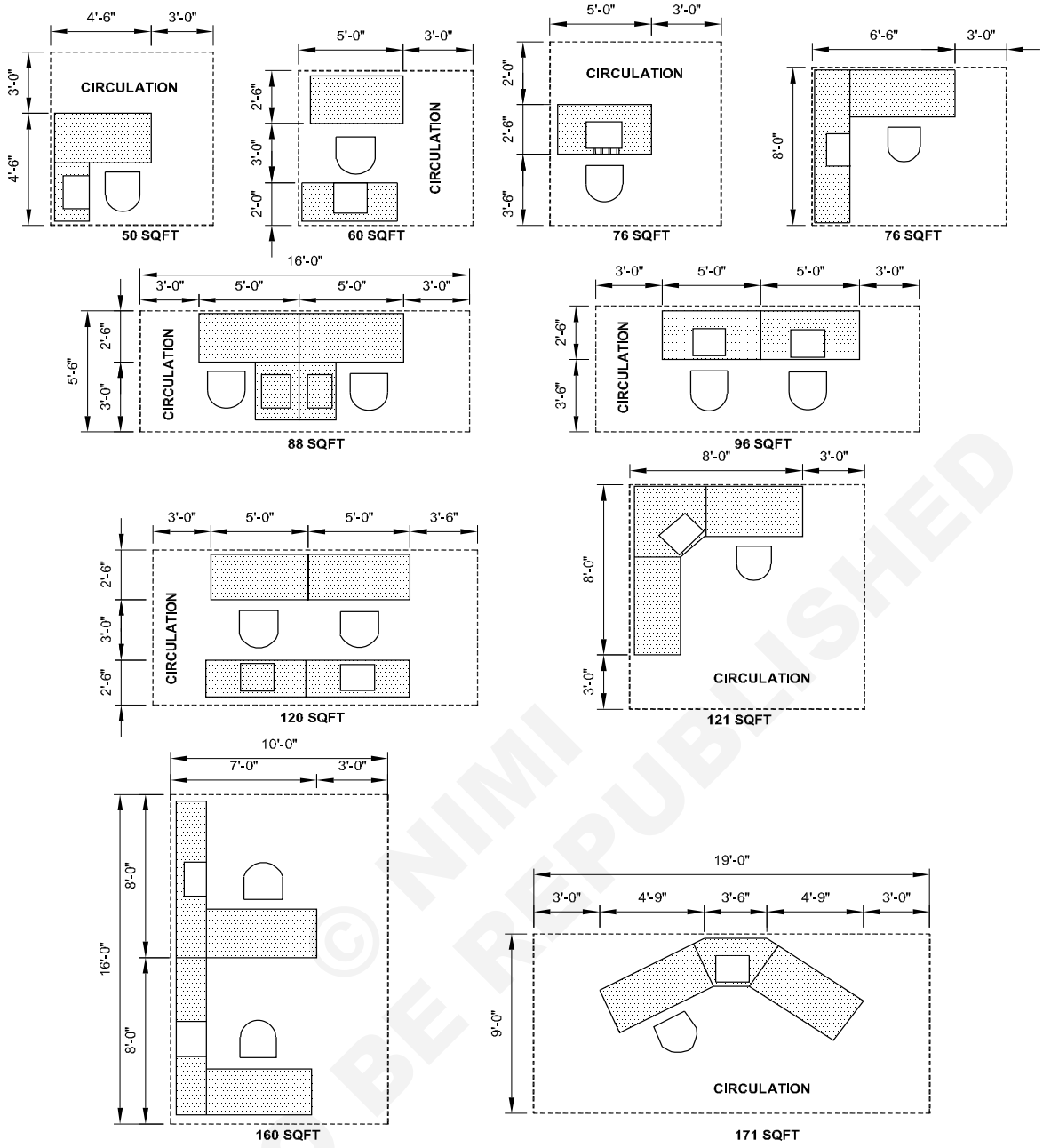
Office spaces

Conference rooms

Planning data: Table sizes and seating capacities (Fig 14)

These conference tables are useful in making initial space planning allocations.

