WOOD WORK TECHNICIAN

NSQF LEVEL - 3

TRADE THEORY

SECTOR : WOOD & CARPENTRY

(As per revised syllabus July 2022 - 1200 of 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

Sector : Wood & Carpentry

Duration : 1 Year

Trade : Wood Work Technician - Trade Theory - NSQF Level - 3 (Revised - 2022)

Developed & Published by

National Instructional Media Institute
Post Box No.3142
Guindy, Chennai - 32
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

First Edition : December 2022 Copies: 500

Rs.330/-

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 **Wood Work Technician - Trade Theory -** NSQF Level - 3 (Revised 2022) **in Wood & Carpentry Sector** under **annual Pattern.** 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

SHRI. ATUL KUMAR TIWARI., I.A.S.,

Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

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 Directorate General of Training, 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 syllabus 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.

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 **Wood Work Technician NSQF Level - 3 (Revised 2022)** under **Wood & Carpentry** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. G. Elumalai	-	Training Officer (Retd) Goverment ITI, Ambattur, Chennai - 98.
Shri. R. Sekaran	-	Junior Training Officer, (Rtd) MDC member, NIMI, chennai.
Shri. C. C. Subramanian	-	Training Officer (Retd) Balamandir PHMITI, Chennai - 17.

NIMI CO-ORDINATORS

Shri. Nirmalya Nath	-	Deputy Director, NIMI, Chennai - 32.
Shri. G. Michael Johny	-	Manager, NIMI, Chennai - 32.

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 practical workshop. It consists of a series of practical exercises to be completed by the trainees during the Course of the **Wood Work Technician** 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) syllabus are covered. The manual is divided into Ten modules.

Module 1 Safety precautions hand tools and timber

Module 2 Framing housing dovetail broadening & lengthening joints

Module 3 Simple furniture making

Module 4 Wood carving

Module 5 Wood finishing

Module 6 Advanced wood working machine

Module 7 Modular kitchen

Module 8 Basic fitting

Module 9 Modular furniture

Module 10 Building construction - Wood aluminium and PVC

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 **Wood Work Technician** Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 3 (Revised 2022) syllabus on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation 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 indications about the corresponding practical exercises 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 for 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	**Identify timber / wood / Plywood, apply measuring, marking and testing instrument, Cutting Saws, shaving tools, paring Tools, Screwing Tools, Abrading tools and other holding and supporting devices with following safety precautions.**	1.1.01 - 1.1.07
2	**Identify and apply portable power saw and Mitre saw and Jig saw machines for Ripping, cross cutting, oblique sawing and curve cutting, Mitring etc.**	1.1.08 - 1.1.14
3	**Analyze the surface finish with exact sizing by planning operations, with identifying and applying various shaving tools or portable power planning machine.**	1.1.15 - 1.1.20

SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Identify timber / wood / Plywood, apply measuring, marking and testing instrument, Cutting Saws, shaving tools, paring Tools, Screwing Tools, Abrading tools and other holding and supporting devices with following safety precautions.	1. Demonstrate first aid, fire safety equipment, different types of fire extinguisher and their application. (10hrs.) 2. Identification of different wooden sample piece i.e. - soft wood & hard wood, wooden grains etc. & their applications. (04hrs.) 3. Identification of wooden sample piece (Annual ring, knots, shakes & chicks etc.). (03hrs.) 4. Demonstrate use of hand operated tools and showing different audio-visual clips. (08 hrs.)	• Introduction of carpentry trade. • General discipline, workshop discipline & Housekeeping. • Safety precaution in the workshop and industrial safety. • Importance of P.P.E, Types of PPE and their application. • Introduction of timber, growth of timber trees, cross-section of exogenous tree trunk, types of tree, different part of a tree, Soft & hard wood, their differences.(05 hrs)
		5. Identification and use of different types of the measuring, marking and testing tools & their applications. (10hrs.) 6. Identification and use of different types of work holding devices. (06hrs.) 7. Demonstrate use of machinery and hand operated portable tools and their safety. (09 hrs.)	• Common Indian timbers. • Defects in timber, diseases of timber, knots, shakes, grains etc. • Introduction of carpentry hand tools, classification and uses of marking, work holding devices. • Measuring & testing tools. (05 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Identify and apply portable power saw and Mitre saw and Jig saw machines for Ripping, cross cutting, oblique sawing and curve cutting, Mitring etc.	8. Demonstrate the use of bench vice, bench hook, bench stop& their application. (03 hrs.) 9. Demonstrate different types of saws- ripping, cross cutting, curve cutting, oblique sawing. (04 hrs.) 10. Use and practice Portable power circular saw. (04hrs.) 11. Sharpen and set different type saw blade. (06 hrs.) 12. Demonstrate the use of country drill, hand drill, ratchet brace, Breast drill and hand augers & bits. (04hrs.) 13. Demonstrate the use of portable electrical drill machine. (02hrs.) 14. Demonstrate the Auger application. (02hrs.)	• Type of bench vice and their uses. • Introduction of different saw and their uses. • Introduction of power circular saw and its use. • Type of special saw and its uses i.e. -compass saw, coping saw, bow saw, fret saw. • Saw sharpening and sharpening tools. (05 hrs) • Description of boring tools - Types, Parts, functions, size and application. • Description of portable electrical drill machine. • Drill bits, types, sizes etc. • Hand augers description, sizes of augers, application of hand augers. (05 hrs)

Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Analyze the surface finish with exact sizing by planning operations, with identifying and applying various shaving tools or portable power planning machine.	15. Planning face, face edge. (04 hrs.) 16. Demonstrate the use of marking, mortise gauge etc. (04 hrs.) 17. Test the accuracy of flatness and twistness of the surface by using try square. (04hrs.) 18. Demonstrate the use of winding strips, cross planning, edge planning. (04hrs.) 19. Grinding and Sharpening process of the planer blade/ cutter. (05 hrs.) 20. Demonstration of portable power planer machine and its function. (04 hrs.)	• Type of different planes and their proper uses in woodwork - Description, function and its size, setting, knowledge of sharpening and uses etc. • Knowledge of using marking gauges. • Important instruments necessary for checking flatness and twistness of surface. • Sharpening and grinding angle of cutter. • Portable power planer - useful in modern woodwork and new technology design. (05 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Identify and apply various paring tools and analyze and choose the positioning and employ holding device for chiselling with better finish.	21. Demonstrate the use of different types of chisel, chiselling, chiselling along& across the grain. (08hrs.) 22. Grind/ sharpen and honing of a chisel. (08hrs.) 23. Demonstrate use of different types of striking tool, hammer and mallets. (04hrs.) 24. Demonstrate the use of clamps 'G' or 'C', saw sharpening vice, carpentry vice etc. (05hrs.)	• Different type chisels - Definition, identification, their uses. • Necessity of grinding and sharpening. • Striking tools- Definition, types, application. • Files - Types, uses • Care & maintenance of files • Function of work bench, bench vice, bench hook, etc. (05 hrs)
Professional Skill 70 Hrs; Professional Knowledge 30Hrs	Identify and classify various types of joints, analyze and prepare correct joint at correct position, related with strength and appearance.	**Demonstration and making framing joint** 25. Single Mortise and tenon Joint. (03hrs.) 26. Double tenon & mortise joint. (02hrs.) 27. Plain hunched tenon and mortise joint. (02 hrs.) 28. Mitre corner tenon & mortise joint. (02hrs.) 29. Task tenon mortise joint. (02 hrs.) 30. Bare faced tenon joint. (03hrs.)	• Seasoning of timber - Definition, advantage and disadvantage of seasoning. • Moisture content in timber and its effect on timber. • Characteristics of wood, physical and mechanical properties of wood. • Quality of good timber. • Define the classification of wooden joint. • Description of different types joint. • Uses of joint: Framing joint angle joint and lengthening joint etc. (09 hrs)
		Demonstration and making Housing joints 31. Full housing joint. (02 hrs.) 32. Bridle joint etc. (02hrs.) 33. Stopped housing joint. (02 hrs.) 34. Dovetail housing joint. (03 hrs.)	• Preservation of timber. • Application of different types of preservation & Process of each treatment. • Definition of housing joint. • Different type of housing joint. • Uses of housing joint.
		Demonstration and making dovetail joint 35. Single dovetail joint. (03 hrs.) 36. Common dovetail joint. (03 hrs.) 37. Lapped dovetail joint. (03 hrs.) 38. Secret mitre dovetail joint uses of dovetail template. (03 hrs.)	• Description of different dovetail joint and their function. • Uses of dovetail joint. • Glues - Types of glue and their uses. (07 hrs)

		Demonstration and Making broadening joints 39. Simple butt joint by hard wood (100 mm width and 15mm thick). (02 hrs.) 40. Riveted butt joint on hard wood (100mm width and 25mm thick). (02 hrs.) 41. Pocket screw butt joint on hard wood (100mm width and 15mm thick). (02 hrs.) 42. Secret pocket screw butt joint on teak wood or hard wood (100mm width and 100mm thick). (04 hrs.) 43. Glued butt joint with dowel by a hard wood (100mm width and 15mm thick). (02 hrs.) 44. Tongue and groove joint on hard wood (100mm width and 15mm thick). (03 hrs.)	• Broadening joint description. • Types of broadening joint. • Application of broadening joint. • Setting of end side according to annual Rings as well as matching the grain stranding. • Advantage of adhesives use and their types. • Method of Dowel application. (07 hrs)
		Making lengthening joint 45. End half lap joint on hard wood (50mm X 50mm). (02hrs.) 46. End over lap joint by hard wood 150mm X 25mm. (01 hr) 47. End bends lap joint on hard wood (50mm X25mm). (02 hrs.) 48. Table scrat joint on hard wood (50mm X 50m). (03 hrs.) 49. Too then end table & scarf joint on hard wood (50mm X 50m). (03 hrs.) 50. Bend scarf joint on teak wood or hard wood (50mm X 50m). (03 hrs.) Making of Frame using different type of joints - 51. Stopped Tenon & mortise Joint on hard wood to make tea table frame to lock four legs, top rail and bottom rails. (02 hrs.) 52. Lapped half lap dovetail joint on bottom rails on hard wood. (02 hrs.) 53. Tongue & Groove joint on tabletop by hard wood as a broadening joint. (02 hrs.)	• Lengthening joint description. • Types of lengthening joint. • Application of different lengthening joint. • Setting of two tapper wedges. • Advantages of table & scarf joint. • Veneer, Plywood • Types of plywood • Advantage of plywood • Application of plywood, block board, laminated board, hard board, insulation board, mica etc. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 10Hrs	Make small wooden job as per drawing with schedule sizes of timber or alternatives of timber i.e. FRP, MDF, FOAM, WPC using various hardware.	**Make small wall bracket -** 54. Make joint on hard wood to make small frame. (03hrs.) 55. Stopped Tenon & Mortise joint on hard wood in the frame to set the selves. (02hrs.) 56. Make selves by six pieces of hard wood with single lapped half lap dovetail joint with frame (two nos. of selves). (03 hrs.)	

		57. Four sides of chalk box. (100mm X 120mm X 100mm) locked with hard wood by common dovetail joint (3 pin). (03 hrs.) 58. Grooves on three sides. (02 hrs.) 59. Make the lid & base with Masonite with handle levelled with top. (02 hrs.) 60. Common dovetail joint apply to lock four sides of tray (400mm X 300mm X 200mm). (02 hrs.) 61. Bases made with ply wood (5mm thick) and make the handle. (02 hrs.)	• Parts & terms of portable disc sander. • Application of portable disc sander. • Care & maintenance of disc sander. • Method of making a wooden partition. • Door frames. • Door & window panels. (02 hrs)
		62. Layout of stool and make cutting List for mass production. (03hrs.) 63. Prepare standard height tapper legged stool as per layout. (03hrs.) 64. Demonstrate application of adhesive. (03 hrs.) 65. Layout making for notice board or display board by hard board, plywood and insulation board. (03 hrs.) 66. Making a small rack by layout with hard wood and plywood. (02 hrs.)	• Calculation of timber required for stool. • List out the sequence of operation of the job. • Timbers used in furniture work - describe Sal, teak, gamar, pine, deodar etc. • Properties and characteristics of different furniture wood. (02 hrs)
		67. Make Frame structure with the block board, layout as per the size and cutting by portable circular saw machine with Common dovetail joint used in the structure. (8 hrs.) 68. Painting and polishing or fixing sun mica with adhesive. (08 hrs.) 69. Setting glasses and hard works as on required location. (03 hrs.)	• Conversion and types of conversion. • Parallel sawing Radial sawing Quarter sawing Tangential sawing Process and advantage • Design of wooden wall unit uses in bed rood, dining hall, library, office, workshop classroom. (02hrs)
		70. Make a small table use of lock, hinges, hasp and staple etc. making a small box with sun mica top. (Mortise and tenon joint. 'T' half tap dovetail joint. Secret dovetail joint). (17 hrs.) 71. Uses sun mica and pest on the top of table. (05 hrs.)	• Uses of joint for small table to stranger strength. • Manufacturing process of various boards and sheets. • Types of hinges, Uses of hinges • Types of door lock & their different uses. (02 hrs)
		Demonstration on nailing screwing on job 72. Use selected nail for the table and small box. (12 hrs.) 73. Use selected screw for the table and small box. (08 hrs.) 74. Application of different types of Nails, screws etc. (06 hrs.)	Nails and screws - • Nail and screws - type, Uses etc. • Nut, bolts and washer - types and Uses • Lock hinges hasp and staple. • Knowledge of other fittings - types, sizes and lenses. (02 hrs)

Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Analyze and identify various carving tools and convert a wooden block/ piece into a decorative article.	75. Demonstrate wood carving using carving tools, sharpen carving tools and finish by smoothing. (25 hrs.)	• Description of different carving tools. • Tools required for ornamental carving. • Properties of wood. • Preparation a bill of materials. • Estimate the material. (05 hrs)
Professional Skill 40 Hrs; Professional Knowledge 08Hrs	Demonstrate Seasoning, Conversion and preservation of Timber, wooden item through surface finishing with various processes such as Painting, polishing & varnishing etc.	76. Prepare surface for Painting. (02 hrs.) 77. Apply paints. (03 hrs.) **Varnish surface of woodwork** 78. Prepare surface for varnishing by smoothing plane. (03 hrs.) 79. Smoothing plane on knotty and interlocked cross grained. (04 hrs.) 80. Smoothen surface by scraping with sandpaper or portable sander machine. (03 hrs.) 81. Varnish on finished surface. (04 hrs.)	• Paints, ingredients of paints. • Name of the agent of paints. • Method of preparation of surface for staining. • Necessary tools and equipment required for staining. • Uses of different grade sandpaper. • Portable sander machine - uses • Preparation of putty and use. • Staining - type, process, methods applied for different timber. (04 hrs)
		Polishing of Furniture - 82. Cleaning of furniture surface. (02hrs.) 83. Application of French polish. (05hrs.) 84. Application of wax polishes. (05hrs.) 85. Remove old polish and re-polish old furniture. (05hrs.) 86. Prepare an estimation of wooden furniture. (04hrs.)	• Description & method of French polish. • Method of wax polish and its uses. • Methods of old furniture re-polish. • Estimation process of wooden furniture. (04 hrs)
Professional Skill 60 Hrs; Professional Knowledge 14 Hrs	Demonstrate ripping, cross cutting, curve cutting etc. on band saw/ circular saw machine and grinding and setting of blade/ cutter.	87. Demonstrate band saw machine with different parts & their functions. (05 hrs.) 88. Demonstration to the safety precaution with operational techniques. (05 hrs.) 89. Remove and refit band saw blades. (02 hrs.) 90. Grinding and setting operation of band saw blade. (04 hrs.)	• Describe constructional features of band saw machine. • Types of band saw machine. • Sizes of band saw machine. • Parts of band saw machine. • Function of band saw machine. • P.P.E for band saw machine (03 hrs.)
		91. Ripping & cross cutting operation on band saw machine with hard wood. (05 hrs.) 92. Curve cutting operation on hard board or soft wood or ply board by band saw machine. (04 hrs.) 93. Bevelling operation on hard wood/ soft wood. (05 hrs.) 94. Chamfering operation on hard wood/ soft wood/ ply board by bend saw machine. (05 hrs.)	• Operation of band saw machine. • Safety precaution of bad saw machine. • Care & maintenance of band saw machine with oiling & greasing. (07 hrs)

		95. Demonstrate circular saw machine, its parts and their operational techniques with safety precaution. (04 hrs.) 96. Remove and refit of circular saw blade. (02 hrs.) 97. Grinding and setting operation of the circular saw blade. (04 hrs.) 98. Ripping & cross cutting operation on hard wood/ soft wood/ ply wood (not less than 12 mm) by circular saw machine. (04hrs.) 99. Rebating & grooving operation on hard wood/ soft wood by circular saw machine. (04 hrs.) 100. Mitering operation on hard wood/ soft wood/ plywood (not less than 12 mm) (02 hrs.) 101. Demonstrate portable Circular saw machine with different parts & their functions. (04 hrs.) 102. Remove and refit of saw blade. (01 hr.)	• Describe circular saw machine. • Types of circular saw machine. • Sizes of circular saw machine. • Identify the parts of circular saw machine. • Function of circular saw machine. • Different types of saw blades used in circular saw machine. • Safety precaution of circular saw machine. • Care & maintenance of circular saw machine with oiling & greasing. • Operation of portable type circular saw machine. • Safety precautions • P.P.E for the circular saw machine (04 hrs)
Professional Skill 40 Hrs; Professional Knowledge 08Hrs	Demonstrate different operations on Jointer/ surface Planer/ Thickness planer machine along with sharpening blades. (Range of operations - Surfacing, thicknessing, chamfering, edge bending etc.)	103. Demonstrate Jointer/surface Planer machine, its parts and their operational techniques and safety precaution. (04 hrs.) 104. Remove and refit of cutter of planning machine. (04 hrs.) 105. Sharpening and honing operation of cutter of planning machine. (10 hrs.)	• Describe of planning machine. • Types of planning machine. • Sizes of planning machine. • Parts of surface/thickness planning machine. • Function of surface/ thickness planning machine. • P.P.E for the surface/ thickness planning machine. • (04 hrs)
		106. Surfacing operation on hard wood/ soft wood by planning machine. (06hrs.) 107. Thickness operation on hard wood/ soft wood by planning machine. (05hrs.) 108. Chamfering Operation (06hrs.) 109. Edge bending operation on hard wood/ soft wood by planning machine. (05hrs.)	• Operation of surface / thickness planning machine. • Safety precaution of surface / thickness planning machine. • Care & maintenance of surface / thickness planning machine • Oiling & greasing. (04 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Demonstrate working on pedestal grinding (Range of operations - grinding of mushroom head, cutting edge of tools, drills, etc.)	110. Demonstrate pedestal grinding machine, its parts and their operational techniques with safety precautions. (06hrs.) 111. Demonstrate off hand grinding operation as per requirement of the trade. (07 hrs.) 112. Grind mushroom head, cutting edge of tools, drill bits and check correctness. (12 hrs.)	• Pedestal grinding machine - Description, Types, Sizes, Parts, Function, Operation of pedestal grinding machine. • Safety precaution and P.P.E for the pedestal grinding machine • Care & maintenance of pedestal grinding machine with oiling &greasing.(05 hrs)

Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Demonstrate working on pedestal /potable drilling machine, use of different types of drill bits, make holes of different sizes in correct location on woodwork.	113.Demonstrate pedestal drilling machine and its parts & their operational techniques and safety precaution. (06 hrs.) 114.Make different sizes of drill hole on wooden block/ job using straight/ taper shank drill bit. (10 hrs.) 115.Use of counter sinking bit on job. (07 hrs.) 116.Demonstrate care & maintenance. (02 hrs.)	• Pedestal drilling machine - Description, Types, Sizes, Parts, Function, Operation of pedestal drilling machine. • Safety precaution and P.P.E for the pedestal drilling machine • Care & maintenance of pedestal drilling machine with oiling & greasing • Types of drill bits used in drill machine.(05 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Demonstrate different operations on wood turning lathe along with sharpening of cutting tools.	117.Demonstrate wood turning lathe, its parts & chisels sets with operational technique and safety precaution. (04 hrs.) 118.Remove, grind and refit cutting tools and set job. (04 hrs.) 119.Plain turning operation on hard wood/ soft wood by wood turning lathe. (04 hrs.) 120.Drilling, boring, taper turning operation on hard wood/ soft wood by wood turning lathe. (05 hrs.) 121.Make chisel handle, table lamp stand, etc on wood turning lathe. (05 hrs.) 122.Internal turning operation using face plate. (03 hrs.)	• Wood turning lathe - Description, Types, Sizes, Parts, Function, Types, Operation of wood turning lathe. • Safety precaution and P.P.E for wood turning lathe. • Care & maintenance of wood turning lathe with oiling & greasing. • Types and application of set of chisels • Signature of cutting tools. (05 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Demonstrate different operations on Tenon and mortise machine.	123.Demonstrate working of mortise machine, its part, their operational techniques and safety precaution. (06 hrs.) 124.Adjust table along with feed and job holding. (03 hrs.) 125.Mortising operation on hard wood/ soft wood (300mmX50 mm X 25mm). (05 hrs.) 126.Remove and refit of chain & sprocket with the machine. (05 hrs.) 127.Make groove at the face or edge on the job. (06 hrs.)	• Mortise machine - Description, Types, Sizes, Parts, Function, Operation of mortise machine. • Safety precaution and P.P.E for mortise machine. • Care & maintenance of mortise machine with oiling & greasing • Calculation of timber, weight, area, volume etc. (05 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Demonstrate different operations on Sanding machine.	128.Demonstrate working of different types Sanding machine, its part, their operational techniques and working safety precaution. (10 hrs.) 129.Operation on hard wood/ soft wood by using sanding machine. (15hrs.)	• Sanding machine - Description, Types, Parts of sanding machine. • Safety precaution and P.P.E for sanding machine. (05 hrs)
Professional Skill 60 Hrs; Professional Knowledge 10 Hrs	Demonstrate on Modular Kitchen (Domestic)	130.Demonstrate the modular kitchen and operational technique and working safety precautions (09 hrs.) 131.Study the drawing and make a plan for making desired Cabinet (09hrs) 132.Select proper material and tool for making Cabinet. (06hr.)	• Introduction of Modular Kitchen • Different hand tool including machineries. • Different allocation • Different Material and its characteristics, application. • Assemble Procedure.

Professional Skill 25 Hrs;		133.Prepare layout for Structure (09 hrs.) 134.Make the material as per layout considering scale and check the dimensions. (09 hrs.) 135.Perform Structuring the cabinet with Plywood material and finally finishing with the sunmica and hardware. (09hrs.) 136.Check for accuracy and finishing of the job. (09 hrs.)	• Application of hardware. • Different types of timber used. • Types of Job dressing. • Application of Sunmica in different Colour contrast. (10 hrs)
Professional Knowledge 05 Hrs Knowledge 05 Hrs	Produce component involving different operations of fitting work and check for functionality.	137.Mark and make hanging plate, corner plate, name plate, different types of clamps and angle plate by chipping, sawing filling, drilling, counter sinking etc. (14 hrs.) 138.Make nuts, bolts, washers, screws by drilling, taping and dieing. (06hrs.) 139.Grind chisels, drills and check for correct cutting angle. (05hrs.)	**General safety in fitting shop** • Types of marking and cutting tools and their uses. (viz., marking block, chisels, hammer, hacksaw, files, etc.) • Uses and maintenance of tools - Steel rule, try squares, scriber, divider, callipers and other tools. Marking table, marking block etc. • Application of bench vice, clamps. • Types of drill bits, counter boring tool, taps and dies used in fitting work. • Types of nuts, bolts, washers, machine screws etc. (05 hrs)
Professional Skill 40 Hrs; Professional Knowledge 8 Hrs	Demonstrate on Modular Furniture (office and Domestic).	**Modular Furniture** 140.Study the drawing and make a plan for making desired Cabinet. (06hrs.) 141.Select proper material and tool for making Cabinet. (08hrs.) 142.Prepare layout for Structure. (12hrs.) 143.Make the material as per layout considering scale, and check the dimensions, Check for accuracy and finishing of the job. (10hrs.) 144.Perform Structuring the cabinet with Plywood material and finally finishing with the sunmica and hardware. (04hrs.)	• Introduction of Modular Furniture. • Different hand tool including machineries and application. • Different allocation. • Different material and its characteristics, application. • Assemble Procedure. • Application of hardware. • Different types of timber used . • Types of Job dressing. • Application of Sunmica in different Colour contrast. (08 hrs)
Professional Skill 70 Hrs; Professional Knowledge 13 Hrs	Prepare various roof truss, door and windows frame, shutters, assembling & fixing (wooden, aluminium & PVC).	145.Revision of basic joint related with building work. (02 hrs.) 146.Making door shutter. (03 hrs.) 147.Making panel door. (06 hrs.) 148.Making door glazed shutter. (03 hrs.) 149.Fitting moulding with glass. (03 hrs.)	• Introduction about building construction. • Different type door & windows and different size. • Different type panel used for panel shutter, glazed shutter. • Substitute of wood viz., block board, hard board etc. (03 hrs)
		150.Marking and making window frame and window shutter. (06 hrs.) 151.Use protection bar. (02 hrs.) 152.Roof trusses layout. (04hrs.) 153.Make Model type king post and queen post. (08 hrs.)	• Description of window frame and shutter • Uses of frame and shutter of window • Definition of roof trusses • Terms of king post and queen post. (04 hrs)

		Prepare sliding window & 'Z' battened window by aluminum channel 154.Angular cutting of aluminium bar at different angle and size. (03 hrs.) 155.Join angular aluminium bar by screw and modern adhesive like dendrite, feviquick etc. (03 hrs.) 156.Aluminium channel bar joining by fibre glass (03 hrs.) 157.Fiber glass shutter fitted with aluminium channel. (03 hrs.)	• Description of aluminium • Anodising of the aluminium windows, channel, section etc. • Knowledge of different aluminium section, channels required for manufacturing the windows. • Drilling of aluminium bar and joining by screw and adhesive. • Knowledge of fibre glass • Introduce about rubber padding /gasket and aluminium wheel. • Uses of channel window which is involved in building construction. (04 hrs)
		158.Assembling and fixing of P.V.C door for kitchen and W.C bath. (21 hrs.) • Cutting angular wise P.V.C door frame. • Forming shape by joining adhesive and screwing. • P.V.C shutter door finish by adhesive and screwing. • Assembling & fixing the PVC door.	• Uses of P.V.C as substitute of wood. • Give more get-up and cheapest in price. • New style framing work. • Modern technologies follow up P.V.C moulding. • Advantages and disadvantages (02 hrs)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Paint various door, windows frame, stair and furniture (wooden or aluminum).	159.Removal of old painting by application of chemical paint remover. (04 hrs.) 160.New painting for door, window stair, furniture, etc. (04 hrs.) 161.Plain and smoothing of door & window and staircase railing. (05 hrs.) 162.Apply Synthetic enamel primer on the new surface. (08 hrs.) 163.Apply synthetic enamel paint or oil paint on the priming surface as finishing coat. (04 hrs.)	• Apply of removing old painting by new chemical then after repainting on furniture • Uses of new painting and priming on furniture. (05 hrs)
Professional Skill 35 Hrs; Professional Knowledge 8 Hrs	Prepare various type of wooden floor, partition wall, and stair etc. Check, identify, analyze the design, Installation and repair the wooden job.	164.Identification of simple floor construction. (07hrs.) 165.Use the cogged joint for wooden floors. (07hrs.) 166.Demonstrate different type basement floor single joint wooden floor and double joint wooden floor. (07hrs.) 167.Make structure of wooden partition wall. (07hrs.) 168.Repair and recondition furniture, door and window, staircase hand railing. (07hrs.)	• Purpose of using floor construction with different types of joist. • Basic principal of repairing work, door window, staircase rack etc. • Illustrate of nail screw bracket angle plate nut bolt, etc. • Economic factors and material estimates. • Hilti laser tools, types and their applications (8 hrs)

Introduction of carpentry trade

Objectives: At the end of this lesson you shall be able to
- **state the introduction of carpentry trade**
- **describe the further learning pathways craftsman training scheme**
- **explain employment opportunities on complete of carpenter trade.**

Carpentry is a wood working trade of cutting, shaping and installation of building material in the construction of buildings ships, timber bridges and so on. Carpenters are usually the first to start a job and remain toll the completion of the job.

- Carpenter, makes, assembles, alters and repairs wooden structures and articles according to sample or drawing using hand or power tools or both.
- Studies drawing on sample to understand type of structure or article to be made and calculates quantity of timber required.
- Selects timber to suit requirements.
- Marks them to size using square, scriber etc.
- Saws, chisels and planes wooden pieces to required sizes.
- Makes necessary joints such as half lap, Tenon mortise, dove - tail etc., using saws, planes, mortising, chisels, drills and other carpentry hand or power tools as required.
- Checks parts frequently with square, foot rule, measuring tape etc., to ensure correctness.
- Assembles parts and secures them in position by screwing, nailing or doweling.
- Checks assembled structure with drawing or sample; rectifies defects, if any, and finishes it to required specification.
- Alters, repairs or replaces components in case of old structures or articles in similar manner.
- Glue parts together.
- Smoothen and finish surface with sand paper and article made.
- Calculate cost of furniture.
- Plan and organize assigned work and detect & resolve issues during execution in his own work area within defined limit.
- Demonstrate possible solutions and agree tasks within the team.
- Communicate with required clarity and understand technical English.
- Sensitive to environment, self- learning and productivity.

Further learning pathways

Also on successful completion of the trade candidate can pursue apprenticeship training in registered industries organization, further for a period of two year under apprenticeship training scheme to acquire practical skills and knowledge.

Employment Opportunities

On successful completion of this trade, the candidates shall gain to be fully employed in the following industries:

- Structural like bridges, roof structures, building & construction.
- Automobile body building
- Site construction activities for power stations, process industries and mining.
- Furnishing works on railway coaches.
- Ship building and repair
- Infrastructure and defence organizations
- In public sector industries like BHEL, NLC, etc and private industries in India & Abroad
- Hotel and hospital furniture repairing work
- Self employment

General discipline, workshop discipline and house keeping

Objectives: At the end of this lesson you shall be able to
- **state the general discipline in the institute**
- **state the work shop discipline**
- **concept of house keeping and steps in 5s.**

General discipline in the institute: Always be polite, courteous while in institute.

– Do not arguments with others, on matters of related to your training or with the office while seeking clarifications.

– Do not bring bad name to your institute by your improper habitude.

– Do not waste your precious time in gossips with your friends and on activities other than training.

– Do not be late to the theory practical and other classes.

– Do not unnecessarily interfere in other's activities.

– Do very attentive and listen to the lecture carefully during the theory classes and practical demonstration given by the training staff.

– Give respect to your trainer and all other training staff, office staff and co-trainees.

– Be interest in all the training activities.

– Do not make noise or be playful while undergoing training.

– Keep the institute premises neat and clean avoid polluting the environment.

– Do not take away any material from the institute which does not belong to you.

– Always attend the institute well dressed and good physical appearance.

– Be regular to attend the training without fail and avoid absent from the theory or practical classes for simple reasons.

– Prepare well before writing a test/examination.

– Avoid any malpractice during the test/examination.

– Write your theory and practical records regularly and submit them on time for correction.

– Take care of your safety as well as other's safety while doing the practical's.

Workshop discipline

Before you can use equipment and machines or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.

Keep the floor and gangways clean and clear.

Move with care in the workshop, do not run.

Don't leave the machine vice is in motion.

Don't touch or handle any equipment/machine unless authorized to do so.

Don't walk under suspended loads.

Don't cut practical jokes while on work.

Use the correct tools for the job.

Keep the tools at their proper place.

Replace worn out or damaged tools immediately.

Never direct compressed air at yourself or at your co-worker.

Ensure adequate light in the workshop.

Clean the machine only when it is not in motion.

Sweep away the wood cutting.

Know everything about the machine before you start it.

House keeping

House keeping is the systematic process of making home/ work place neat and clean. House keeper is responsible for administering housekeeping maintenance and for assuring that every thing is in order and he is responsible for systematic administration of activities that provide segregation, storage, transfer, processing treatment and disposal solid waste (which is collected during cleaning)

Scope of house keeping maintenance

The scope of work highly depend on where the house keeping activity is performed in general, maintains clean lines and orderliness, furnishes the room, office, workplace, house keeping supervisor assisted by an assistant house keeper.

– eye appeal

– Safety

– maintenance

Elements of house keeping and cleanliness at workplace: The major elements which are normally included in the house keeping and cleanliness practices at the workplace are described below.

Dust and dirt removal: Working in dusty and dirty area is unhygienic as well as unhealthy for the employees since there can be respiratory type irritations. Also, If dust and dirt are allowed to accumulate on surfaces, there is a potential for a slip hazard. Hence, regular sweeping the workplace for the removal of dust and dirt is and essential housekeeping and cleanliness practice.

Employees facilities: Adequate employees facilities such as drinking water, wash rooms, toilet blocks and rest rooms etc., are to be provided for the employees at the workplace so that employees can use them when there is a need. Cleanliness at the place of these facilities is an important aspect of the facilities.

Flooring: Floors are to be cleaned regularly and immediately if liquids or other materials are spilled. Poor floor conditions are a leading cause of accidents in the workplace.

Lighting: Adequate lighting reduces the potential for accidents. It is to be ensured that inoperative light fixtures are repaired and dirty light fixtures are cleaned regularly so that the light intensity levels are maintained at the workplace.

Spill control: The best method to control spills is to prevent them from happening. Regular cleaning and maintenance on machines and equipment is an essential practice. Also, the use of drip pans where spills might occur is a good preventative measure. When spills do occur, it is important to clean them up immediately. When cleaning a spill, it is required to use the proper cleaning agents or absorbent materials. It is also to be ensured that the waste products are disposed of properly.

Waste disposal: The regular collection of the waste materials contribute to good housekeeping and cleanliness practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities. Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing containers for wastes near the place where the waste is produced encourages orderly waste disposal and makes collection easier.

Tools and equipment: Tools and equipment are required to be inspected prior to their use. Damaged or worn tools are to be cleaned and returned to their storage place after use.

Maintenance: One of the most important elements of good housekeeping and cleanliness practices is the maintenance of the equipment and the buildings housing them. This means keeping buildings, equipment and machinery in safe and efficient working condition. When a workplace looks neglected means there are broken windows, defective plumbing, broken floor surfaces and dirty walls etc. These conditions can cause accidents and affect work practices. If is important to have a replacement program for replacing or fixing broken and damaged items as quickly as possible.

Storage: Proper storage of materials is essential in a good house keeping and cleanliness practice.

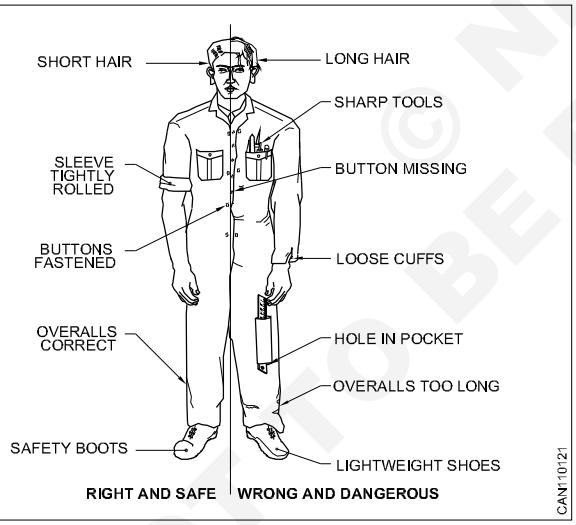
Safety precautions in the workshop and industrial safety

Objectives: At the end of this lesson you shall be able to
- **state the importance of safety**
- **list the general safety precautions to be observed in a work shop/ Industry.**

Importance of safety

Generally accidents do not happen; they are caused. Most accidents are avoidable. A good craftsman, having a knowledge of various safety precautions, can avoid accidents to himself and to his follow workers and protect the equipment from any damage. To achieve this, it is essential that every person should follow safety procedure. (Fig 1)

Fig 1



General safety precautions work shop/industry.

– The general safety precaution to be observed in a carpentry shop are as follows.

– Give all your attention to the job and don't distract others.

– Be sensible in your behaviour, don't play with hand tools.

– If you are not sure of the correct way to use a tool, ask your instructor.

– Make sure that your work piece is safe and securely fastened in place before you start cutting or any work.

– Wear safety goggles when cutting blocks, and grinding tools.

– Carry tools with the pointed ends down.

– When you finish working with a tool, clean it and return it to the tool box.

– Never throw or drop tools.

– Keep the place tidy.

– A work piece scattered with tools is dangerous.

– Maintain your tools.

– Work only with clean and sharp tools.

– A good quality, well maintained tool can do half the work for you.

– Always avoid loose clothing.

– Tools which are not used, should always be kept in their respective places. They should not be allowed to be scattered on the work place.

– The tools should always be kept well-sharpened since a blunt or dull tool is apt to slip and cause injury.

– Boards and other wooden pieces carrying nails should never be allowed to remain and injury to foot.

– The shop floor should always be kept clean and free from debris otherwise it may cause us to slip over and fall on it.

– All modern machines are provided with proper guards for their moving parts and these guards should be fully utilized.

– No machine should be operated without the permission of the shop charge/instructor.

– The shop floor and around machineries should always be free from any obstructions.

– Prior to starting the machines. ensure that the guards are in proper position and are well-secured.

– Never try to feed the stock faster than the cutting capacity of the machine and always it is advisable to use a push-stick to force the stock beyond the rotating wheel.

– While working on a circular saw, avoid always standing in line with the plane of the rotating blade and always keep the hands at a distance from the blade.

– Before start of the cutting, allow the saw to attain the full speed.

– Adjust the guides properly before using a band saw.

– Feed the stock directly against the moving band and do not press from sides.

– While working on a lathe, the job should be properly held between centres, the tool rest should be properly adjusted to correct height and close to the work. Employ the correct spindle speed while working on a lathe, hold firmly the turning tools, wear goggles while working on wood turning machines.

– While working on a spindle moulder feed the work by firmly holding it.

– Avoid use of stocks with knots.

– While working on a jointer never use a stock less than 30cm in length. Feed it in the correct direction of grains keeping the hands away from the rotating knife and use proper guards.

Importance of personal protective equipment (PPE)

Objectives: At the end of this lesson you shall be able to
- **state the purpose of personal protective equipment**
- **name two categories of personal protective equipment**
- **list the most common type of personal protective equipment**
- **list the conditions for selection of personal protective equipment.**

Personal protective equipment (PPE)

Devices, equipments, or clothing used or worn by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or controlled by engineering methods rather than protecting the workman through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution, ventilation, mechanical handling, automation, etc. In situations where it is not possible to introduce any effective engineering methods for controlling hazards, the workman shall use appropriate types of PPE.

As changing times have modernized the workplace, government and advocacy groups have brought more safety standards to all sorts of work environments. The factories Act, 1948 and several other labour legislations 1996 have provision for effective use of appropriate types of PPE. Use of PPE is an important.

Categories of PPEs

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories:

Non - respiratory: Those used for protection against injury from outside the body, i.e. for protecting the head, eye, face, hand, arm, foot, leg and other body parts

Respiratory: Those used for protection from harm due to inhalation of contaminated air.

They are to meet the applicable BIS (Bureau of Indian standards) standards for different types of PPE.

The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in Table 1.

Table 1

No	Title
PPE 1	Helmet
PPE 2	Safety footwear
PPE3	Respiratory protective equipment
PPE4	Arms and hands protection
PPE5	Eyes and face protection
PPE6	Protective clothing and cover all
PPE7	Ears protection
PPE8	Safety belt and harnesses

Quality of PPE's

PPE must meet the following criteria with regard to its quality-provide absolute and full protection against possible hazard and PPE's be so designed and manufactured out of materials that it can withstand the hazards against which it is intended to be used.

Proper use of PPEs

Having selected the proper type of PPE, it is essential that the workman wears it. Other the workman avoids using PPE. The following factors influence the solution to this problem.

- The extent to which the workman understands the necessity of using PPE
- The ease and comfort with which PPE can be worn with least interference in normal work procedures
- The available economic, social and disciplinary sanction which lead interference in normal work procedures

- The available economic, social and disciplinary sanctions which can be used to influence the attitude of the workman
- The best solution to this problem is to make 'wearing of PPE' mandatory for every employee.
- In other places, education and supervision need to be intensified. When a group of workmen are issued PPE for the first time.