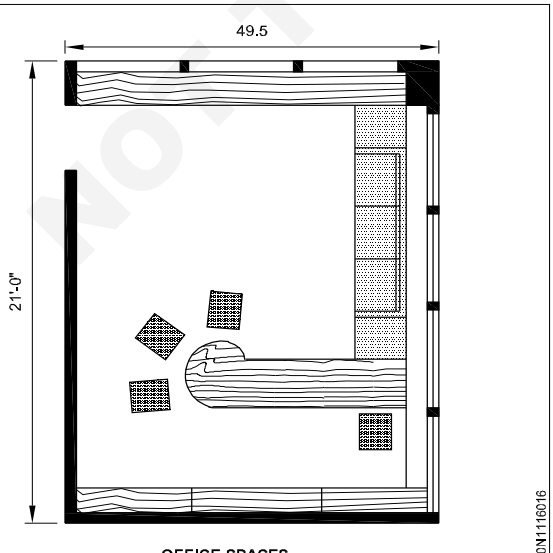
Fig 5



GENERAL OFFICES AND MUILTIPLE WORKSTATIONS

ID20N1116015

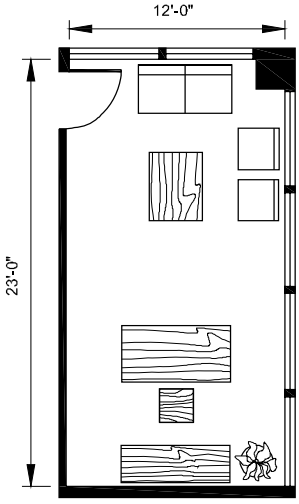
Fig 6



OFFICE SPACES

ID20N1116016

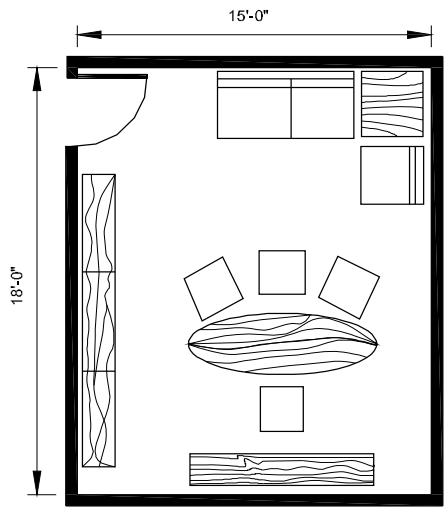
Fig 7



OFFICE SPACES

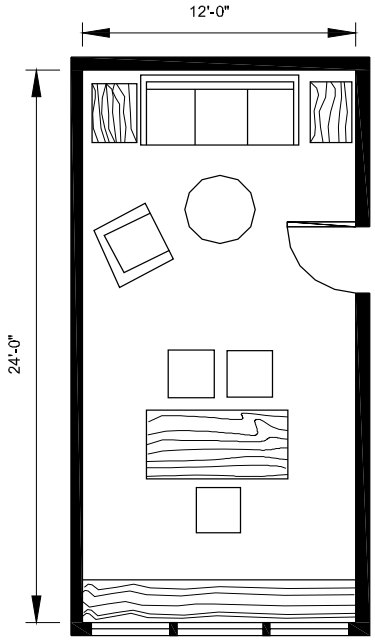
ID20N1116017

Fig 8



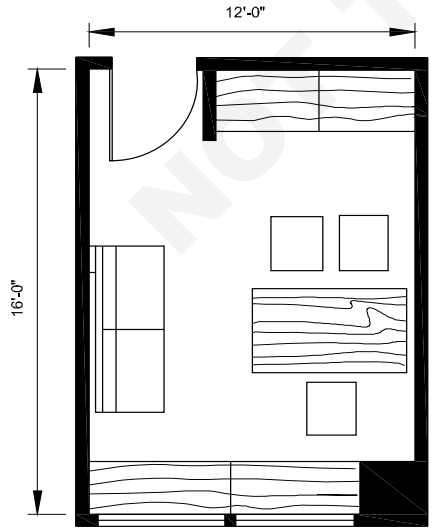
OFFICE SPACES

Fig 9



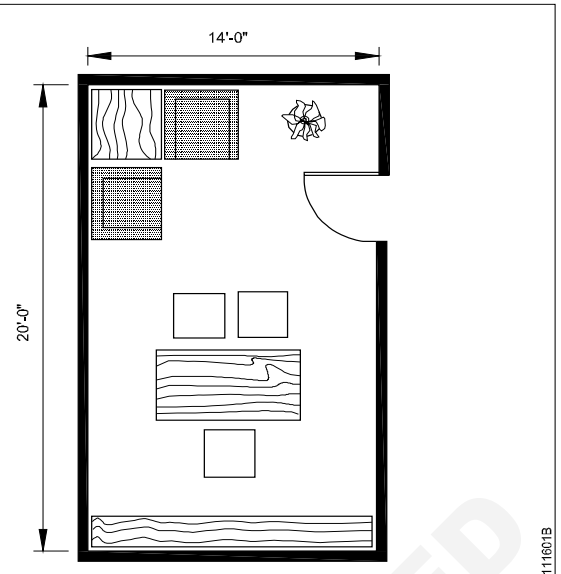
OFFICE SPACES

Fig 10



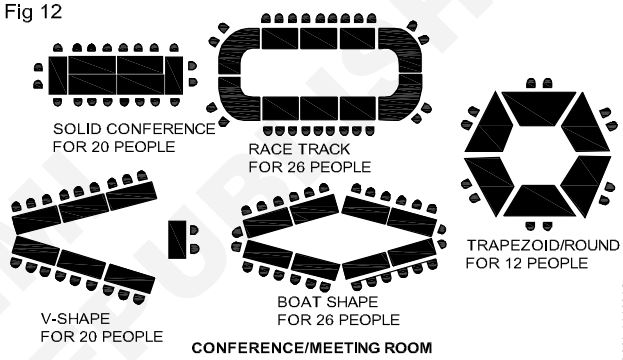
OFFICE SPACES

Fig 11



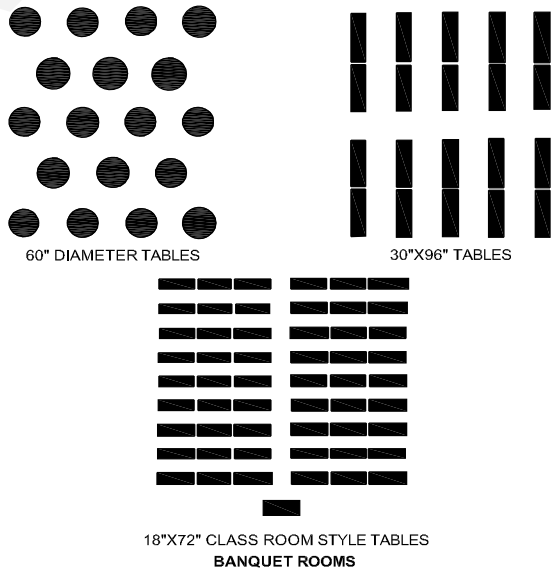
OFFICE SPACES

Fig 12



CONFERENCE/MEETING ROOM

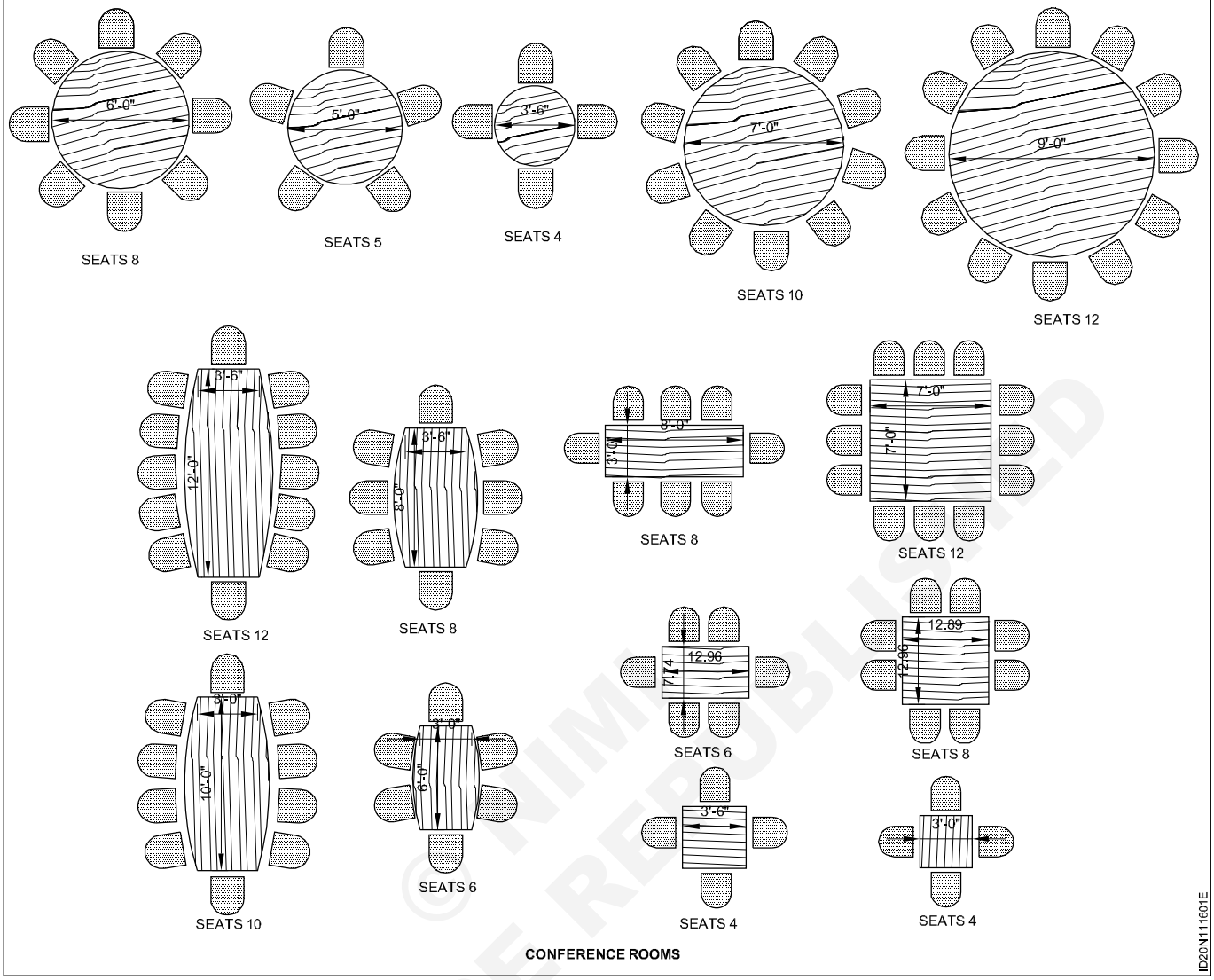
Fig 13



BANQUET ROOMS

Reception areas (Figs 15 &16): Large reception desk can accommodate work surfaces on three sides, as shown here. With this type of configuration, however, the designer must be concerned with the orientation of the open side. As with all custom reception desks, the designer must anticipate the integration of wiring and electronic equipment within the architectural woodwork.

Fig 14



Furniture, furnishings, and equipment

Desks and seating (Fig 17) : Furniture, furnishings, and equipment are the basic building blocks in the design of office spaces. The illustrations and dimensional data contained in this part are based on the product lines available from particular manufacturers.

Although the data, to a great extent, are fairly standard throughout the industry, there will be some variations according to manufacturer. Accordingly, although the information presented is adequate for preliminary planning purposes, the designer is cautioned to reconcile preliminary assumptions with the actual dimensional data of the manufacturer whose product is ultimately specified.