Personal protective equipments and their uses and hazards are as follows

Types of protection	Hazards	PPE to be used
Head protection (Fig 1)	1 Falling objects 2 Striking against objects 3 Spatter	Helmets
Foot protection (Fig 2)	1 Hot spatter 2 Falling objects 3 Working wet area	Leather leg guards Safety shoes Gum boots
Nose (Fig 3)	1 Dust particles 2 Fumes/ gases/ vapours	Nose mask
Hand protection (Fig 4)	1 Heat burn due to direct contact 2 Blows sparks moderate heat 3 Electric shock	Hand gloves
Eye protection (Fig 5, Fig 6)	1 Flying dust particles 2 UV rays, IR rays heat and high amount of visible radiation	Goggles Face shield Hand shield, Head shield
Head with face protection (Fig 6, Fig 7)	1 Spark generated during Welding, grinding 2 Welding, spatter striking 3 Face protection from UV rays	Face shield Head shield with or without ear muff Helmets with welders screen for welders
Ear protection (Fig 7)	1 High noise level	Ear plug, Ear muff
Body protection (Fig 8, Fig 9)	1 Hot particles	Leather aprons

Fig 1

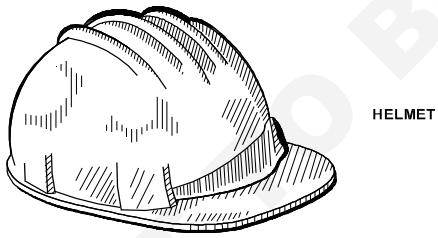


Fig 2

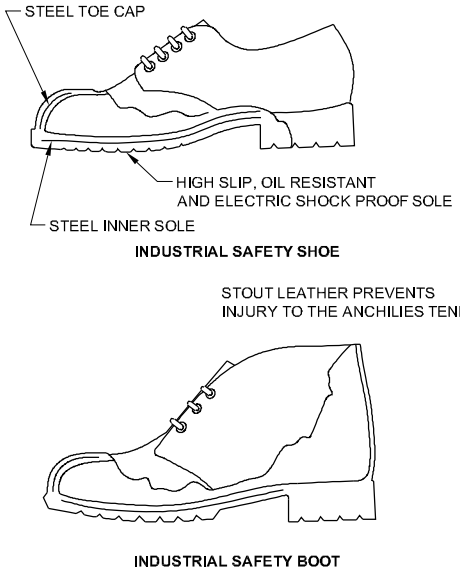


Fig 3

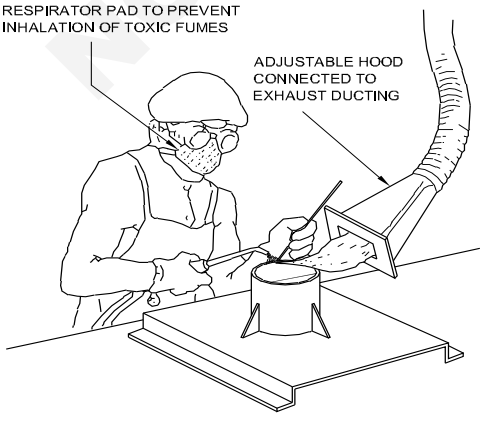
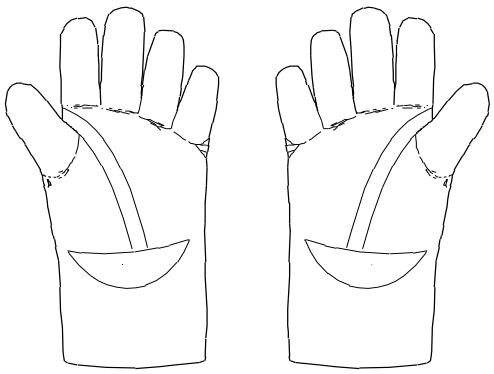


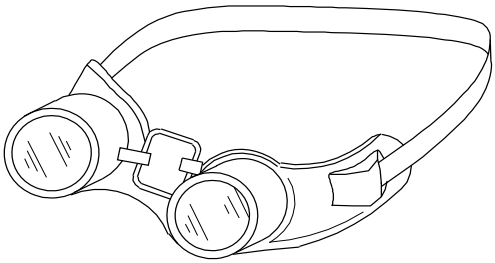
Fig 4



GLOVES

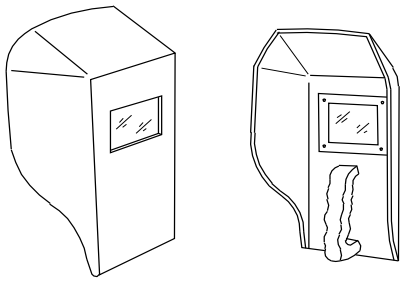
CAN110134

Fig 5



CAN110135

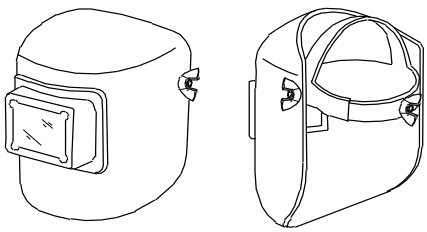
Fig 6



HAND SCREEN

CAN110136

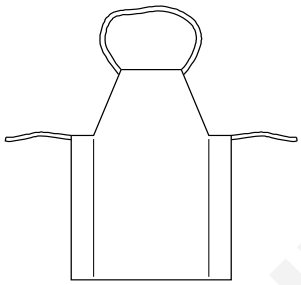
Fig 7



WELDING HELMET

CAN110137

Fig 8



APRON

CAN110138

Fig 9

LEG GUARDS

CAN110139

Safety practice - Fire extinguishers

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

- **state the effects of a fire break out**
- **explain the causes for fire in a workshop**
- **brief the conditions required for combustion relevant to fire prevention**
- **state the general precautionary measure to be taken for the prevention of fire.**

Fire is caused by ignition of combustible material. A fire in an unwanted occasion and in uncontrollable quantity can cause damage or destroy property and materials. It might insure people, and sometimes cause loss of life as well. Hence, every effort must be made to prevent fire. When a fire outbreak is discovered, it must be controlled and extinguished by immediate correction action.

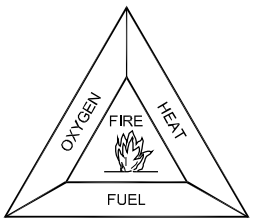
Is it possible to prevent fire? Yes, fire can be prevented by eliminating anyone of the three factors that causes fire.

The following are the three factors that must be present in combination for a fire continue to burn (Fig 1)

Fuel

Any substance, liquid, solid or gas will burn, if there is oxygen and high enough temperatures.

Fig 1



CAN110141

Heat : Every fuel being to burn at a certain temperature. It varies and depends on the fuel. Solids and liquids give off vapour when heated, and it is this vapour which ignites. Some liquids do not have to be heated as they give off vapour at normal room temperature say 15°C, eg. Petrol.

Oxygen: Usually exists in sufficient quantity in air to keep a fire burning.

Extinguishing of fire: Isolating or remove any of these factors from the combination extinguish the fire. There are three basic ways of achieving this.

– **Starving** the fire of fuel removes this element.

– **Smothering** -ie. Isolate the fire from the supply of oxygen by blanking it with foam,. Sand etc.

– **Cooling** -use water to lower the temperature.

Removing any one of these factors will extinguish the fire.

Preventing fires: The majority of fires begin with small outbreaks which burn unnoticed until they have a secure hold. Most fires could be prevented with more care and by following some simple common sensor rules.

Accumulation of combustible refuse (cotton waste soaked with oil, scraps wood, paper, etc.) in odd corners are a fire risk. Refuse should be removed to collection points.

The cause of fire in an electrical equipments is the misuse or neglect. Loose connections, wrongly rated fuses and overloaded circuits cause overheating which may in turn lead to a fire. Damage to insulating between conductors in cables also causes fire.

Clothing and anything else which catch fire should be kept well away from heaters. Make sure that the heater is shut off at the end of the working day.

Highly flammable liquids and petroleum mixtures (thinner, adhesive solution, solvents, kerosene, spirit, LPG gas etc.) should be stored in the flammable materials storage area.

Blowlamps and torches must not be left burning when they are not in use.

Extinguishing fires: Fires are classified into four types in terms of the nature of fuel.

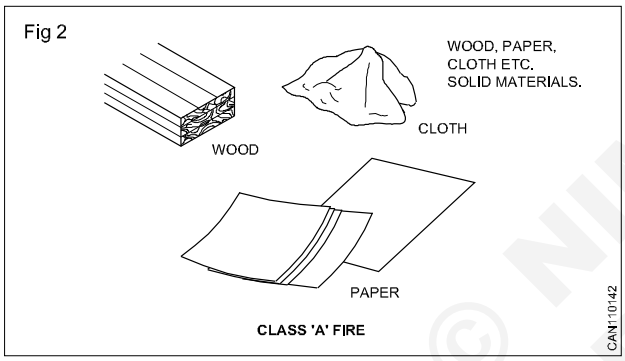
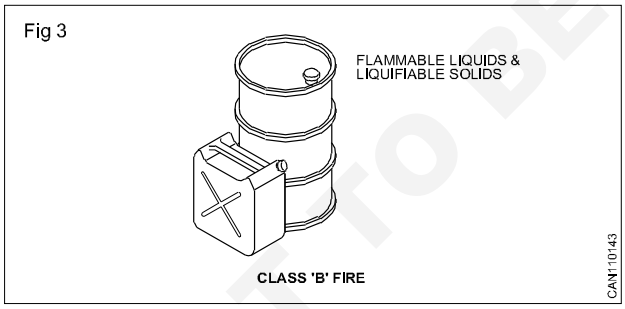
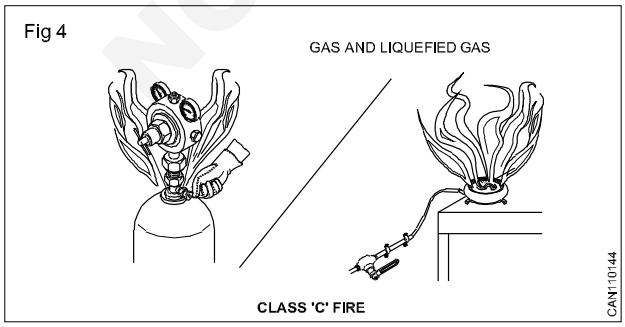
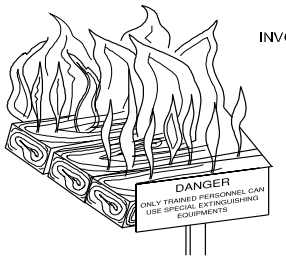
Fuel	Extinguishing
Fig 2  CLASS 'A' FIRE	Most effective ie. cooling with water. Jets of water should be sprayed on the base of the fire and then gradually upwards.
Fig 3  CLASS 'B' FIRE	Should be smothered. The aim is to cover the entire surface of the burning liquid. This has the effect of cutting off the supply of oxygen to the fire. Water should never be used on burning liquids. Foam, dry powder or CO_2 may be used on this type of fire.
Fig 4  CLASS 'C' FIRE	Extreme caution is necessary in dealing with liquefied gases. There is a risk of explosion and sudden outreak of fire in the entire vicinity. If an appliance fed from a cylinder catches fire-shut off the supply of gas. The safest course is to raise an alarm and to leave the fire to be dealt with by trained personnel. Dry powder extinguishers are used on this type of fire. Special powders have now been developed which are capable of controlling and/or extinguishing this type of fire.

Fig 5



CLASS 'D' FIRE

CAN1101145

The standard range of fire extinguishing agents is inadequate or dangerous when dealing with metal fires.

Fire on an electrical equipment.

Halon, Carbon dioxide, dry powder and vapourising liquid (CTC) extinguishers can be used to deal with fires in electrical equipment. Foam or liquid (eg. water) extinguishers must not be used on an electrical equipment under any circumstances.

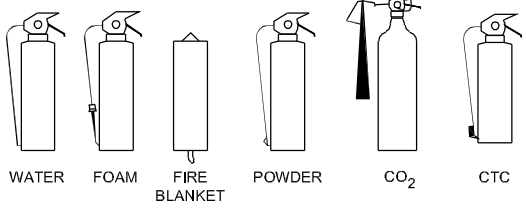
Use of different types of fire extinguishers

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

- **determine the correct type of fire extinguisher to be used based on the class of fire.**

Many types of fire extinguishers are available with different extinguishing 'agents' to deal with different classes of Fires.(Fig 1)

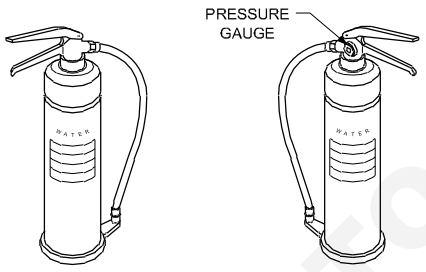
Fig 1



CAN1101151

Water-filled extinguishers: There are two methods of operation. (Fig 2)

Fig 2



GAS CARTRIDGE TYPE STORED PRESSURE TYPE

CAN1101152

- Gas cartridge type
- Stored pressure type

With both methods of operation the discharge can be interrupted as required, conserving the contents and preventing unnecessary water damage.

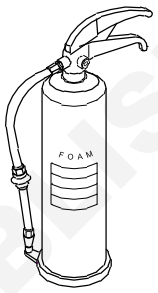
Foam extinguishers (Fig 3): These may be of stored pressure or gas cartridge types. Always check the operating instructions on the extinguisher before use.

Most suitable for

- flammable liquid fires
- running liquid fires.

Must not be used on fires where electrical equipment is involved.

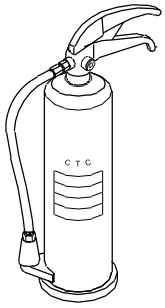
Fig 3



CAN1101153

Dry powder extinguishers (Fig 4): Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type. Appearance and method of operation is the same as that of the water- filled one. The main distinguishing feature is the fork shaped nozzle. Powders have been developed to deal with class D fires.

Fig 4



CAN1101154

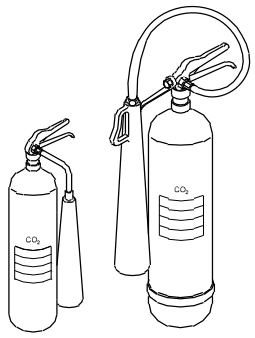
Carbon dioxide (CO_2): This type is easily distinguished by the distinctively shaped discharge horn. (Fig 5).

Suitable for class B fires. Best suited where contamination by deposits must be avoided. Not generally effective in open air.

Always check the operating instructions on the container before use. Available with different gadgets of operation such as-pluger, lever, trigger etc.

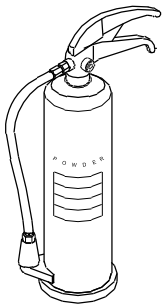
Halon extinguishers (Fig 6) : These extinguishers may be filled with carbon-tetrachloride and bromochlorodifluoro methlene (BCF). They may be either gas cartridge or stored pressure type.

Fig 5



CAN1101155

Fig 6



CAN1101156

They are more effective in extinguishing small fires involving pouring liquids. These extinguishers are particularly suitable and safe to use on electrical equipment as the chemicals are electrically non-conductive.

The fumes given off by these extinguishers are dangerous, especially in confined space.

The general procedure in the event of a fire:

- Raise an alarm.
- Turn off all machinery and power gas and electricity
- Close the doors and windows, but do not lock or them. This will limit the oxygen feed to the fire and prevent its spreading.
- Try to deal with the fire if you can do so safely. Do not risk getting trapped.
- Any body not involved in fighting the fire should leave calmly using the emergency exit and do to the designated assembly point. Failure to do this mean that some person being unaccounted for others may have to put themselves to the trouble searching for him or her at risk to themselves.

Introduction to First-aid

Objectives: At the end of this lesson you shall be able to
- **state the aims of first aid**
- **explain the ABC of the first aid**
- **brief how to give first- aid for a victim who need first aid.**

Introduction to first aid

First aid is defined as the immediate care and support given to an acutely injured or ill person, primarily to save life, prevent further deterioration or injury, plan to shift the victims to safer places, provide best possible comfort and finally help them to reach the medical centre/hospital through all available means. It is an immediate life-saving procedure using all resources available within reach.

Imparting knowledge and skill through institutional teaching at younger age group in schools, colleges, entry point at industry level is now given much importance. Inculcating such habits at early age, helps to build good healthcare habits among people.

First-aid procedure often consists of a range of simple and basic life saving techniques that an individual performs with proper training and knowledge.

The key aims of first aid can be summarized in three key points :

- **Preserve life :** If the patient was breathing, a first aider would normally place them in the recovery position, with the patient leant over on their side, which also has the effect of clearing the tongue from the pharynx. It also avoids a common cause of death in unconscious patients, who is choking on regurgitated stomach contents. The airway can also become blocked through a foreign object becoming lodged in the pharynx or larynx, commonly called choking. The first aider will be taught to deal with this through a combination of 'back slaps' and 'abdominal thrusts'. Once the airway has been opened, the first aider would assess to see if the patient is breathing.
- **Prevent further harm :** Also sometimes called prevent the condition from worsening, or danger of further injury, This covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- **Promote recovery :** First aid also involves trying to start the recovery process from the illness or injury. In some cases the might involve completing a treatment, such as in the case of applying a plaster to a small wound.

Training

Basic principles, such as knowing to use an adhesive bandage or applying direct pressure on a bleed, are often acquired passively through life experiences. However,to provide effective,life-saving first aid interventions requires instruction and practical training. This is especially true where it relates to potentially fatal illnesses and injuries, such as those that require Cardiopulmonary resuscitation (CPR), these procedures may be invasive and carry a risk of further injury to the patient and the provider. As with any training, it is more useful if it occurs before an

actual emergency, in many countries, emergency ambulance dispatchers may give basic first aid instructions over the phone while the ambulance is on the way. Training is generally provided by attending a course, typically leading to certification. Due to regular changes in procedures and protocols, based on updated clinical knowledge, and to maintain skill, attendance at regular refresher courses or re-certification is often necessary. First aid training is often available through community organizations such as the red cross and St. John ambulance.

ABC or First-aid

ABC stands for Airway, Breathing and Circulation

- **Airway :** Attention must first be brought to the airway to ensure it is clear. Obstruction (choking) is a life-threatening emergency.
- **Breathing :** Breathing if stops, the victim may die soon. Hence means of providing support for breathing is an important next step. There are several methods practiced in first-aid.
- **Circulation :** Blood circulation is vital to keep person alive. The first aiders now trained to go straight to chest compressions through CPR methods.

Reassurance

Reassure the victim by speaking encouragingly with him.

Stop the bleeding

If the victim is bleeding, try to stop the bleeding by applying pressure over the injured part.

Cleaning and Dressing

Always clean the wound thoroughly before applying the bandage. Lightly wash the wound with clean water.

First aid

- Call emergency number.
- Check the person's airway, breathing and pulse frequently. If necessary, begin rescue breathing and CPR.
- If the person is breathing and lying on the back, and after ruling out spinal injury, carefully roll the person onto the side, preferably left side. Bend the top leg so both hip and knee are at right angles. Gently tilt the head back to keep the airway open. If breathing or pulse stops at any time, roll the person on to his back and begin CPR.
- If there is a spinal injury, the victims position may have to be carefully assessed. If the person vomits, roll the entire body at one time to the side. Support the neck and back to keep the head and body in the same position while you roll.
- Keep the person warm until medical help arrives.
- If you see a person fainting, try to prevent a fall. Lay the person flat on the floor and raise the level of feet above and support.
- If fainting is likely due to low blood sugar, give the person something sweet to eat or drink when they become conscious.

Do Not

- Do not give an unconscious person any food or drink.
- Do not leave the person alone.
- Do not place a pillow under the head of an unconscious person.
- Do not slap an unconscious person's face or splash water on the face to try to revive him.

Loss of consciousness may threaten life if the person is on his back and the tongue has dropped to the back of the throat, blocking the airway. Make certain that the person is breathing before looking for the cause of unconsciousness. If the injuries permit, place the casualty in the recovery position with the neck extended. Never give anything by mouth to an unconscious casualty. (Fig 1)

Fig 1

Introduction of timber and growth of trees

Objectives: At the end of this lesson you shall be able to
- **state the introduction of timber**
- **explain the growth of timber trees**
- **describe the cross-section of exogenous tree trunk**
- **differentiate between hard wood and softwood.**

Introduction of timber

Timber

Timber is one of the important engineering materials. It finds its extensive use in building and other industries. The general study of timber will be helpful for better understanding of various processes a timber undergoes during its transformation into a product of actual use.