Included in the data provided in this part are examples of filling cabinets, storage cabinets, conference tables, desks, and electronic media.

Reception and lounge seating can assume various sizes, shapes, and configurations. Modular seating units can offer a custom built-in look, and can often incorporate table and storage components. Overall sizes will vary from manufacturer to manufacturer.

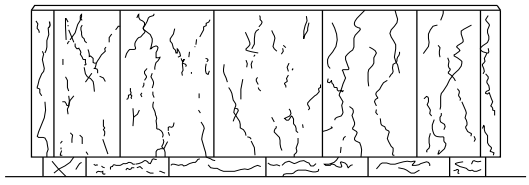
Furniture, Furnishing and equipment (Fig 18)

Conference tables: Conference tables come in an infinite variety of shapes and sizes. Figs 19 & 20 attempt to provide a representative sampling of such tables, along with dimensional information and seating capacities. The designeris cautioned to use such information as a preliminary planning tool only, and to carefully lay out conference rooms with actual furniture pieces that have been selected. Chair width and spacing will ultimately dictate conference table seating capacity.

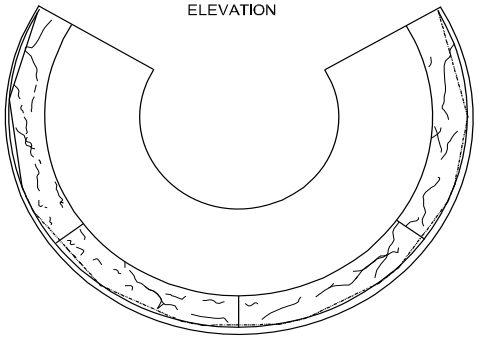
Furniture, furnishings, and equipment

Standard cabinets often provide a fast, flexible, and economical solution to many storage problems. Table 7 provides dimensional data and capacities for four typical cabinet types. These cabinets are manufactured by Steelcase. The dimensions of cabinets of other manufacturers will differ somewhat. The data in table 1, however, are adequate for preliminary planning purposes.

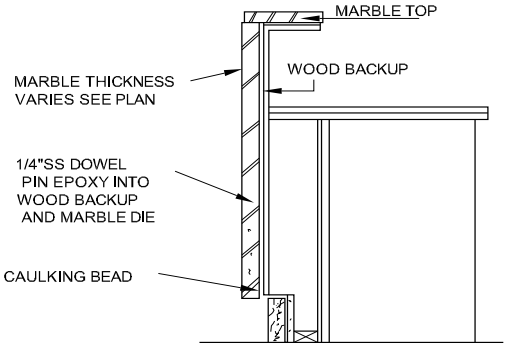
Fig 15



ELEVATION



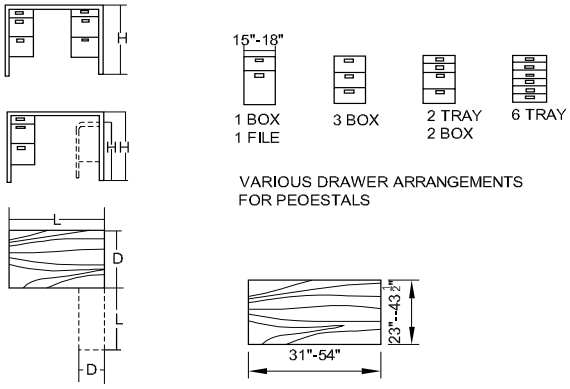
PLAN RECEPTION DESK



SECTION RECEPTION DESK

ID20N111601F

Fig 16



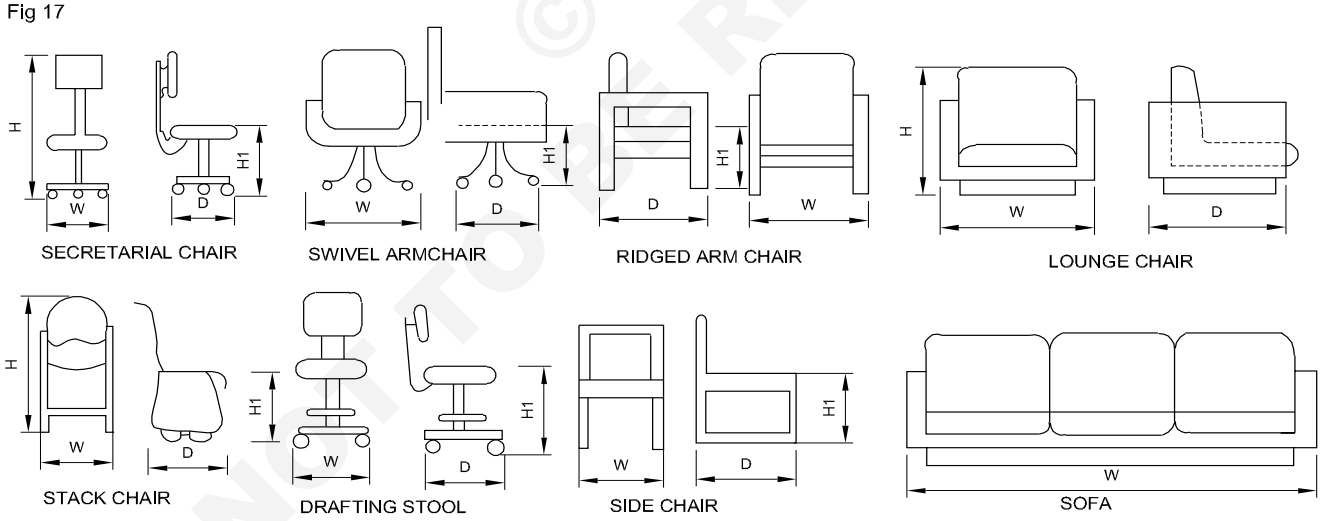
VARIOUS DRAWER ARRANGEMENTS FOR PEOESTALS

DESKS				RETURNS	
DOUBLE PEDESTAL		SINGLE PEDESTAL		FOR EXECUTIVE DESKS RETURNS ARE AVAILABLE AT SAME HEIGHT AS DESK	
STANDARD	RANGE	STANDARD	RANGE	STANDARD	RANGE
2'-6"	2'-0" 3'-3"	2'-6"	2'-0" 3'-3"	1'-6"	1'-3"-1'-8"
2'-5"	2'-4"-2'-6"	2'-5"	2'-4"-2'-6"	2'-2"	2'-1"-2'-3"
5'-0"	4'-6"-7'-0"	5'-0"	3'-9"-7'-0"	3'-0"	2'-0"-5'-0"

OFFICE PLANNING - DESKS

ID20N111602G

Fig 17



CHAIR DIMENSIONS

	SECRETARIAL		SWIVEL ARM CHAIR		RIGID ARM CHAIR		STACK CHAIR		RIGID AND ADJUSTABLE DRAFTING CHAIR		SIDE CHAIR	
	STD.	RANGE	STD.	RANGE	STD.	RANGE	STD.	RANGE	STD.	RANGE	STD.	RANGE
W	1'-5"	1'-4"-1'-8"	2'-4"	1'-8"-2'-6"	1'-10"	1'-6"-2'-3"	1'-9"	1'-6"-1'-11"	1'-6"	1'-5"-2'-0"	1'-8"	1'-4"-2'-0"
D	1'-71/2"	1'-6"-2'-0"	2'-3"	1'-8"-2'-6"	1'-10"	1'-7"-2'-8"	1'-9"	1'-7"-1'-10"	1'-8"	1'-6"-2'-0"	1'-10"	1'-6"-2'-8"
H	2'-6"	2'-5"-2'-10"	2'-9"	2'-6"-3'-0"	2'-6"	2'-4"-2'-9"	2'-6"	2'-4"-2'-9"	3'-0"	2'-11"-3'-6"	2'-6"	2'-4"-2'-10"
H1	1'-5"	1'-4"-1'-8"	1'-5"	1'-4"-1'-10"	1'-6"	1'-4"-1'-7"	1'-5"	1'-5"-1'-6"	2'-4"	1'-5"-2'-10"	1'-6"	1'-5"-1'-7"