Timber is a general name given to the wood suitable for engineering and building purposes. It is lighter and generally stronger than the materials commonly used in engineering practice when compared in proportion to their weight. Timber can be easily handled and put to any shape by cheaper cutting tools. It is best suited for decorative work, furniture and intricate patterns. It is also used in making sound-proof buildings. If protected and treated properly, the life of timber can be increased considerably. There are some woods which do not catch fire and are often used for decoration work in buildings.

Growth of timber trees

The root anchors the tree to the ground. The root takes the mineral food from the soil. The stem conducts the food materials to the leaves. Leaves take in carbon -di-oxide from the atmosphere and with energy obtained from sun light prepare the substances required for the growth.

Cambium is responsible for the growth of the tree and this produces bark towards outside and wood towards inside the cambium is active only during the growth season and occurs by continuous division of cells.

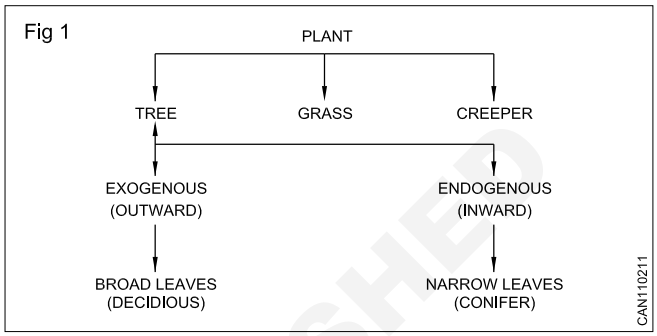
The growth in height is characteristic life of plant. There is no limit to the growth of a tree. In thick forests, the trees struggle for light and tends to grow taller, trees grown in the open, tend to be short with a bulky top

The growth of a tree is normally once during of a year, the tree adds one ring to its girth in each year. the growth is normally divided into two parts, early growth and late growth. In many trees there is a marked difference between these two and this gives rise to what is known as annual rings. The number of rings in a tree indicates the age of the tree.

Types of trees

According to their mode of growth trees are divided into two categories. (Fig 1)

Fig 1



Endogenous trees

Endogenous trees are those which grow end wards by depositing each tree layer internally. The vertical growth of an endogenous tree is generally in the form of links attached end to end, with a knot in between two links.

Leaves of these trees needle shape.

The most common example of endogenous trees is bamboo, palm and coconut tree.

Exogenous trees

Those trees which grow (out ward) by the addition of new layers of wood on the outside of the tree trunk and branches.

Leaves of these trees broad shape

Leaves of these trees fall in autumn and new ones appear in spring season. Timber for engineering purposes is mostly used from these trees.

The most common example of exogenous trees is sal, teak and deoder.

Another important classification of timber is dicotyledons (hard woods) and conifers (soft woods).

The dicotyledons or angiosperms are broad leaved trees are entirely different in characteristic than the conifers (gymnosperms) which have needle shaped leaves and grow in temperature regions and in high altitudes.

Cross-section of exogenous tree trunk and different parts of a tree

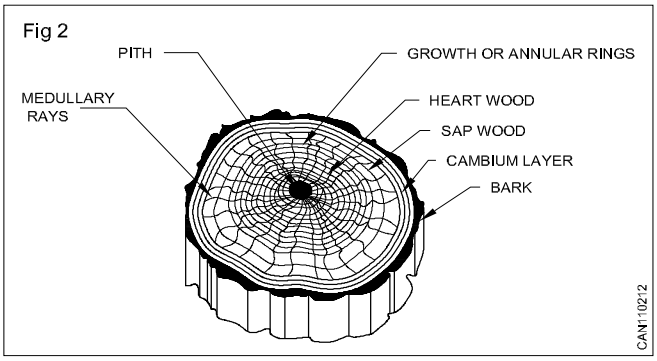
Pith or medulla

At the centre of the cylinder of wood is the pith or the heart of medulla usually about 1.25cm in diameter but some times barely visible. This is the fibrous tissue representing the original sapling. It is usually darker in colour than the rest of the tree.

Pith or medulla is the centre of or heart of the tree and forms a passage for the sap in the young tree. It varies in size and shape for different types of trees.

True wood or heartwood (Fig 2): It is the fully developed wood which surrounds the pith. It is called true wood because it reached the stage of maturity. Most of the timber for building materials is usually harder taken from this part. Truewood is darker in colour, and more durable harder than the sap wood surrounding it. It indicates dead portion of tree and as such it does not have active part in the growth of tree.

Fig 2



Heart wood is the inner most part of the tree leaving a small portion in the centre. In all trees after a period of useful life the living part ultimately dies. This results in gradual accumulation of dead wood in the centre of a tree. called heart wood. As the age of tree increases more and more of inner layers of sapwood get converted to heart wood. Heart wood thus increases to size as the tree ages.

Sap wood: This often surrounds the true wood (or) heard wood which is softer and lighter in colour. As the tree grows the sapwood will harder and mature into true wood. Owing to the sweet food stored, it is liable to attack by insect pests. Trees cut down before maturities have greater amount of sapwood. It has active part in the growth of tree a sap moves in an upward direction through it.

Cambium layer

It is a layer of specialised cells immediately beneath the bark. It forms new bark on the outside and new sapwood on the inside over the last years growth and is fed by the food brought down from leaves, through the inner layer of the bark. It cannot be seen without microscope.

Bark

The outer most layer that can be distinguished is the bark. The main function of the bark is to give protection to soft tissues of wood. The bark can be seen in a freshly cut out piece as the inner bark and outer bark. The outer bark is hard and tough and it protects the wood from external destroying agencies. The bark is normally rich in resinous materials and dyes.

Annular ring

Annular rings are layers of wood usually formed each year and may be seen in most woods in both true wood and sap wood. The number of rings in a tree indicates the age of the tree.

Medullary rays

These are rows or build of cells running radially from the cambium layer to the pith or inter mediate growth rings. They serve to store the sap food and convey it to the inner growing parts of the tree. They also tend to find the growth rings together.

Differences between Hard wood and Soft wood

Hard wood	Soft wood
• Which grow outward	• Which grow inward
• Broad leaves	• Lengthy needled shaped leaves
• Cell has no resin and turpentine	• Cell has resin and turpentine.
• Annual rings are not clear	• Annual rings are clear
• Medullary rays are clear	• Medullary rays are not clear
• Annual rings are very near to each other	• Annual rings are far away from each other.
• Leaves of these trees fall in autumn	• Leaves of these trees fall at equal intervals. and new ones appear in spring season.
• Hard wood cannot cut easily	• This wood can cut easily
• Not burnable because of absence of resin and turpentine	• Burnable because of presence of resin and turpenting
• Strength of the wood grain same both vertically and horizontally	• Strength of the wood grain is strong vertically but horizontally weak.
• It can hold vibration	• It cannot hold vibration
• It has straight and attractable grains	• It has hard irregular but straight grains
• Teak, sal, oak, peach and ash include this type	• Pine, fir, ceader, red wood include this type
• High quality building material	• Used in general wooden articles
• Dark in colour	• Light in colour
• Less moisture content	• More moisture content
• Seasoning very quick	• Seasoning to much time

Common Indian timbers

Objectives: At the end of this lesson you shall be able to
- **state the types of common Indian timbers**
- **explain the properties of Indian timbers**
- **brief the uses of Indian timbers**
- **list the advantages of Indian timbers.**

Teak

It is very valuable timber. It is a large tree with light coloured leaves.

The wood is straight grained and of rich brown yellow color.

Sap wood is pale yellowish and heart wood is golden brown. In India it is found in Madhya pradesh, Maharastra, Andhra pradesh, Kerala and Gujarat, maximum of teak out put is from Madhya pradesh. It is hard and heavy and weighting about **650 kg/m^3** at 12% moisture content suitable for any work, ship building furniture and cabinet making etc.,

Deoder

It has straight tall trunk having short branches and pointed leaves. It is found in altitudes of 1200 to 3000m. The tree has lofty straight trunk with small branches. It is found in Arunachal Pradesh, Punjab, Himalayas, Kashmir and U.P.

The sap wood is white and heart wood is light yellowish brown. The wood is hard and heavy with average weight **545 kg/m^3** at 12% moisture content. It has a medium fine and even texture deoder is a non-porous wood.

Uses

Construction purposes, furniture, packing cases, railways sleepers, carriages etc.,

Chir

It is similar to deoder but is inferior in quality. The sap wood is white and heart wood is light yellowish brown.

It is hard and heavy with an average weight of **575 kg/m^3**. It is medium and uneven textured with straight to spiral or twisted grain.

Uses

Construction purposes, furniture,height packing and cabinet making.

Kail

It is an ever-green tree.

Kail is similar structure to chir. It is found in foot hills of Himalayas Kashmir, Punjab, and Uttarpradesh. The sap wood is white and heart wood is light and pinkish red.

It is closely grained hard and durable.

It has resinous colour when freshly cut.

It is soft and light with average weight **515 kg/m^3**

Uses

Cabinet making, furniture, packing cases, drawing boards and railways sleepers etc.,

Shisham (sissoo)

It is a tree having short trunk and large branches.

It is found in Assam, Orissa, U.P. Punjab, Himachal Pradesh, Bihar etc.,

Sap of sissoo is pale yellowish and heart wood is golden or dark brown. It generally grows along the road side.

It is hard and heavy with an average width of **780 kg/m^3**

It has medium coarse texture with fairly straight inter locked grains.

Sal

It is a straight growing up right tree.

It is found in Assam UP, Orissa, Maharashtra, Andhrapradesh, Tripura, Madhya Pradesh etc.,

The sap wood is pale yellowish and heart wood is brown or reddish brown.

The wood is hard and heavy with an average of **855 kg/m^3**

It is coarse textured with inter locked grains.

Uses

It is a valuable timber and recommended for all.

Construction purposes and railways sleepers.

Babul

It has small leaves and the not available in large shapes.

It is available in abundance all over India. The wood is closed grained and tough colour of wood is pale red and weighing about **785 kg/m^3**. It is not available in large sizes.

Uses

Tool handles, wheels and bodies of carts, ploughs and other structural works.

Mango

Mango is found all over India. The wood is of inferior quality, coarse and open grained and weighting about **690 kg/m^3** colour of wood is yellowish gray. It contains large amount of moisture and sap.

Uses

Inferior quality doors and windows, packing case etc.,

Bamboo

This tree is found practically all the parts of India. It is a flexible and strong material.

Bamboo grows naturally on soils which are neither too acidic nor too alkaline. The greater concentration of Bamboo is however found in Assam Region.

It is used for making the poor man's hut all over the country.

Uses

Walls, portions, flooring, ceiling, roofing ladder, basket making mats, walking sticks, umbrella handle, toys and paper pulp.

Advantages of timber

1 It can be easily converted to any size and shape.
2 It has a high resale and salvage value.
3 Timber construction is light in weight.
4 Timber has better insulating properties.
5 Timber can be used for loading and loading elements.
6 Timber connections are easy to make.
7 In terms of specific strength timber is better to many other building materials.
8 Durability of timbers is very high, if properly seasoned and pressed.

Defects in timber

Objectives: At the end of this lesson you shall be able to
- **identify the defects in timber**
- **explain the knots, shaks and grains**
- **state the causes for defects in timber.**

Defects in timber

Natural defects occurs in all kind of timber depending upon the soil upon which they grow and climatic conditions to which they are subjected while growing.

A defect in any irregularities occurring in or on the timber

Defects reduces strength durability or utility value of the timber.

Causes

Lighting, strong winds, fires, diseases, parasite (insects, fungi etc),

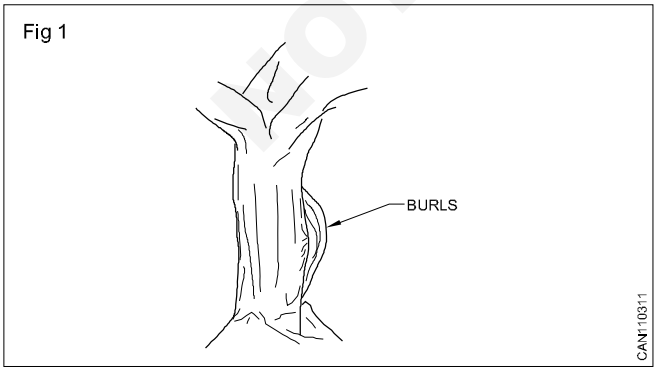
Carelessness while felling, seasoning, Conversion, fungi and insects.

Common defects

Burls

Burls are abnormal growths on the side of the tree caused by some injury or irritation of the trunk. (Fig 1)

Fig 1



Case hardening

Is a condition of the outer layer of timber is abnormally hard.

Caused by in complete seasoning and this outer layers are dried too quickly.

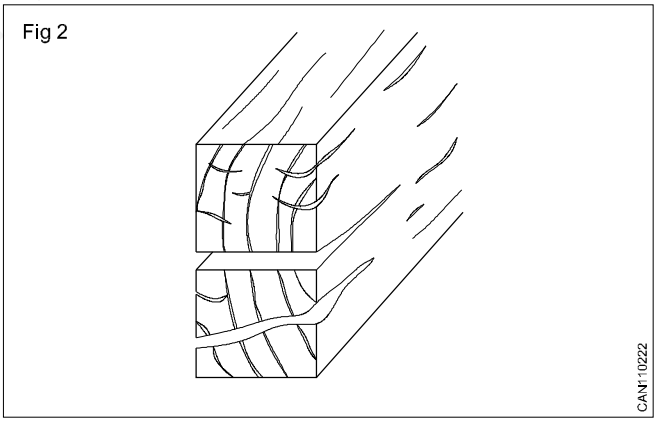
Check

Check is the separation of the wood extending for a few (inches) centimeter along the grain and formed while drying.

End check

Occurring on the end of the piece of timber. (Fig 2)

Fig 2



Internal check

Occurring in the interior of the piece

Surface check

Occurring on the surface of the piece.

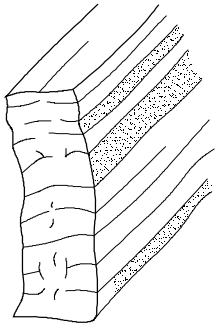
Through check

On which extends through the piece from one surface to the other.

Collapse

A flattering of the cells may be due to excessive or uneven drying. (Fig 3)

Fig 3



COLLAPSED BOARD

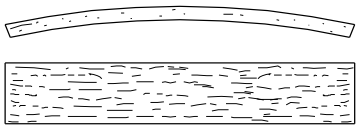
CAN110313

This may be prevented if drying in low temperature.

Bowing

A curvature from plane along the wide surface of the board. Caused by uneven shrinkage and uneven drying during seasoning.(Fig 4)

Fig 4



BOWING

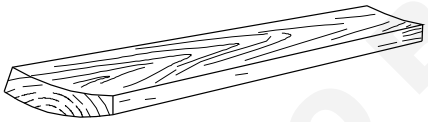
CAN110314

Board not being out parallel to the growth rings.

Cupping

A simple curvature across the width of board due to greater shrinkage on the concave side. (Fig 5)

Fig 5



CUPPING

CAN110315

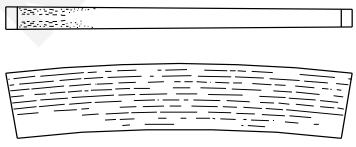
It is more pronounced in back sawn boards.

The curvature is usually away from the heart

Spring

A curvature along the edge of the board. (Fig 6)

Fig 6



SPRING

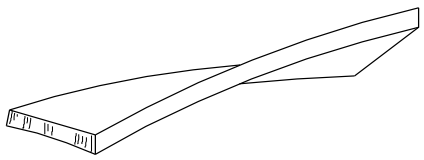
CAN110316

Not affecting the face, the face remaining flat caused by uneven shrinkage and poor drying of the timber.

Twisted fibres (Fig 7)

This defect is due to the tree being twisted constantly in one direction by the force of prevalent wood.

Fig 7



TWIST

CAN110317

A spiral distortion along the length of the piece of timber.

This may caused by uneven shrinkage due to uneven drying.

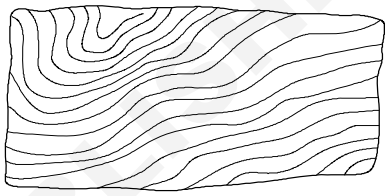
Warp

Any variation from a true flat surface (not perfectly flat).

Upsets

This is the fracture of the fibre across the grain and may be the result of injury in felling. (Fig 8)

Fig 8



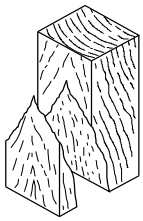
UPSETS OR RUPTURES

CAN110318

Grain

Refers to the direction of the cells and vessels of the wood.(Fig 9)

Fig 9



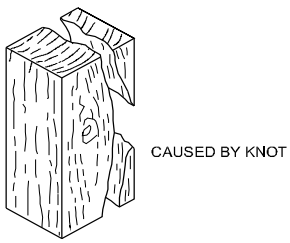
GRAIN

CAN110319

Cross grain

When have a varying inclinations to the axis of the piece due to cutting from timber in which the straightness of the grain is imperfect. (Fig 10)

Fig 10



CAUSED BY KNOT

CROSS GRAIN

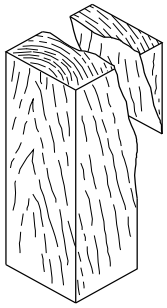
CAN1031A

Diagonal grain

When the fibers do not run parallel to the axis of the piece, although cut from straight grained timber.

This is caused by cutting parallel to the axis of the log instead of parallel to the bark.(Fig 11)

Fig 11



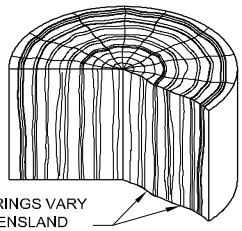
DIAGONAL GRAIN

CAN11031B

Inter lock grain

Caused by the fibers of adjacent layers of wood being spirally inclined in opposite directions. This grained surface is difficult to plane. (Fig 12)

Fig 12



INTERLOCK GRAIN

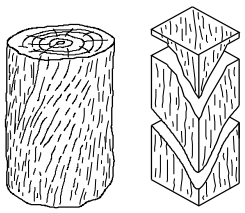
CAN11031C

Spiral grain

Occurs when the fibers have taken a spiral course in the tree trunk as if the tree have been twisted.

The cause is not definitely known.(Fig 13)

Fig 13



SPIRAL GRAIN

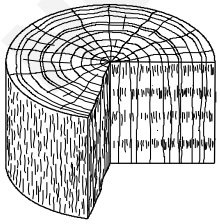
CAN11031D

Wavy grain

A wavy arrangement of the fibers, also known as curly or fiddle back grain.

This grained surface is difficult to place and work.(Fig 14)

Fig 14



WAVY GRAIN

CAN11031E

Waney edge

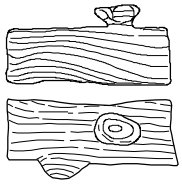
This defect lies in the sap wood which accompanies wane due to economical conversion of logs.

Rind galls

These peculiar curved swelling found on living on dead tree.

Generally caused by the growing of the layer over the "Wounds" left after the branches have been imperfectly cut off or removed. (Fig 15)

Fig 15



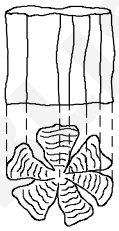
RIND-GALLS

CAN11031F

Wind cracks

These are shakes or splits on the sides of a bark of timber due to the shrinkage of the exterior surface exposed at atmospheric agencies like sun and wind etc.(Fig 16)

Fig 16



WIND CRACKS

CAN11031G

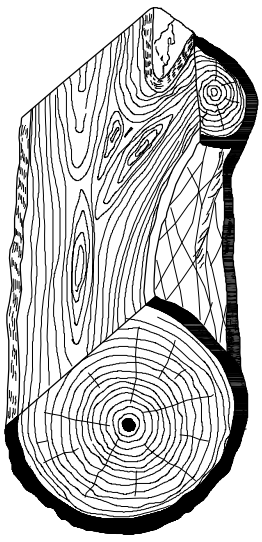
Knots

Caused by a branch or limb being cut through during the process of sawing up the log.

They may live or dead but break the continuity of fibres.

Generally these are distinct defect either in appearance or weakening the wood.(Fig 17)

Fig 17



CAN11031H

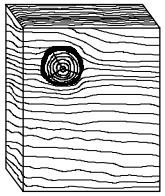
Loose or dead knot

Left by branches that have been cut off or broken before felling.