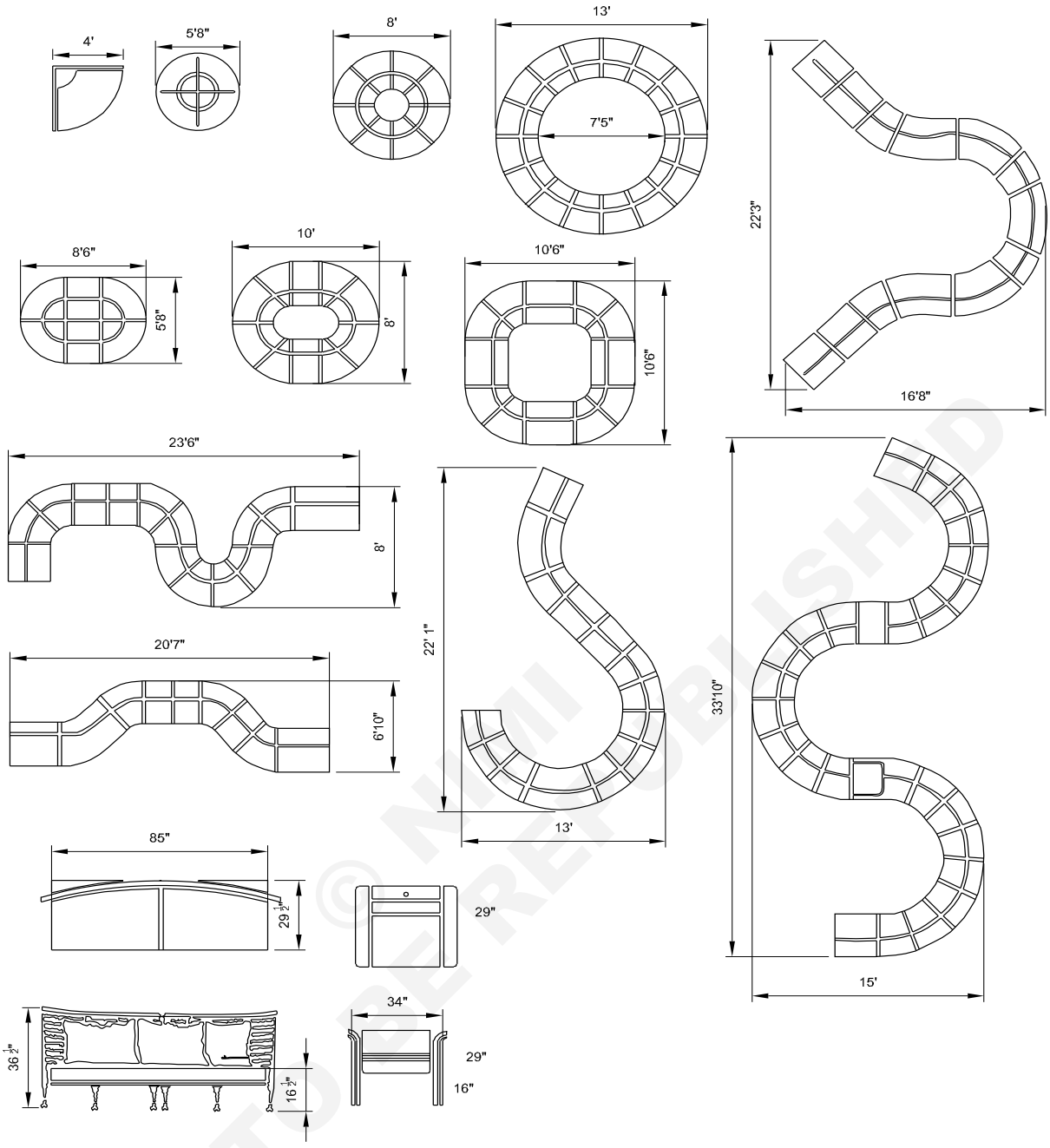
LOUNGE CHAIR AND SOFA DIMENSIONS

LOUNGE CHAIR		SOFA
STD.	RANGE	
2'-6"	2'-6"-3'-4"	D,H AND H1 SIMILAR 2 SEATS-5'-0"-6'-7" 3 SEATS-6'-0"-7'-6" 4 SEATS-7'-8"-9'-0"
2'-7"	2'-2"-3'-4"	
2'-6"	2'-4"-2'-10"	
1'-3"	1'-0"-1'-6"	