It is loose in position on the surface of the piece.

It cannot be relied on to remain in position in the piece. (Fig 18)

Fig 18



DEAD KNOT

CAN11031I

Live or sound knot

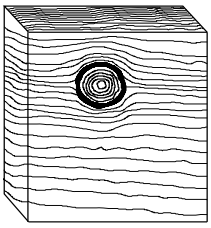
It is left by a branch when the tree is felled.

It is solid across its face and hard as the timber surrounding it.

It is free from decay

Knots are considered to add beauty and effect in the final appearance.(Fig 19)

Fig 19



LIVE KNOT

CAN11031J

Shakes

Is the partial or complete separation between adjoining layers of wood.

Due to the relief of growth stresses present in the stem at the time of felling.

To impact of the tree with the ground.

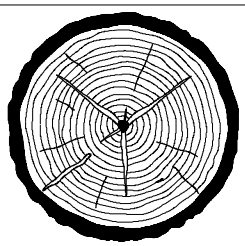
Heart shake

These are the cracks or splits in the centre.

Starting from the pith and extending in the direction of the medullary rays in one or opposite directions towards sap wood.

Such defects are found in over matured trees, but some times they may be caused by quick drying of central part of the tree. (Fig 20)

Fig 20



HEART SHAKES

CAN11031K

If a tree nearing maturity is felled and left unbreakable for a long time.

This defect is caused due to shrink of heart wood.

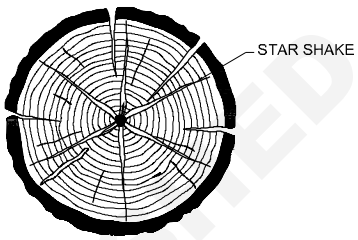
Star shake

These are crack or split which extend from bark towards sap wood.

This defect is caused when the tree is subjected to serve heat or frost during its growth.

The width of these cracks or shake is more at the outer ends and reduces when they extend towards centre. (Fig 21)

Fig 21



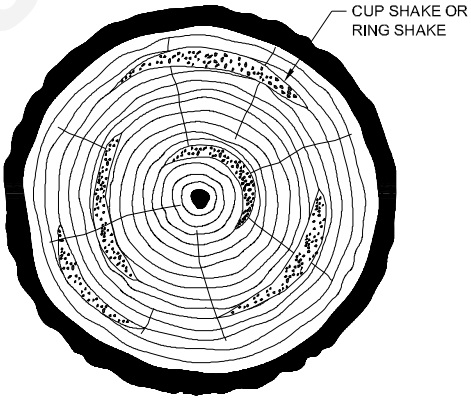
CAN11031L

Cup shake or ring shake

These are formed by the rapture of tissue in a circular direction across the cross section of a log.

It forms usually along the annual rings. (Fig 22)

Fig 22



CAN11031M

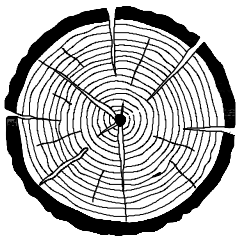
Radial shake

These are similar to star shake, but it occur due to exposure to sun when felled timber is placed for seasoning.

These cracks are fine, irregular and numerous.

Many cracks or split run for a short distance from bark towards centre than follow the course of an annual ring and lastly go towards the centre radially. (Fig 23)

Fig 23



RADIAL SHAKES

CAN11031N

When the rupture extends only a part round, it is called cup shake.

When the whole way round or almost so it is called ring shake.

This defect is caused either due to unequal growth or due to sudden contraction for timber under atmospheric changes assisted by twisting action due to wind.

Diseases in timber and decay of timber

Objectives: At the end of this lesson you shall be able to
- **state the decay that occur in timber**
- **explain the effects caused by the diseases in timber.**

Decay

When timber is confined to a place where it is liable to be subjected to alternate dry and wet conditions or when used in dark unventilated position it gives birth to two common diseases.

1 Dry rot

2 Wet rot

Dry rot

The disease in timber is caused due to lack of ventilation. Due to improper ventilation there is growth of fungus which eats away the fibres of timber and reduces them to powder. The growth of fungus accelerates the process of dry rot, but the origin of the disease is due to the decomposition of sap in the timber. This decomposition supplies food for the growth of fungi. The disease is highly infectious and causes tremendous destruction of the timber. This disease may develop in seasoned timber, timber or unseasoned timber treated with preservatives. This disease is common in warms cellars, unventilated wooden floors basements ends of timbers built into walls.

This disease can be detected by tapping at one end of timber post or log and hearing the sound on the other end. If distinct sound is heard then it indicates a sound timber and if a dull sound is heard then it is a sign of decayed or diseased timber.

The following method can be adopted to prevent or eradicate this disease.

1 By allowing free circulation of free air.

2 Portion of wood attacked by dry rot should be cut off and the remaining portion painted with copper sulphate.

3 By exposing the infected portion to sunlight and sweeping of fungus.

Wet rot

This disease is the result of decomposition of timber caused by damp and moisture. This disease is further induced by alternate wet and dry conditions. The portion of the timber attacked by wet reduces to greyish brown powder. In this disease the timber is just decomposed while wet and then it scales of when it dries.

This disease can develop in a timber whether dead or alive. All types of timber used in uncovered situations is likely to be exposed to rain and hence subjected to wet rot.

This wet rot disease can be avoided by removing sap from timber through seasoning first and then treating it with preservatives.

Diseases

Timber is said to be decayed when it is deteriorated to the extent it looses its value as an engineering material. Timber deteriorates in strength when it is subjected to excessive defects, diseases or attacked by insects. These insects damage the appearance and reduce their strength. Following insects generally attack the timber.

a) Pinhole borers

They attack the standing tree or recently felled timber.

b) Powder post beetles

They attack timber while it is stacked for seasoning sale or awaiting use for years.

Termite or white ants

They attack timber used for structural purposes in buildings bridges, poles, sleepers fence posts etc. The following are various causes of decay.

1 Alternate dry and wet conditions .

2 Improper stacking storage of timber.

3 Improper seasoning or unseasoned timber.

4 Use of unseasoned timber treated with preservatives.

5 Use of seasoned timber without treating with preservatives.

6 Presence of moisture sap and different types of insects.

7 Development of defects during growth conversion improper use etc.

8 Improper position of structural member of timber.

9 Development of timber disease.

10 Effect of natural agencies.

Introduction of carpentry hand tools

Objective: At the end of this lesson you shall be able to
- **Describe carpentry hand tools .**

Carpentry hand tools are listed as per the following:

1 Marking and testing tools

(e.g) scriber, spirit level, try squares, marking gauge etc.,

2 Holding and supporting tools

(e.g) mitre box, work table, clamps etc.,

3 Measuring tools

(e.g) Foot rule, tape rule, caliper etc.,

4 Cutting tools

(e.g) saws, chisels etc.,

5 Planning tools

(e.g) Planes, spoke shave etc.

6 Boring tools

(e.g) Hand drill, auger, bits, twist bit, etc.,

7 Striking tools

(e.g), Hammers, mallet etc.,

8 Driving tools

(e.g), Screw driver, spanner's etc.,

9 Miscellaneous tools

(e.g) Punches, Pincer etc.,

10 Abrasion tools

(e.g), Files, oil stone etc.,

Classification and uses of marking tools

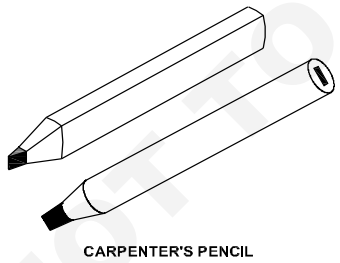
Objectives: At the end of this lesson you shall be able to
- **state the different type of marking tools**
- **explain the use of marking tools**
- **brief constructional features of marking tools.**

Marking off or layout is carried out to indicate the location of operation to be done and provide guidance during sequence of operations.

– Marking out is done with pencil or scriber etc.,

Carpenter's pencil (Fig 1)

Fig 1



CARPENTER'S PENCIL

CAN110511

– Carpenter's pencil usually is an oval cross-section.

– It is sharpened with a chisel.

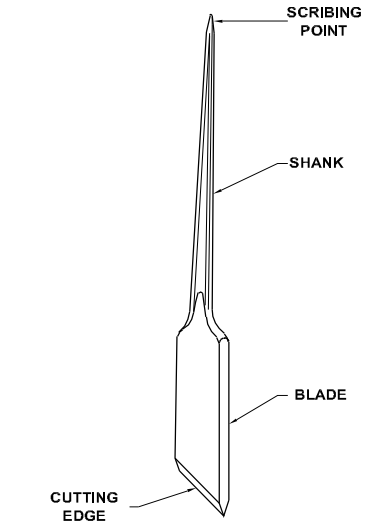
– The pencil is not used for an accurate work.

– Suitable pencil hardness for marking out on 'HB', 'H' and 'F'

Marking knife (Fig 2)

It is made of steel fashioned to a point at one end and a sharp blade at the other end to form a cutting edge. The blade or knife is used for marking cut lines where a vertical shoulder is to be cut with a saw or chisel. The point is used for marking distances and scribing lines.

Fig 2

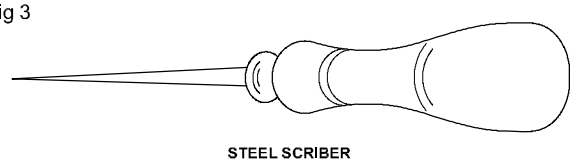


MARKING KNIFE (OR SCRIBER KNIFE)

CAN110512

Steel scriber (Fig 3)

Fig 3



STEEL SCRIBER

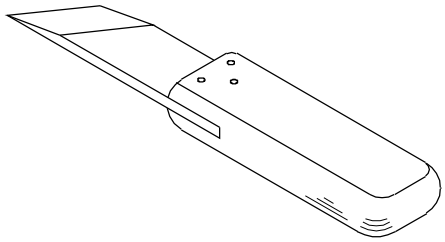
CAN110513

A steel scriber should be sharp at its point. It is used for scribing lines on which a chisel cut or a saw cut is made.

The scriber should not be used as an awl. Do not strike the handle with a hammer.

Marking knife is also used for marking and scribing .It is a steel blade fixed in a wooden handle. it serves the same purpose as that of scriber. (Fig 4)

Fig 4

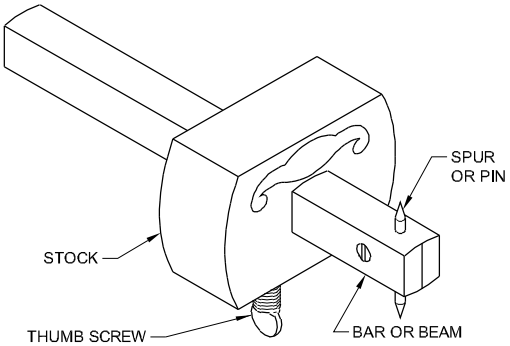


MARKING KNIFE

CAN110514

Marking gauge (Fig 5)

Fig 5



CAN110515

Making gauge is used for marking lines parallel to a face and edge (e.g) gauging width and thickness.

The marking gauge can be made of wood or steel. The gauge consists of square, wooden bar or beam on which wooden block or stock is sliding. This block can be fastened at any required measurement by use of a thumb screw.

In better form of gauges the stock is protected from wear by a piece of brass set flush with surface. The bar is graduated in millimeter and provided with a spur or steel point at the end. It is always advisable to measure the distance from the spur to the face of the block, with an 'ordinary rule'.

The gauge is set by loosing the screw and the stock is shifted to the distance required from the spur. Measurement are taken from a rule.

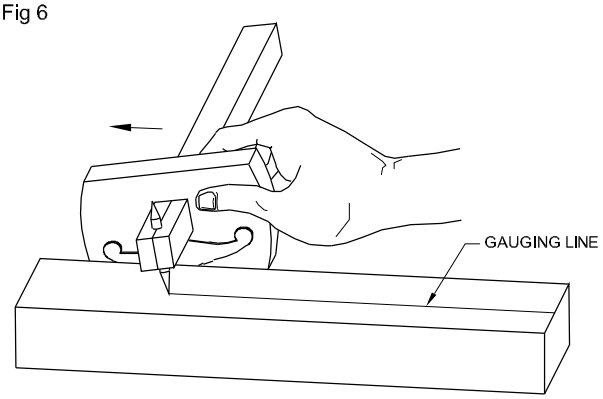
After setting the screw is tightened while gauging the stock is firmly help against the wood and pushed in forward direction. (Fig 6)

Mortise gauge (Fig 7)

A mortise gauge is a making gauge with two spurs. The two spurs can be spaced at different distances and mark two parallel lines at a time.

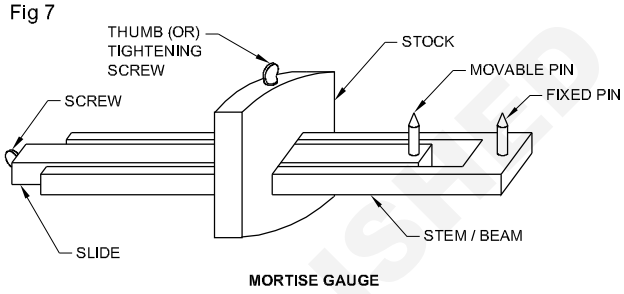
This is made of hard wood and has an adjusting screw in the end of the beam.

Fig 6



CAN110516

Fig 7



MORTISE GAUGE

CAN110517

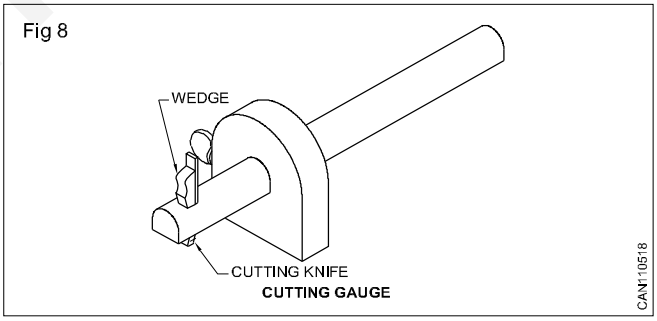
The screw moves one of the spurs up and down or as desired. The other side of the beam is fitted with a single point as no the ordinary marking gauge.

The gauge is used for marking mortises and tenons, and similar joints using parallel lines.

Stem/beam and stock made of beech wood. Thumb screw made of box wood. Pin or spur made of steel.

Cutting gauge (Fig 8)

Fig 8



CUTTING GAUGE

CAN110518

This is just the construction of a marking gauge.

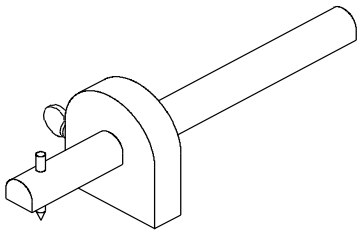
At the end of the stem scribing knife is fixed with aid of one weddge. By loosening the wedge, the length of knife may be increased or decreased. In broad planks scribing marks can be marked with this gauge.

Deep marks can be scribed with this cutting gauge for making grooves, rebates and dovetails. It is possible to cut thin strips of timber and plywood upto 3mm thick.

Panel gauge (Fig 9)

This is just like single marking gauge but the stem and stock are long. The length of stem is 450mm. In planks longer than 150mm scribing marks are made with the panel gauge.

Fig 9

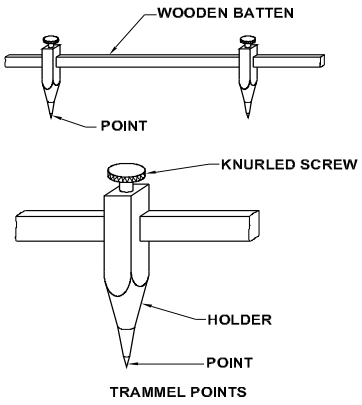


PANEL GAUGE

CAN11051G

Trammal points (Fig 10)

Fig 10



TRAMMEL POINTS

CAN11051A

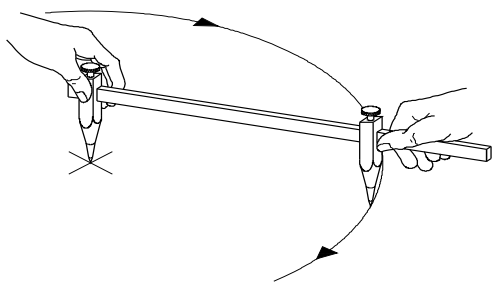
Trammel points are used for laying out larger circles and arcs.

Two sliding points are fastened to a wooden batten or a steel rod at any distance required from each other by turning the knurled screw. The point is fastened to the batten or steel rod.

Sometimes one of the points can be replaced by a pencil lead. (Fig 11)

Wing compass: If consists of a pair of dividers (legs) made of steel.

Fig 11



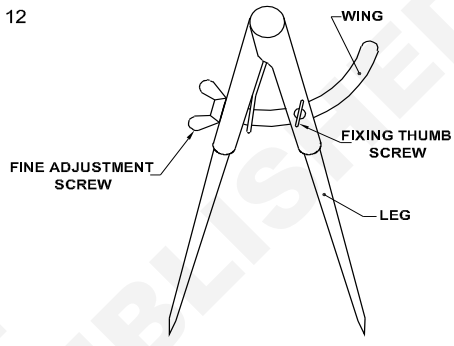
USING THE TRAMMEL POINT

CAN11051B

The legs are sharpened to points and at the top they are rivetted or screwed.

They are fixed at the required radius by means of a set screw. (Fig 12)

Fig 12



WING COMPASSES

CAN11051C

Uses

1 For setting out arcs of circles.

2 To transfer the measurement from the steel rule to the job.

3 To mark curves.

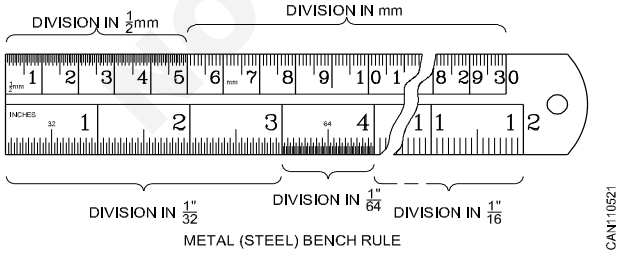
Measuring and testing tools

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

- **state the different types of measuring and testing tools**
- **explain the use of measuring and testing tools**
- **brief the constructional and features of measuring and testing tools.**

The Rule (Steel) (Fig 1)

Fig 1



METAL (STEEL) BENCH RULE

CAN11052I

– In the workshop wooden or steel rules are used

– The division in cm is 30cm long and sub divided in mm (2) and half mm (3).

– The division in inches is 12 inches (12") long twelve inches equals one English foot 12" = 1'

– The Sub division is accurate in 1/16" (4) in 1/32" (5) and In 1/64" (6).

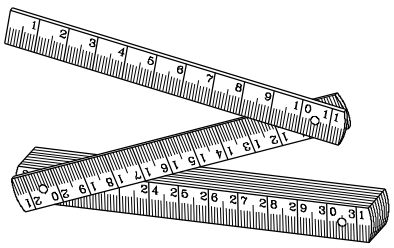
– For the conversion of parts of an Inch in to the metric system (with units: m, cm, mm) a conversion table might be useful.

1/16"	=			1.6 mm
2/16"	=	1/8"	=	3.2 mm
3/16"	=			4.8 mm
4/16"	=	1/4"	=	6.35mm
5/16"	=			8.0mm
6/16"	=	3/8"		9.5mm
7/16"	=			11.1mm
8/16"	=	1/2"	=	12.7mm

9/16"	=			14.3mm
10/16"	=	5/8"	=	15.9mm
11/16"	=		=	17.5mm
12/16"	=	3/4"	=	19.05mm
13/16"	=		=	20.6mm
14/16"	=	7/8"	=	22.2mm
15/16"	=		=	23.8mm
16/16"	=	1"	=	25.4mm

Collapsible Carpenter's rule (Zig-Zag) (Fig 2)

Fig 2



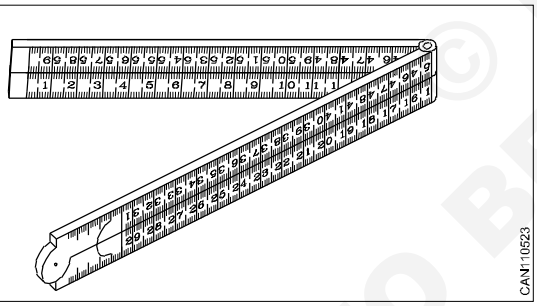
CAN110522

It is also called Zig-Zag rule. It consists of 10 pieces each loosely riveted to one another. Each piece is 10cm long and total length is 1 metre.