OFFICE PLANNING - SEATING SIZES

ID20N111601H

Fig 18



FURNITURE, FURNISHINGS AND EQUIPMENT

ID20N1116011

Table 1

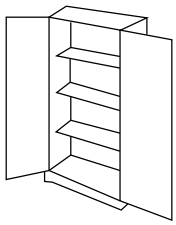
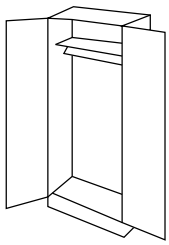
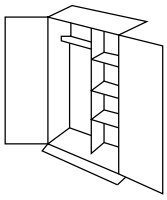
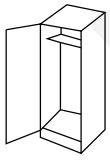
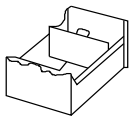
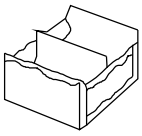
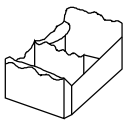
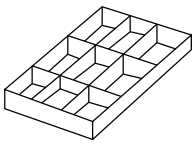
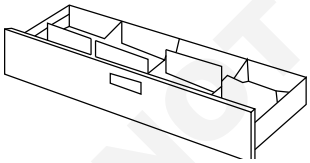
Storage cabinets				
	Outside/inside dimensions			
Description	**Depth**	**Width**	**Height**	**Linear capacity**
Storage cabinet 	18"/17"	36"/331/8"	41¼"/355/8"	99½" side-to-side on shelves (2 adj., 1" thick)
	18"/17"	36"/331/8"	52 3/8"/46 3/8"	99 ½" S to S on 3 shelves (2 adj., 1" thick)
	18"/17"	36"/331/8"	64 5/8"/58 3/4"	132 ¾" S to S on 4 shelves (3 adj ., 1" thick)
	18"/17"	36"/331/8"	80 1/2"/74 1/2"	165 7/8" S to S on 5 shelves (4 adj ., 1" thick)
	24"/23"	36"/331/8"	64 5/8"/58 3/4"	132 ¾" S to S on 4 shelves (3 adj ., 1" thick)
	24"/23"	36"/331/8"	80 1/2"/74 1/2"	165 7/8" S to S on 5 shelves (4 adj ., 1" thick)
Wardrobe cabinet 	18"/17"	36"/331/8"	52 3/8"/46 3/8"	Not for filling
	18"/17"	36"/331/8"	64 5/8"/58 3/4"	Not for filling
	18"/17"	36"/331/8"	80 1/2"/74 1/2"	Not for filling
	24"/23"	36"/331/8"	64 5/8"/58 3/4"	Not for filling
	24"/23"	36"/331/8"	80 1/2"/74 1/2"	Not for filling
Wardrobe/storage cabinet 	18"/17"	36"/331/8"	52 3/8"/46 3/8"	43 ¼" S to S on 3 shelves (2 adj., 1" thick)
	18"/17"	36"/331/8"	64 5/8"/58 3/4"	58" S to S on 4 shelves (3 adj., 1" thick)
	18"/17"	36"/331/8"	80 1/2"/74 1/2"	58" S to S on 4 shelves (3 adj., 1" thick)
	24"/23"	36"/331/8"	64 5/8"/58 3/4"	58" S to S on 4 shelves (3 adj., 1" thick)
	24"/23"	36"/331/8"	80 1/2"/74 1/2"	58" S to S on 4 shelves (3 adj., 1" thick)
Wardrobe 	18"/16 5/8"	18"/15 1/8"	41 1/8"/35 7/8"	15 1/8" on bar
	18"/16 5/8"	18"/15 1/2"	52 1/4"/4/"	15 ½" on bar
	18"/16 5/8"	18"/15 1/8"	64 1/2"/59 1/4"	15 1/8" on bar

Table 2

Interior card trays

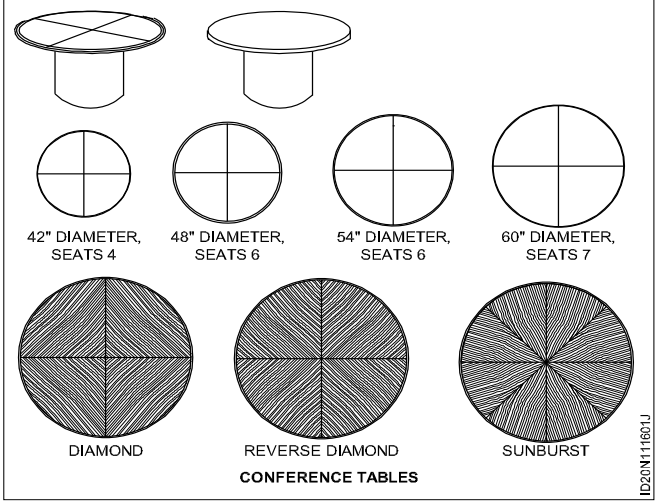
(For use in vertical of lateral files)

Description	Style No.	Inside dimensions			
		Depth	Width	Height	Linear capacity
3 x 5 card 	4335	11 7/8"	5"	3¼"	10¼"
3 x 5 card 	4337 M	14 7/8"	5"	3¼"	13¼"
5 x 8 card	4355	11 7/8"	8 1/8"	4¾"	11¼"
5 x 8 card 	4357	14 7/8"	8 1/8"	4¾"	13¼"
4 x 6 card	800 - TN - 46	12"	6 1/8"	4 3/8"	11 3/8"
5 x 8 card 	800 - TW - 46	15"	6 1/8"	4 3/8"	14 3/8"
Tab card	7201	11 7/8"	7 ½"	3 5/8"	10 3/8"
Tab card	7204	14 7/8"	7½"	3 5/8"	13 3/8"
Coin and bill	4388	8 ¼"	3 1/8"	1 7/8"	*
		5 7/8"	11 1/12"	1 7/8"	+
Coin and bill	4389	7 7/8"	3¾"	1 7/8"	*
		2 3/8"	2 1/4"	1 3/4"	+
		Number of card trays accommodated per 6" - high drawer or shelf			
		4337M	800TW46+	4357	7204M
6" high shelves/drawers 	842 DWD V-6	7	5	4	5
	842 SWD V-6	7	5	-	5
	836 DWD V-6	6	4	3	4
	836 SWD V-6	6	4	-	4
	830 DWD V-6	5	3	3	3
	830 SWD V-6	5	3	3	3
	830 SWD V-3	5	3	-	3

* Dimensions of each of 6 bill compartments.
+ Dimensions of each of 5 coin compartments.
Card trays cannot be installed in 6"- high shelf located directly below a door. Use 3" - high shelf and refer to guidelines

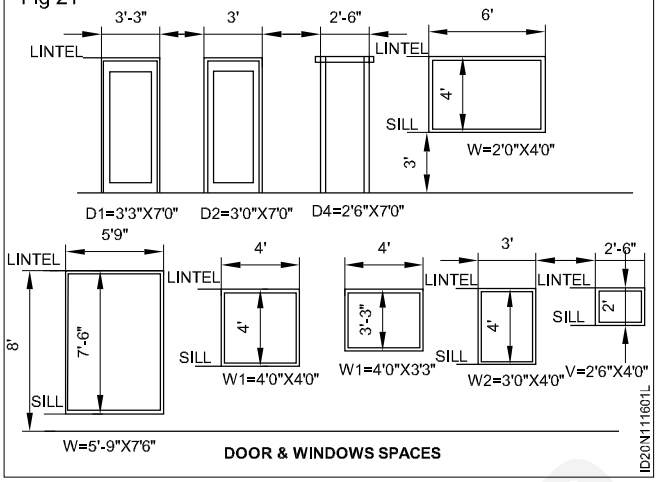
Office space standard door & windows Figs 21 & 22.