Longer distances can be measured with this rule. Some times it contains British system measurements on the other side.

Folding Rule (Foot rule) (Fig 3)

Fig 3

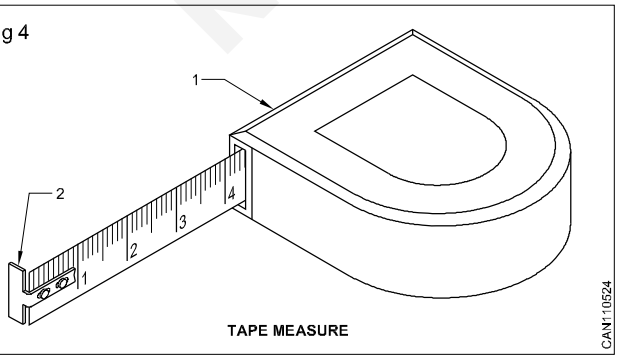


CAN110523

It is also called foot rule. It has four folds each of which is 6 inches or 150mm long. It is joined in a plastic a metallic hinge. After taking measurement, keep the scale folded and free from dust. It is easily carried in packets. Metal clip is provide at the end of this rule to avoid wear and tear.

Tape measurement Rule (Fig 4)

Fig 4



CAN110524

Tape measures are used for longer measurements. The tape is made of steel and is durable and accurate. When not in use, the tape should be kept in the box. Division are made in centimeters or in inches.

Tape measure has a sliding end piece for inside and outside measurement.

Calipers

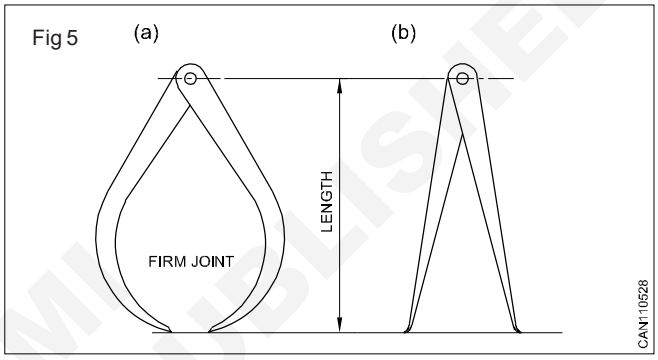
Calipers are simple measuring instruments used to transfer measurements from a steel rule to objects, and vice versa.

Calipers are of different types depending on the type of the joint and the shape of the leg.

Types of Joints: The commonly used calipers are firm joint calipers and spring joint calipers.

Firm Joint Calipers (Fig 5a & 5b)

Fig 5



CAN110528

In the case of firm joint calipers, both legs are pivted at one end.To take measurements of a workpiece, the caliper is opened roughly to the required size. Fine setting is done by tapping the caliper lightly on a wooden surface.

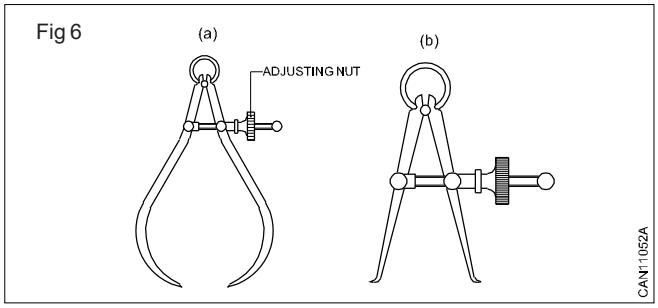
Types of calipers

Outside and inside calipers are differentiated by the shape of the legs.

Calipers used for outside measurements are known as outside calipers. The calipers used for internal measurements are known as inside calipers.

Spring Joint calipers (Fig 6a & 6b)

Fig 6



CAN110052A

For this type of calipers, the legs are assembled by means of a pivot loaded with a spring. For opening and closing the caliper legs, a screw and nut are provided.

Spring joint calipers have the advantage of quick setting. The setting made will not change unless the nut is turned. The size of a caliper is specified by its length, which is the distance between the pivot centre and the tip of the leg.

The accuracy of the measurement taken depends very much on the sense of 'feel' or 'touch' while measuring the job. You should get the feel when the legs are just touching the surface.

Try square

The try square is a precision instrument.

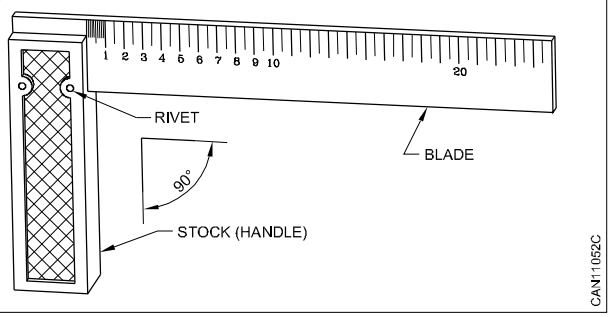
– Which is used to check squareness of a surface.

– the accuracy of measurements by a try square about 0.002mm per 100mm length.

– Which is accurate enough for most work shop purposes.

– The blade is fixed to the stock at 90°. (Fig 7)

Fig 7



Uses

The try square is used

– To check the flatness of the surface.

– To check the squareness of edge.

– To check the inside squareness.

– The blade of try squares are made of hardened steel.

– The stock is made of seasoned hard wood or cast iron, mild steel and aluminium.

– If it is made of wood it must be well seasoned timber.

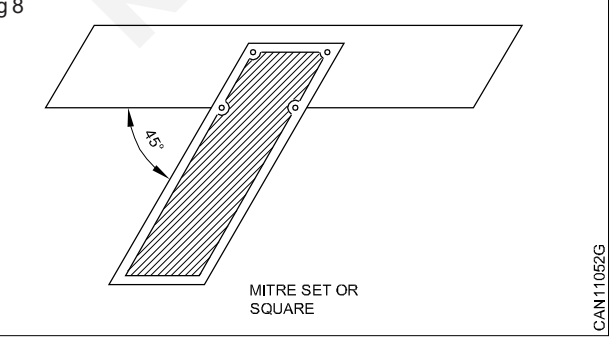
– To prevent the wooden stock from wearing a brass plate is fixed to the inside edge.

– The try squares are specified according to their blade lengths.

– Try square blade lengths are available in 100,150,200,250mm and 300mm.

Mitre square (Fig 8)

Fig 8



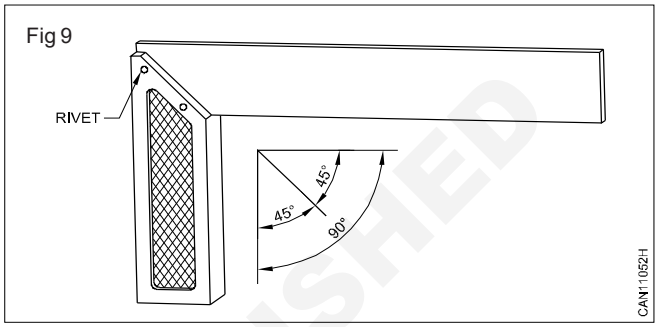
– To mark 45° and to test 45° by mitre square is used at the end of its stock and at the cutting of the blade. It is fixed permanently by rivets, the length of its blade is 200mm to 350mm. There are graduations on its blade.

– The only difference between try square and mitre square is that the blade and stock are fixed at 90° in the try square and 45° in the mitre square.

Try and Mitre square

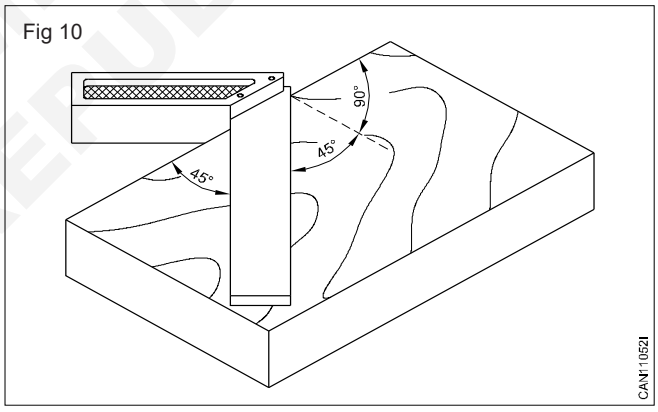
– The try square and mitre square is also useful for angle 45°,90° and 135° (Fig 9)

Fig 9



– The try and mitre square is useful for setting out mitres at 45 testing chamfers and other work 45° or 135°. (Fig 10)

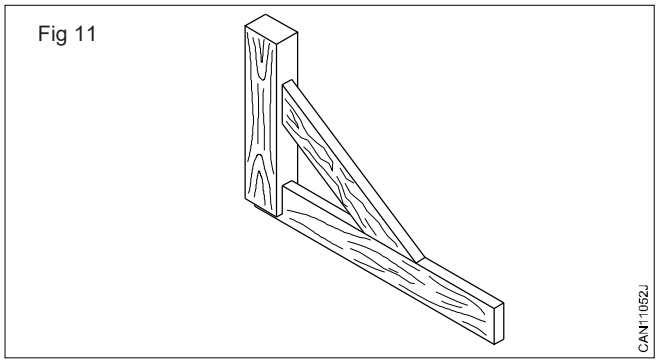
Fig 10



– The blade is permanently fixed so the stock is at an the length of the blade which is 200mm to 350mm.

Wooden try square (Fig 11)

Fig 11



The try square is fully made of wood. Its handle is slightly heavier than blade. The length of blade is 600mm (24") and width is 50mm (2").The length of the handle is 400mm some times up to the length of 450mm.

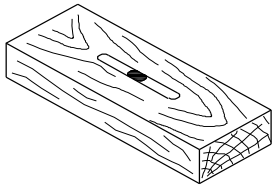
Without changing the angle 90° the handle and the blade are diagonally attached, by a brace. angle of wooden try square is 90°.

Uses

This is used for carpentry works and for building construction works. Large and wide planks are used to scribe the works.

Spirit level (Fig 13): A spirit level is used principally by the carpenter. It consists of a piece of wood (common wood for spirit level is Teak wood) or aluminum into which a spirit level glass is fastened horizontally and vertically. As the glass tube is not filled, a bubble always remains, when the bubble is in the centre of glass indicated by lines marked on it, the structure on which the level rests is absolutely horizontal or vertical.

Fig 12



WOOD SPIRIT LEVEL

CA20N11052K

In some spirit level there will be two glass tubes perpendicular to the horizontal glass tube. This will be called as plumb glass and is used to test the perpendicularly of walls and windows. (Fig 13)

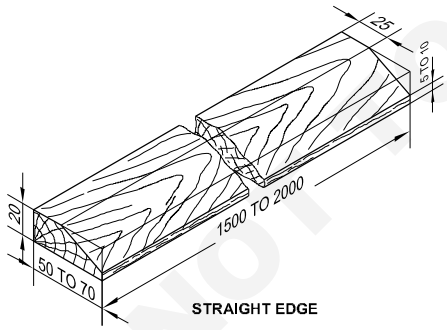
Fig 13

METAL SPRIT LEVEL

CA20N11052L

Straight edge (Fig 14): Straight edge made of steel or wood with perfectly straight parallel edges, although some times has only one straight edge.

Fig 14



STRAIGHT EDGE

CAN11052M

Uses: For testing the straightness of surface and edges.

Its length is 1500mm to 2000mm breadth 50mm to 70mm and thickness 20mm.

'T' bevel or bevel square

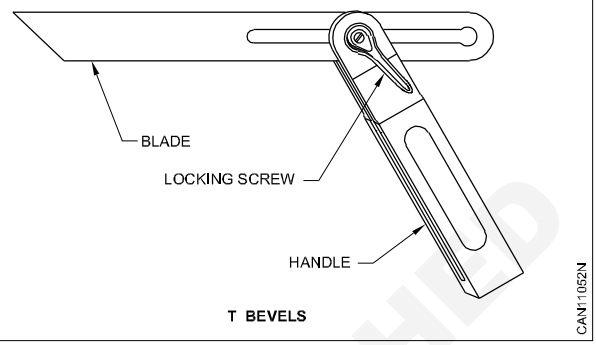
The T- bevel is used to test and transfer angles other than right angles. The bevel is called sliding bevel because it has an adjustable sliding blade. The blade may be locked by a wing nut or set screw.

The required angle is set from a straight edge and the degrees are measured against a protractor.

Uses

The sliding bevel is used for laying out dovetails, side rails for chairs, chamfers, bevels and for transferring angles from the drawing to the work piece. The Parts of the bevel square. (Fig 15)

Fig 15



T BEVELS

CAN11052N

Handle: Handle is made of hard wood, cast iron and aluminum. The top edge is half rounded and there is a slot to fix the bevel square.

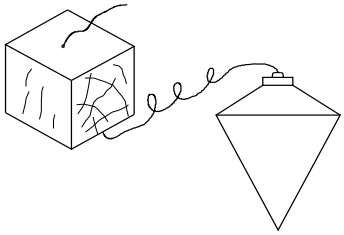
Blade: One edge of the blade is half rounded and their other edge is cut at 45°. There is a longitudinal slot. The handle is fitted with the wing nut in the slot or with a machine screw. The slotted blade passes through a slot in the stock.

On loosening the wing nut the blade can be shifted to any angle. And also the blade can be extended for further length if necessary.

Locking nut: This may be a wing nut or a set screw used for loosening or tightening the blade.

Plumb bob (Fig 16): This tool consists of a solid brass or metal cylinder with a pointed end which is attached to a suspending line so that its tip always pointing vertically down. Its upper part is small wooden block with a hole drilled in its centre so that the line with the cylinder on it can be pulled up on lowered down through the hole.

Fig 16



CAN11052P

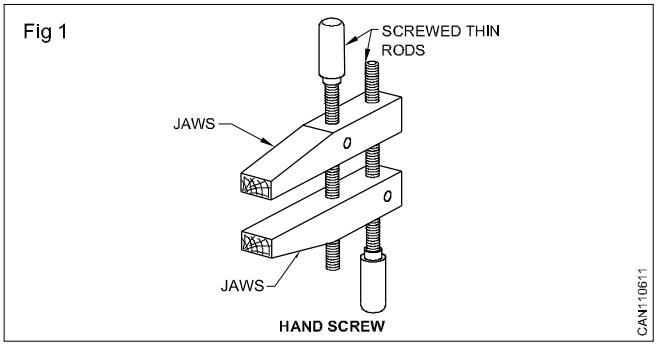
The diameter of the wooden block is slightly greater than the diameter of cylinder so that the cylinder can move freely up and down without touching the work piece.

The main use of the plumb bob is a more accurate replacement for the vertical spirit level and also to transfer points down vertically in marking.

Work holding devices

Objectives: At the end of this lesson you shall be able to
- **explain the uses of Hand screw**
- **state the uses of Bar clamp or 'C' clamp**
- **brief the uses of bench hold fast and the cleat.**

Hand screw (Fig 1)

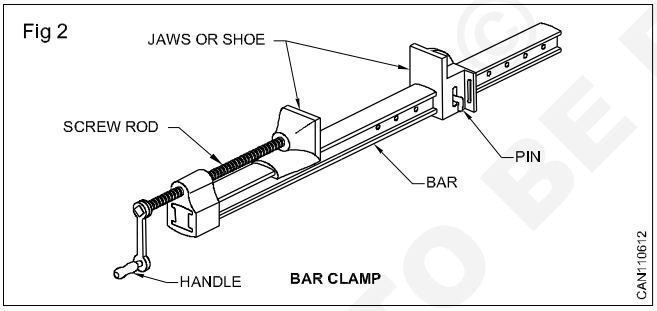


The hand screw is a clamp consisting of a pair of jaws. This is made of either in steel or wood.

It has two jaws one in left and the other in right side. Both the jaws are connected by two screwed thin rods, as shown in figure. Both the screws are to be screwed equally when clamping the job.

This is useful for small jobs and in gluing works.

Bar clamp (Fig 2)



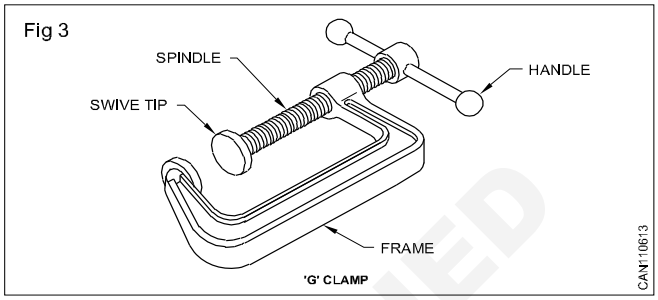
Steel bar clamps are used generally in pairs for gluing purposes. The bar may be of rectangular or 'T' shape.

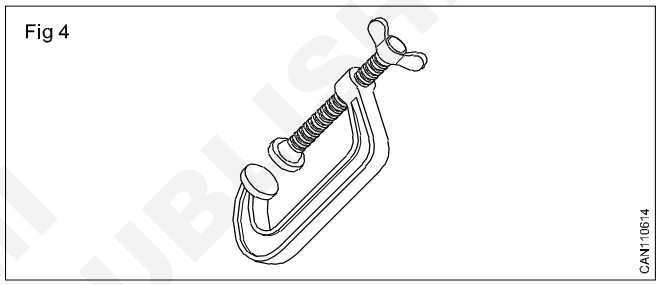
T-bar clamps are heavier. Extra pressure can be applied to the job by this device. It has two sliding shoes. One shoe is attached to the screw rod and the other is pinned where it is necessary. The screw rod has a strong square thread. These are used for clamping up wide works and large frames.

T-clamps are available in clamping capacity of 160mm to 2500mm.

'G' or 'C' clamp (Fig 3 & 4)

These are frequently used for smaller jobs and where the two hands are employed clamps have 'H' section iron and resists any tendency to distortion. The screw has a strong square thread and a round shoe on a ball which is socked joint in addition to the above there are several other clamps such as Corner clamp, Rope clamp, Flexible band clamps,

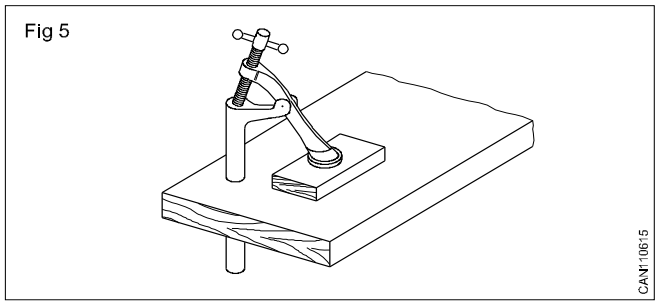




Wooden gluing device etc.

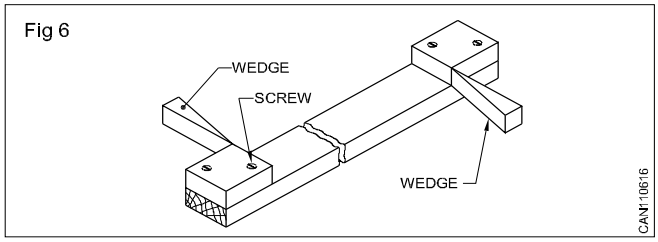
Bench hold fast (Fig 5)

In wooden planks to make holes the planks are help tightly with out moving by this equipment. The stem is made of cast iron, screw rod, handle, hand one made of steel. This may be fixed in holes of the work table and planks can be tightened.



The cleat (Fig 6)

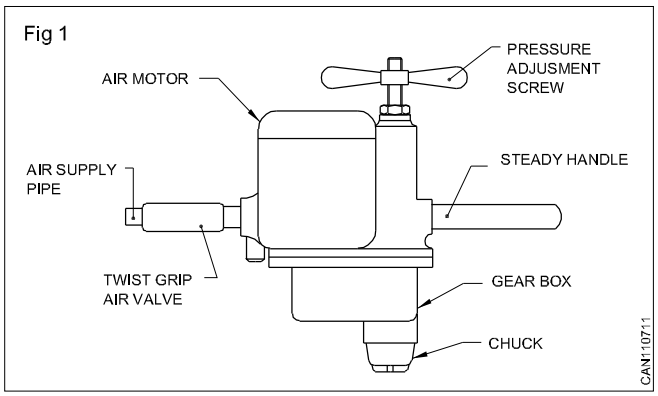
This is made of hard wood. This is 50mm longer than the plank to be tightened. Along with this two wooden pieces are screwed on both the ends. The wood to be placed and tightened is kept in between the wooden pieces and the wedges are tightly inserted. The plank to be lightened is now tightly held.



Hand operated portable tools

Objectives: At the end of this lesson you shall be able to
- **state the function and uses of pneumatic hand drill**
- **explain the function and uses of hand operated drilling machines.**

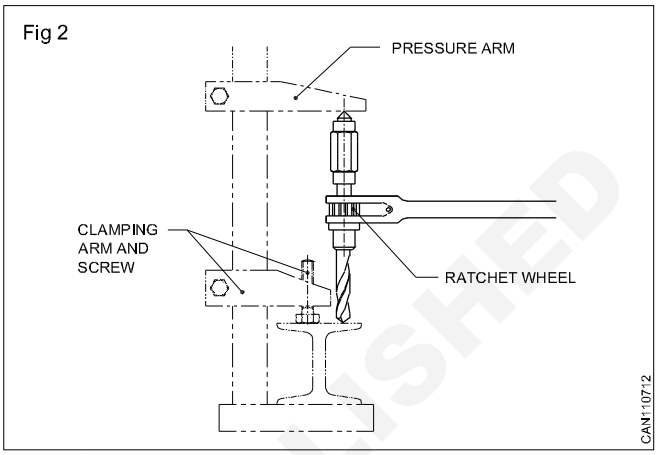
Pneumatic hand drill (Fig 1)



This type of drill is operated by compressed air. An air driven motor is housed in the casing and a handle is fitted along with an air pipe to operate the drill conveniently.

This drill is used where electrically operated drills are prohibited i.e. explosives factories, petroleum refineries etc.

Hand operated drilling machines (Fig 2)



Different types of hand operated drilling machines are used in structural fabrication, sheet metal and carpentry, particularly where electricity or pneumatic supply is not available.

The ratchet drilling machine is commonly used in structural fabrication. Square head, taper shank drills are used on these machines.

Type of bench vice and their uses

Objectives: At the end of this lesson you shall be able to
- **state the constructional features various types of bench vices**
- **explain the uses quick release vice and saw vice**
- **brief the uses of bench vice.**

Wood must be held steadily. If it is to be accurately sawn, chiselled and planed.

– For this reason carpenter's work bench consist different types of vice.

– Most commonly fitted bench vice consist of two metal Jaws to hold the work

– One Jaw of the vice is fixed to the work bench

– The other Jaw is movable parallel to the fixed jaw

– To operate this there is a threaded shaft and a handle.

– Two wooden blocks are used inside the Jaws to protect the work from damage

There are three types of vice

1 Quick release vice (or) wood worker's vice.

2 Saw vice

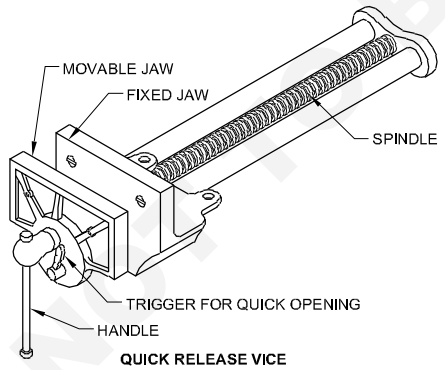
2 Bench vice

Quick release vice

– In the quick release vice moveable jaw is quickly released and get clamped with fixed Jaw.

– A box nut is provided in its threaded shafts for the quick release system (Fig 1).

Fig 1



– The jaw is made of cast iron.

– The threaded shaft is made of steel.

– The vice is specified by the width of the Jaw.

Precautions

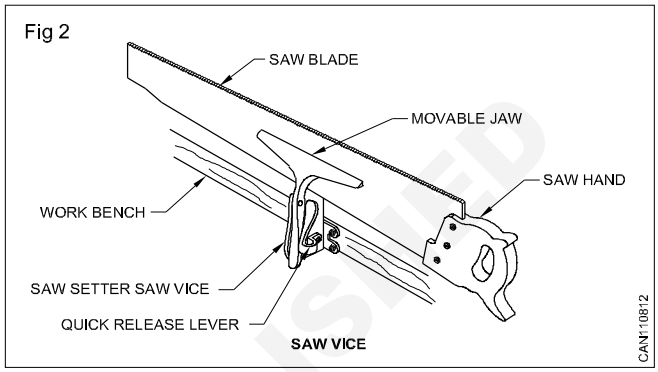
1 Vices should not be used as ANVIL.

2 The thread shaft and box nut should lubricated.

3 The handles should not be hammered to tighten the jaw.

Saw vice (Fig 2)

Fig 2



– It is made of wood or steel the Jaws are long enough to hold the saws while sharpening as teeth.

– The Jaws are hinged so as to make ways to close and open the Jaw.

– It is not useful for any other kind of works.

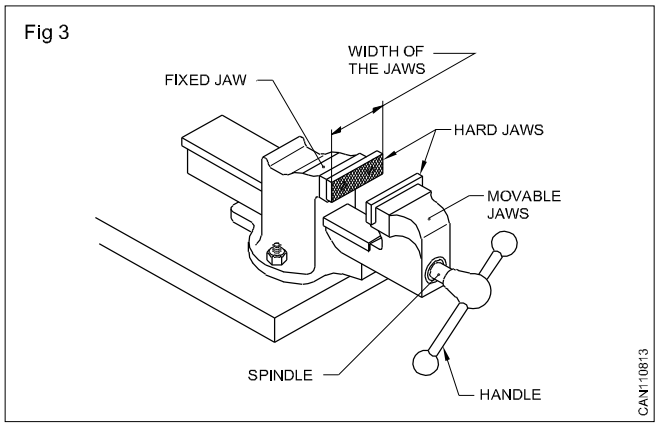
Purpose of Saw vice

– The sharpening of saw teeth the shaping of saw teeth and setting of teeth are done with the aid of this vice

– The Jaws of the saw clamp , should grip the saw 2-3 mm below gullet teeth.

Bench vice (Fig 3)

Fig 3



Vice are used for holding workpieces. They are available in different types. The vice used for bench work is the bench vice or called Engineer's vice.

A bench vice is made of cast iron or cast steel and it is used to hold work for filing, sawing, threading and other hand operations.

The size of the vice is stated by the width of the jaws.eg. 150mm parallel jaw bench vice.

Introduction of different saws and their uses

Objectives: At the end of this lesson you shall be able to
- **state the various types of saws**
- **brief the specific uses of straight cutting saws.**

There are several types of saws for cutting wood. some are used to make straight cuts and others are used make curved cuts. As its name suggests, a cross cut saw is used cut wood perpendicular or at an angle to the wood grain.

Types of Saw

1 Straight cutting saws

2 Curve cutting saws (or) special saws.

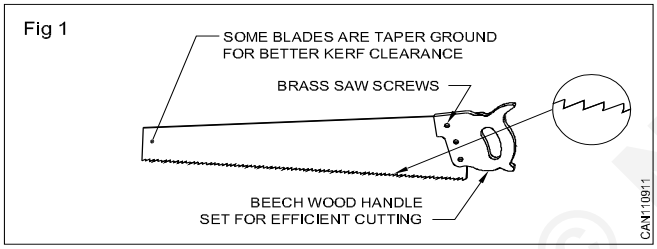
Straight cutting saws

1 Rip saw 2 Cross cut saw

3 Hand saw 4 Panel saw

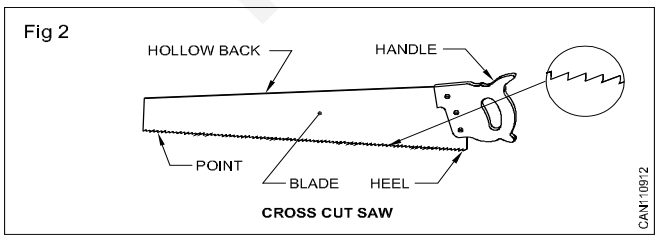
5 Tenon saw 6 Dove tail saw

Rip Saw (Fig 1)



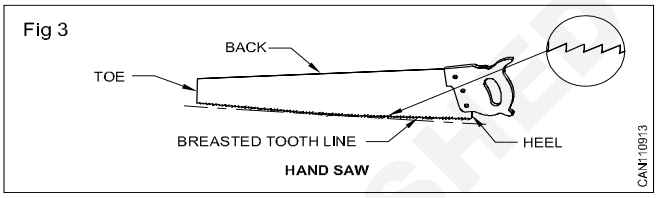
– Blade is made of thin spring steel.
– Used for sawing along the grain
– Blade is fixed to the wooden handle by riveting or screwing
– Teeth of rip saw vary in size as per the need of the fitness of work to be done
– Handle is made of beech (or) apple wood
– It has two teeth per centimetre length
– length of the blade is 60 to 70cm
– Specified by its length
– Teeth angle is less than 90^0
– It has 3 to 6 teeth per 25mm.

Cross cut saw (Fig 2)



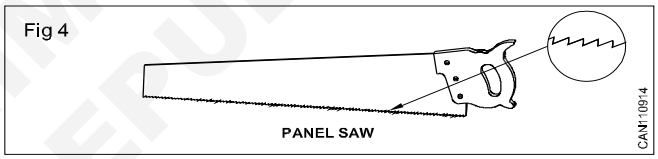
– Used for cutting across the grains of timber
– Length of blade is 56 to 70cm
– It has 5 to 9 teeth per 25mm
– Teeth cutting angle 90^0.
– Teeth has different shape to that of rip saw
– Finer pitch blade is preferred for hard wood. Blade with course pitch is used for soft wood.

Hand Saw (Fig 3)



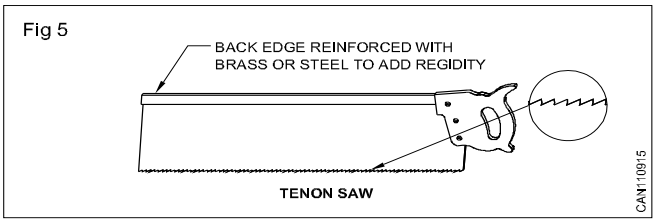
– Length of the blade is less in hand saw than in the rip saw.
– Which is used for lighter work.

Panel Saw (Fig 4)



It is the most commonly used saw
– It is available in many sizes
– It has 10 to 12 teeth per 25mm
– length is 50cms
– Specifically used for cutting panels for door shutters.

Tenon Saw (Fig 5)



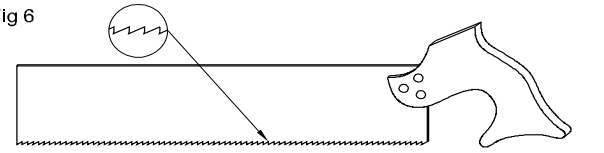
– It is rectangular in shape
– Length is 25 to 40cm long
– It has 12 to 14 teeth per 25mm.
– It is used for finer works like tenon
– Main use is making short and straight cuts
– A reinforcing strip on back is provided at the top to avoid bending of blade.
– Closed handle.

Dove tail saw (Fig 6)

– By appearance is like tenon saw
– Its blade is thinner and narrower

– Its wooden handle is open and free to move to full length of blade
– It is used for finer work
– Specifically used for cutting tongues for dove tail joints
– Length of blades is 20 to 30cm and carries 6 points/cm.

Fig 6



DOVETAIL SAW

CAN:10916

Types of special saw and its uses

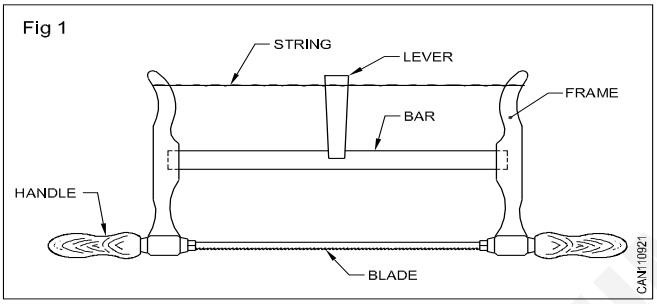
Objectives : At the end of this lesson you shall be able to
- **state the various type of special saws**
- **explain the specific uses of special saws.**

Curve cutting Saw (or) special saws.

1 Bow saw 2 Coping saw
3 Fret saw 4 Compass saw
5 Nest saw 6 Key hole saw

Bow saw (Fig 1)

Fig 1

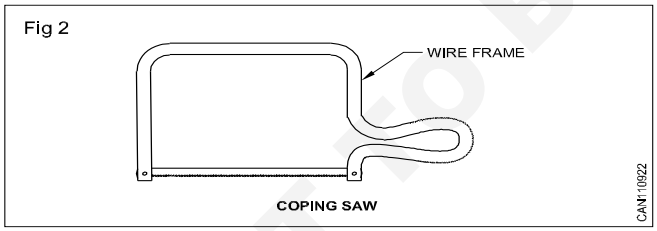


CAN:10921

– It consists of frame made of wood, carrying, connecting bar a string ,lever and two handles on both sides
– Used to cut thin curves and profiles having quick bends
– Length of blades 20 to 30 cm and carries 6 points /cm.

Coping saw (Fig 2)

Fig 2



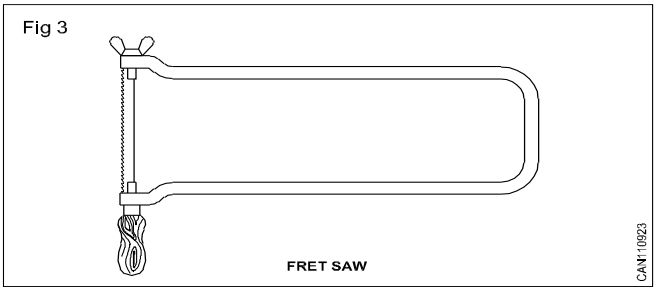
COPING SAW

CAN:10922

– Has very fine blade held in stiff wire frame
– Used for cutting sharp and quick curves internal and externally
– Length of blade is 25cm.

Fret saw (Fig 3)

Fig 3



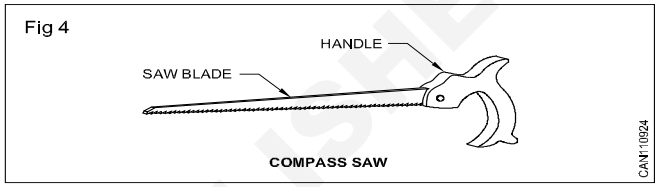
FRET SAW

CAN:10923

– Has very fine blade 150mm to 180mm long help in a steel frame of 300mm to 500mm.
– Used for cutting thin woods.

Compass saw (Fig 4)

Fig 4



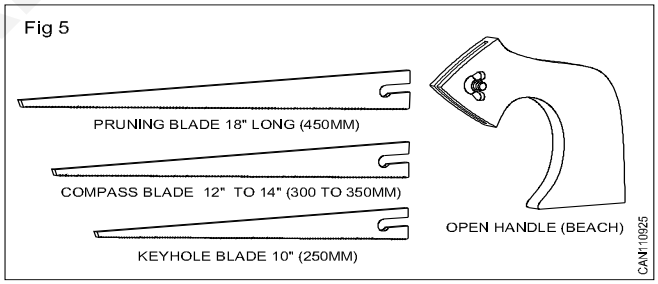
COMPASS SAW

CAN:10924

– Has a narrow tapering blade 300mm to 450mm fitted in a handle..
– Used for cutting large interior curves
– It is necessary to bore a hole in the job to start the saw
– 8 to 12 teeth per 2.5cm length.

Nest of saw (Fig 5)

Fig 5



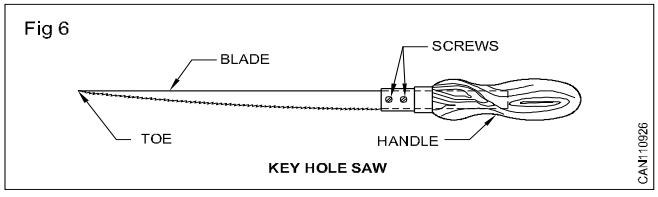
CAN:10925

– It consists of three blades with detachable handles
– The blades are pruning blade, compass blade and key way hole blade, which are used cutting curve
– Length of blade is 25 to 40cm.

Key hole saw(Fig 6)

– It has 20 to 30cm long blade
– It is 6mm wide near handle and 3mm wide at the toe
– Used for intricate and internal works
– Length of blade is 25 to 35cm.

Fig 6



KEY HOLE SAW

CAN:10926

Introduction portable power circular saw machine and its uses

Objectives: At the end of this lesson you shall be able to
- **state the construction of the portable circular saw machine and jig saw machine**
- **explain the uses of portable circular saw machine and jig saw machine**
- **state the parts of portable circular saw machine.**

Introduction

In wood working industries portable electric machines play a vital role in manufacturing of wooden furniture, by craftsmen.

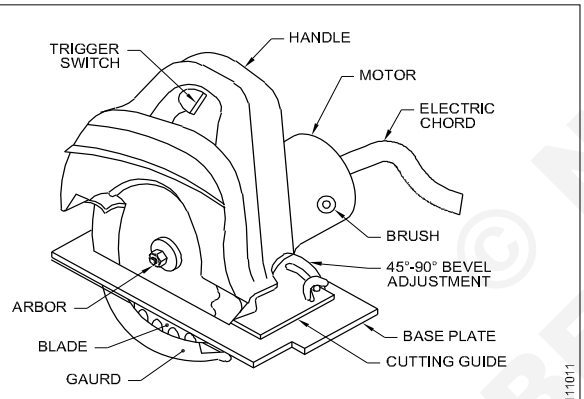
These tools have relieved the craftsmen, much of the laborious works.

Wood working industries demands greater productivity incurring the lowest possible cost, and labour charges.

This demands full use of new technique and mechanical aid, and power tools by all trades in this fast developing modern world.

Portable electric circular hand saw (Fig 1)

Fig 1



PARTS OF THE PORTABLE ELECTRIC CIRCULAR SAW

It is used extensively in building construction works on the site and in wood working workshops.

This power tool has been improved with the development of a built in blade brake.

It is also useful for cutting, grooves and rebates.

The various adjustments on the portable electric circular saw makes possible several different blade positions. It is possible for example, to change the depth of cuts and also to make different bevel cuts, cross cutting and ripping.

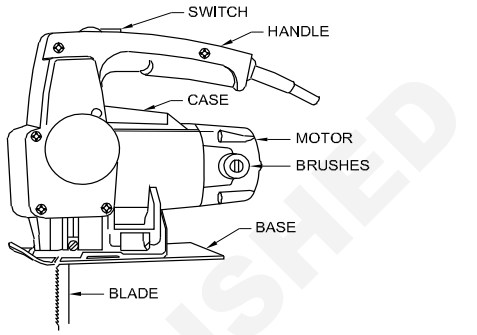
Cross cutting and ripping are done very much the same way; however ripping is a little more difficult especially when the saw is operated free handed.

When using the saw the work should be cramped down as the cutting action tends to cause considerable vibration This is due to the same cutting on its upward stroke which tends to pull the machine into the wood.

Hard wood upto 50 mm thick can be cut. Block boards, plywood sheets or wall boards, can all be cut with special blades, at high speeds.

Portable electric jig saw (Fig 2)

Fig 2



PARTS OF JIG SAW MACHINE

The portable jig saw is a very competent machine tool for cutting wood, composition board, veneer, plastics card boards and leather.

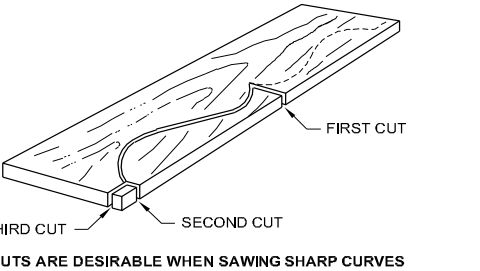
This broad range of possibilities are it is ideal portable electric saw for use in cabinet making shops, furniture factories. It is a safe tool for every one use and run an inexperienced trainees can obtain excellent result with only a few minutes of practice.

The main parts are, motor, switch, handle, backplate and blade. While operating, the handle of the saw held firmly on both the hands and the face plate kept firmly on the job

The switch is put on in advance. A stroke is a straight up and down motion of the saw blade.