Fig 19



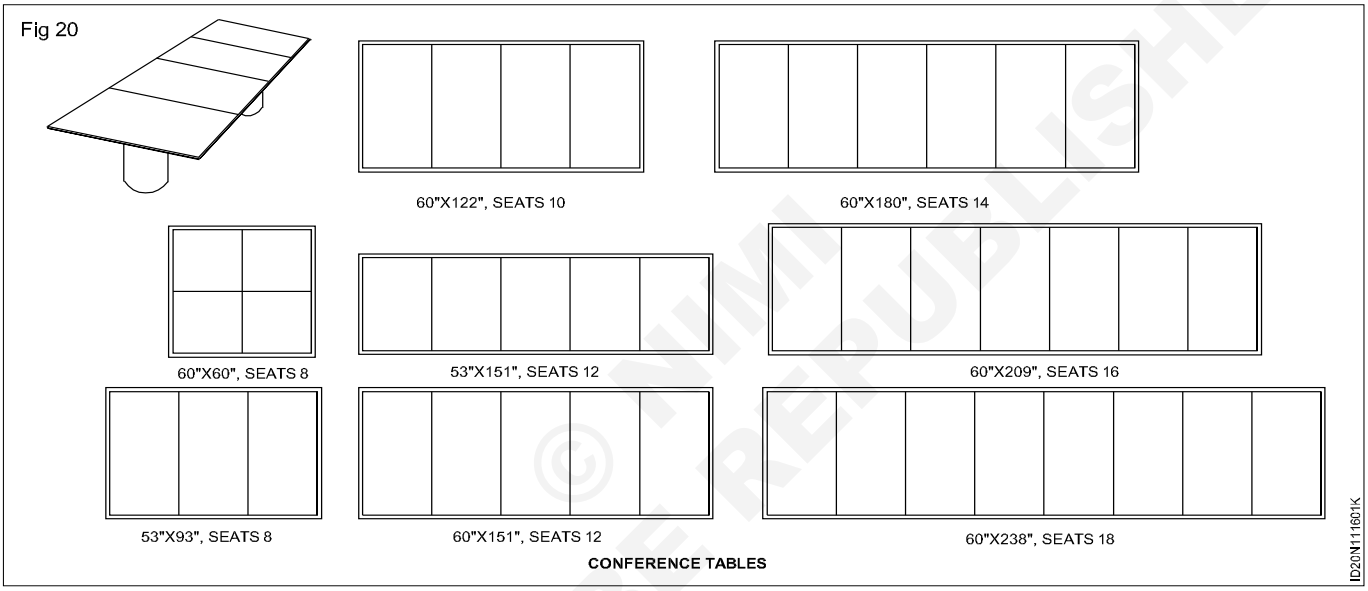
CONFERENCE TABLES

Fig 21



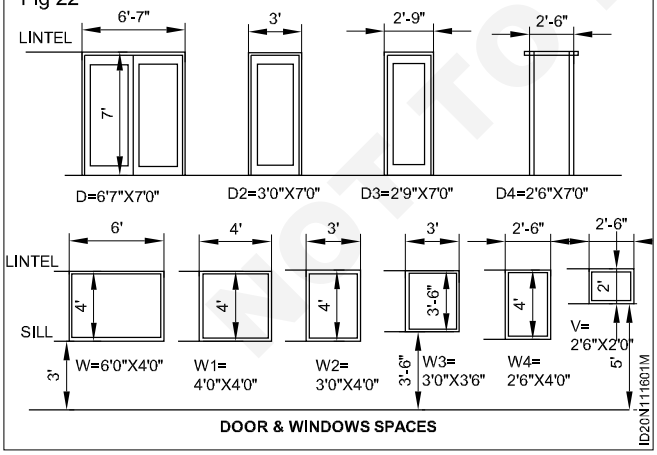
DOOR & WINDOWS SPACES

Fig 20



CONFERENCE TABLES

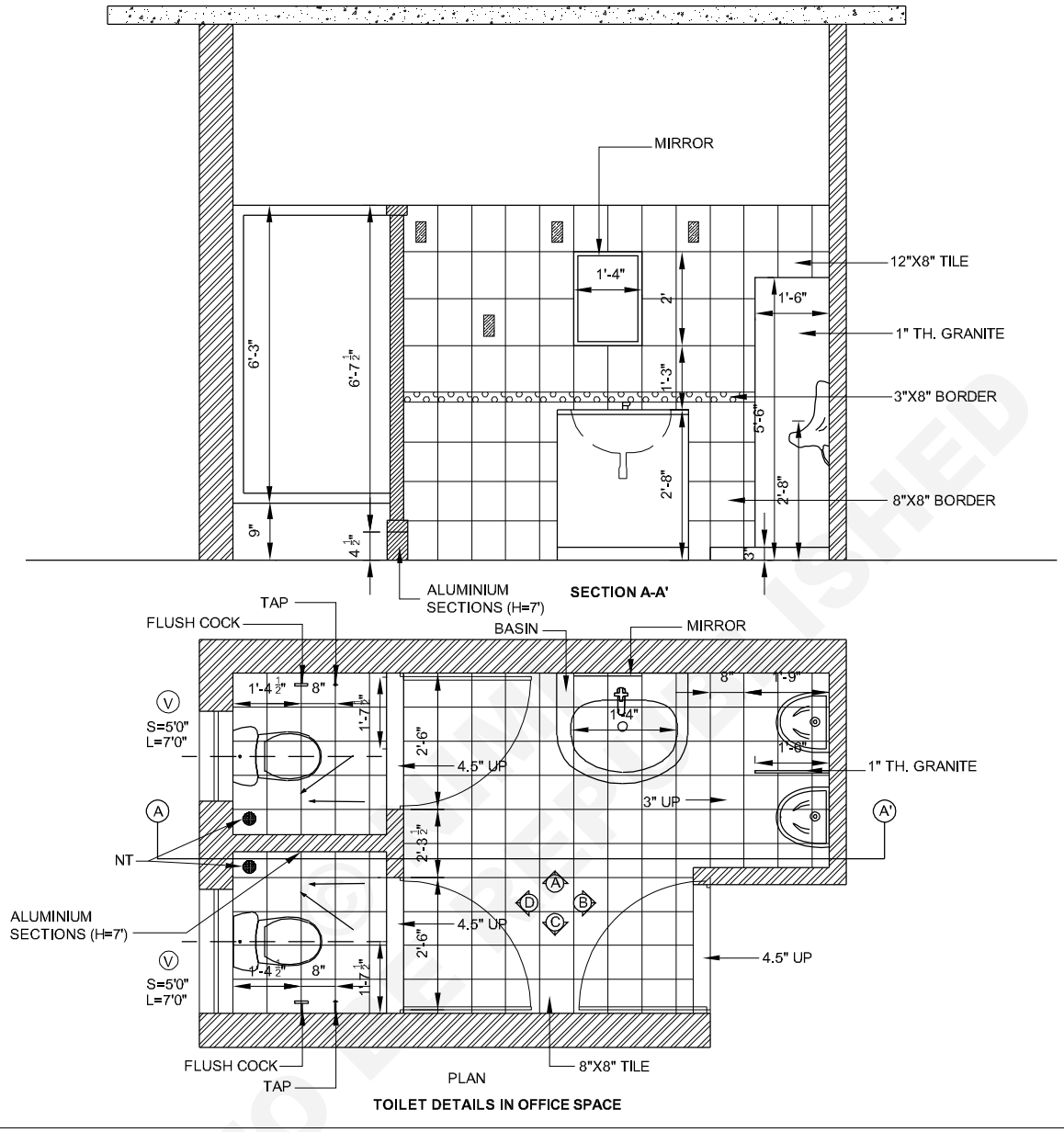
Fig 22



DOOR & WINDOWS SPACES

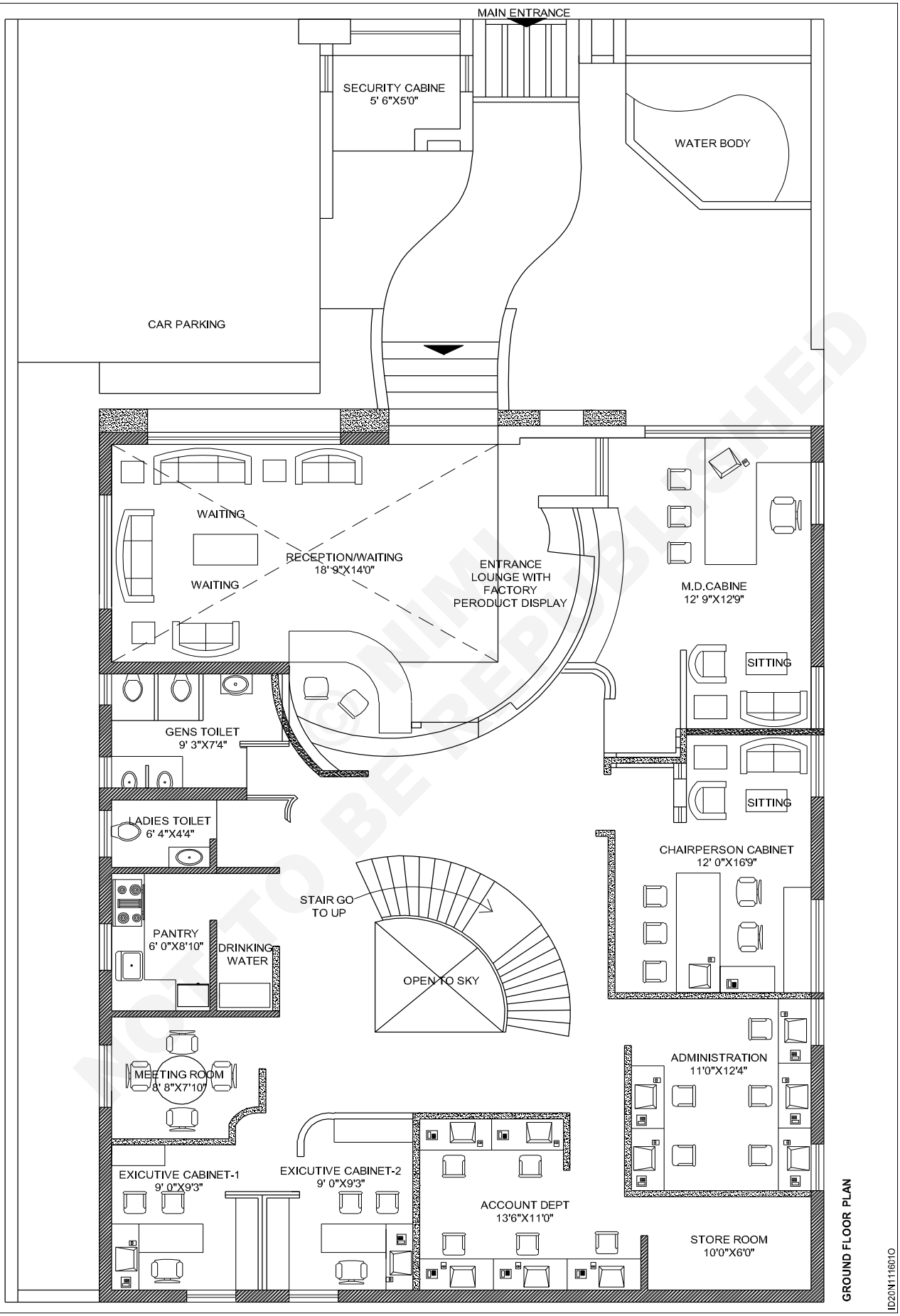
Office space standard details of toilet Fig 23

Fig 23



Example : Typical layout of an office design form an corporate office at plane ->Ground floor plan Fig 24

Fig 24



Typical layout of office design first floor Fig 25.

Fig 25