The blade cuts only on up stroke backing away on the return stroke should pass along the marked line.(Fig 3)

Fig 3



RELIEF CUTS ARE DESIRABLE WHEN SAWING SHARP CURVES

In a round cut a hole should be drilled larger than the blade in waste portion of the job to facilitate initial entry of the blade into the job.

It is designed to operate on normal 110 or 220 volts.

The cutting speed is approximately 4200 strokes per minute (spm). A stroke is a straight up-and-down motion of the saw blade.

Saw sharpening and re-sharpening tools

Objectives: At the end of this lesson you shall be able to
- **describe the steps involved in 'sharpening and setting' of the saw teeth**
- **state the sharpening tools.**

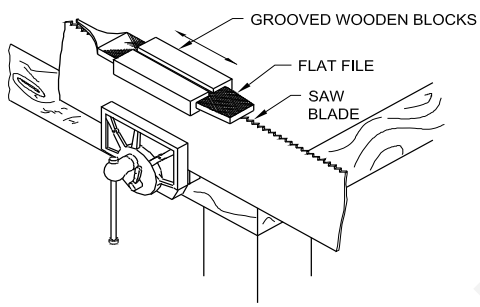
To perform the sawing operations with ease and accuracy the saw must be in good condition with its teeth sharpened and well set.

Sharpening of a saw involves 4 steps which are as follows.

Topping

This is done to bring down the points of all the teeth to the same level. A flat file is held in a wooden block and rubbed over the teeth until the lowest tooth touches the file face. (Fig 1)

Fig 1

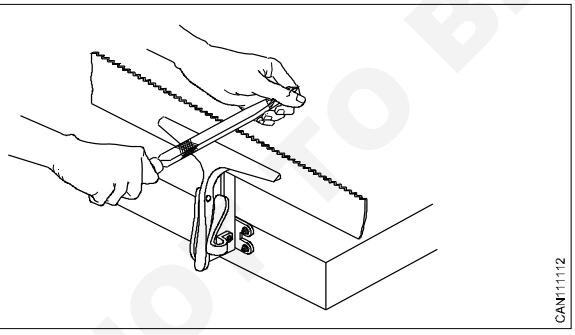


TOPPING A SAW

Reshaping

It is necessary to restore the tips of the teeth. Therefore the gullet of each tooth is filed down using a suitable size triangular file. Care is taken to maintain a uniform depth of gullets, pitch and angles of teeth. (Fig 2)

Fig 2



Setting

Setting is a process of bending every alternate tooth to the opposite direction. This is carried out by using a saw - set pliers. (Fig 3)

Sharpening

This is the final step in which the gullet of each tooth of the saw is filed to produce a keen cutting edge, using a suitable size of a triangular file. (Fig 4)

Topping is necessary only when the saw teeth have become uneven in their height, and re-sharpening follows it.

Fig 3

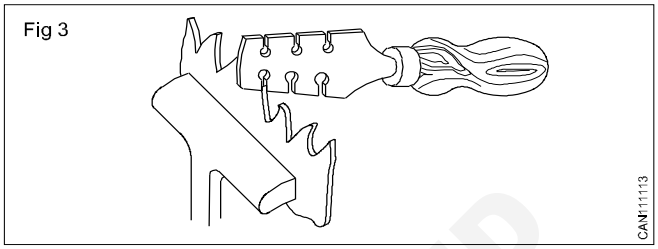
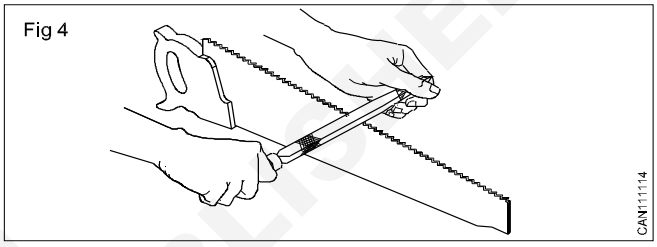


Fig 4

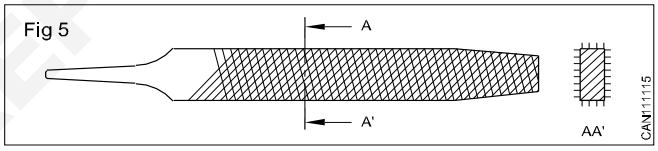


Sharpening tools

Flat file (Fig 5)

Flat file is used for over the topes of saw teeth level

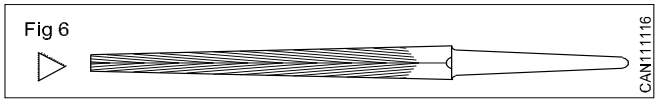
Fig 5



Slim taper triangular saw file (Fig 6)

File is used for all saw teeth to their correct shape and size.

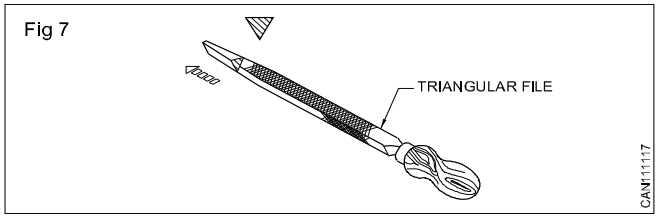
Fig 6



Triangular saw file (Fig 7)

File is used for sharp the teeth of the saw at 30° to 45°

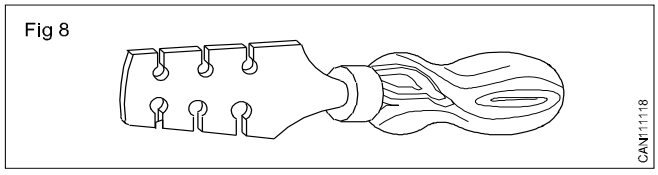
Fig 7



Saw set (Fig 8)

Saw set used for bending over the teeth alternately to one side and then to the other.

Fig 8



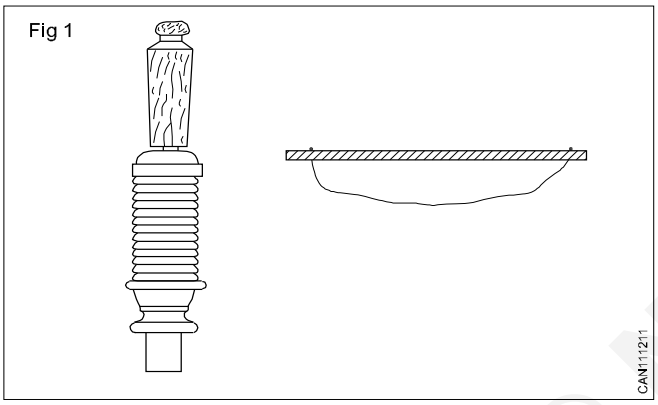
Boring tools

Objectives: At the end of this lesson you shall be able to
- **state types of boring tools**
- **explain the uses of boring tools**
- **identify the parts of boring tools**
- **state the functions of boring tools.**

Boring tools

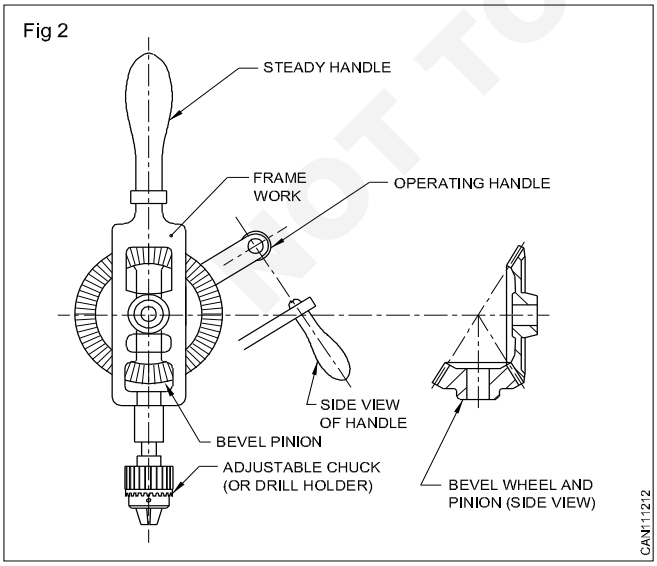
Wooden dowel (or) pegs, nails, screws and bolts are fitted or fastened into wood/wooden products by using various types of boring tools. Round holes are drilled in woods by simple methods and also fastly with the help of boring tools.

Country drill (Fig 1)



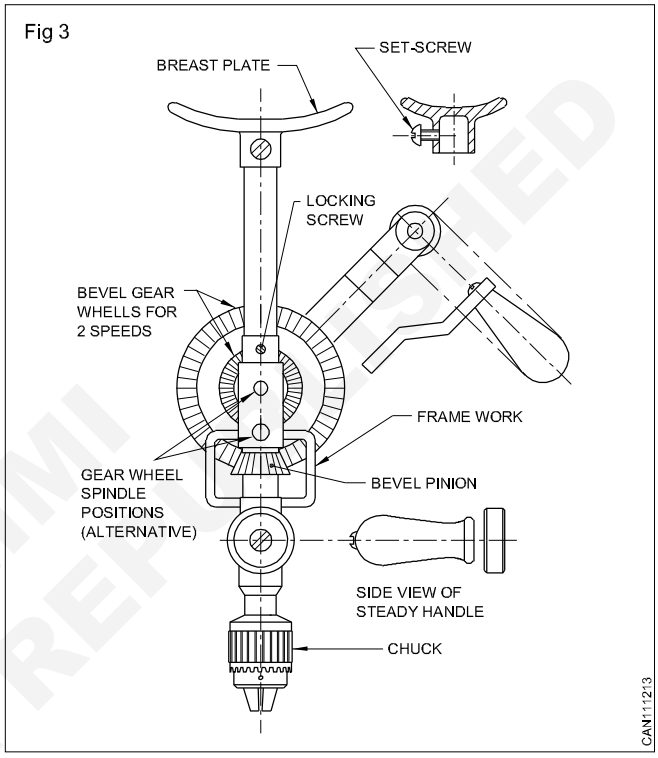
This is made out of wood. Its length ranges from 100mm to 250mm wooden stick having length of 60cm and 90cm length of thread are necessary to rotate this drill. The thread is wringed around the wooden stick like a spring and used for rotation. Drill bits having range of diameters from 3mm to 12mm are fit into drills for drilling.

Hand drill machine (Fig 2)



The bevel gear type drilling machine is used for drilling small diameter holes up to 6mm.

Breast drilling machine (Fig 3)



The breast drilling machine (Fig 3) is used for drilling holes of larger diameter as more pressure can be exerted. Drills between 6mm to12mm can be used on these machines.

The brace

Circular holes are drilled or bored in wood by means of drill. To penetrate into the wooden place it is necessary to use the drill to cut a hole.

Plain brace

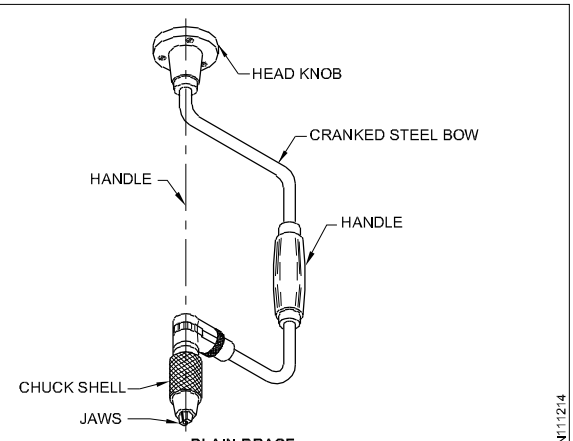
The brace is a cranked tool for holding a bit while boring a hole. The brace is used to give a rotating movement. The head, knob and the handle can rotate freely. (Fig 4)

The chuck consists of a metal screwed chuck shell in which the jaws enclosed. When the shell is loosened the jaws will be open to receive the bit.

The ratchet brace (Fig 5)

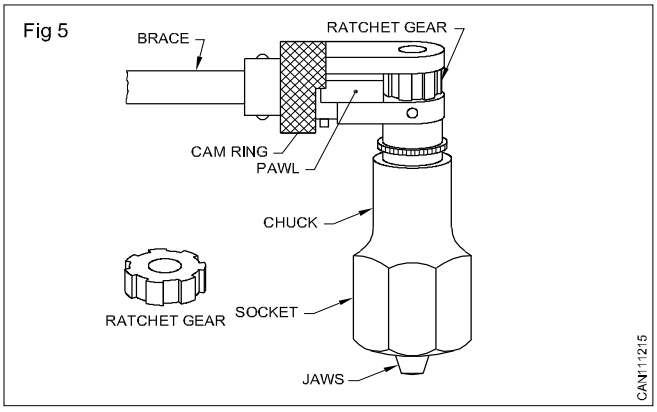
The ratchet brace is provided with a ratchet mechanism. The ratchet permits the brace to be rotated to and fro while the chuck rotates in only one direction. The cam ring can be set in positions for clock-wise and anti-clockwise rotation.

Fig 4



PLAIN BRACE

Fig 5



The brace drill has a tapered tang for use in chuck of the brace. The drill has a single cutting edge. Because of this the drill must not be used where accuracy is required.

Drill bits, types, sizes and uses

Objectives: At the end of this lesson you shall be able to
- **list the types of drill bits**
- **state the uses of drill bits**
- **state the sizes of drill bits.**

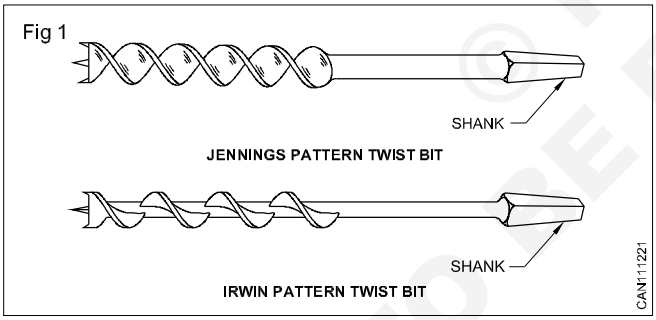
– Bits having been designed for boring holes under special conditions.

– There are many varieties of bits available for different uses.

– Made of high carbon steel or high speed steel.

Twist bit (Fig 1)

Fig 1



– Some times called an auger bit.

– This bit has both twisted point and a twisted shank.

– The twisted point draws the bit into the wood.

– Two varieties are made just one for hardwood (without spurs or scriber).

– Second one for soft wood with spur.

– For boring deep holes in hardwood or soft wood.

– Particularly useful when boring in end grain,

The long twisted shank will keep the hole straight and throw out the waste.

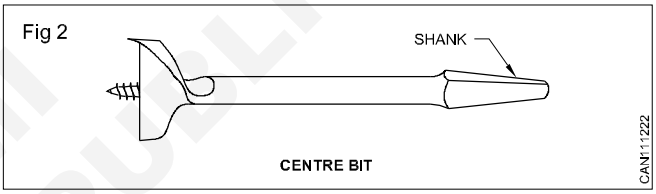
Size ϕ 6mm to ϕ 45 mm.

Centre bit (Fig 2)

This bit differs from other bits as regards to shape.

Its cutting action is similar to the twist bit.

Fig 2



CENTRE BIT

– The centre point guides the bit

– The cutting points some times threaded.

– Spur or scriber (slightly shorter than the point) cuts the rim of the hole.

– Router or cutter (Slightly shorter than the point) cut the waste portions.

– These bits are suitable for boring shallow holes or holes through thin timber only.

– There is no guiding shank to keep the boring straight

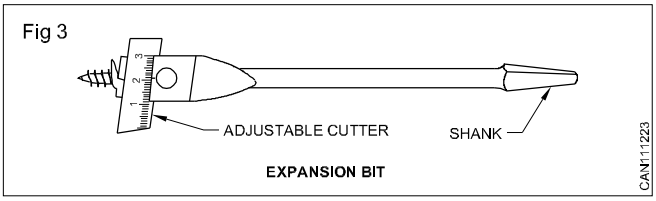
– Size 6mm to 50mm

upto 25 mm = 16 Nos

25 mm to 50mm = 8 Nos.

Expansion bit (Fig 3)

Fig 3



EXPANSION BIT

– This bit is able adjust to cut holes from 12 mm to 75 mm

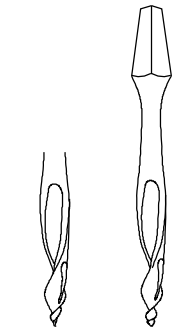
– Its cutting action is similar to the centre bit.

– For boring shallow holes through thin wood.

Cobra bit (Fig 4)

– Has a twisted point which draws the bit into the wood.

Fig 4



NAIL BIT / SCREW BIT / COBRA BIT

CAN111224

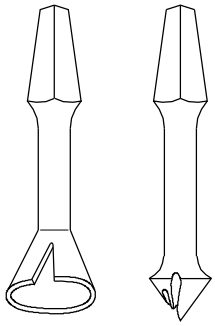
– Care must be taken not to split the timber while boring near the end.

– For boring small holes for nails and screws.

– Size 2 mm to 10 mm.

Dowel bit (Fig 5)

Fig 5



DOWEL ROUNDER OR SHARPENER

CAN111225

– Similar to the twist bit.

– It is shorter than twist bit.

– For boring holes for dowels and preliminary boring out waste of mortises.

– Size 6mm to 15 mm.

Counter sink bit (Fig 6)

Fig 6

COUNTER SINK BIT OR ROSE BIT

CAN111226

– These bits have tapered cutting point which enlarge the tops of holes.

– This process is called counter sinking

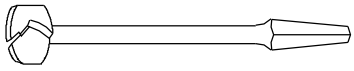
– For counter sinking the tops of holes to receive the head of counter sunk head screws.

The snail pattern is most “suitable for hard woods.

– Size 6mm to 20 mm.

Forstner bit (Fig 7)

Fig 7



FORSTNER BIT

CAN111227

– This bit differs from other bits, is guided not by a centre point but by its circular rim.

– It can be used to bore at any angle to the surface of the work regardless of the direction of the grain.

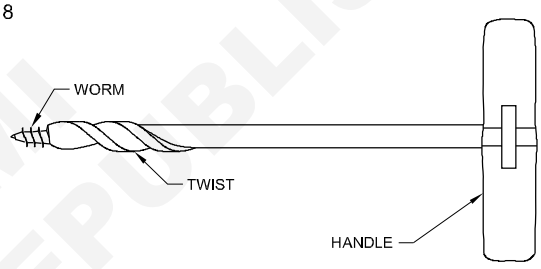
– For boring skewed holes (called pocketing) for screws (Rails of the table)

– Flat bottomed boles in pattern making and recessed carving designs.

– Size from 6mm to 40mm.

Gimlet (Fig 8)

Fig 8



GIM LET

CAN111228

– Similar to a nail bit

– Has a twisted point which draws the bit into the wood

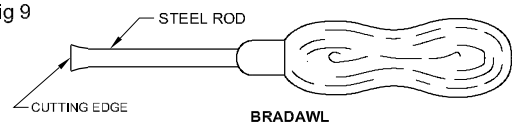
– Has a small cross handle for hand boring

– For boring small holes for screws and nails where the brace cannot be used.

– The gimlet must be used with care, it will split the timber.

Bradawl (Fig 9)

Fig 9



BRADAWL

CAN111229

– Consist of a thin steel rod which is flattened to a small cutting edge at one end.

– The tang fitted into a box wood handle at the other end.

– The flat cutting edge is placed across the grain and forced into the timber while being twisted back and forth. so that the fibres are cut this making a small hole.

– For making small holes where the brace and bit is not necessary.

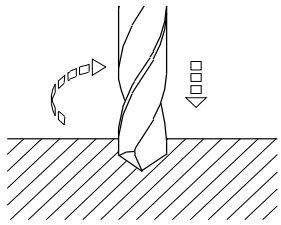
Size 3 mm to 12 mm.

Drill (Parts and Functions)

Objectives: At the end of this lesson you shall be able to
- **state the functions of drills**
- **identify the parts of a drill**
- **explain the functions of each part of a drill.**

Drilling is a process of making holes on work pieces. The tool used is a drill. For drilling, the drill is rotated with a downward pressure causing the tool to penetrate into the material. (Fig 1)

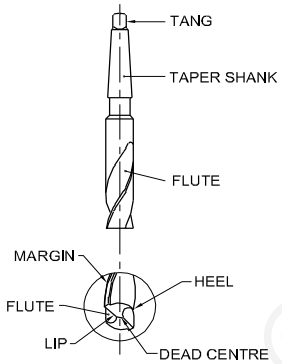
Fig 1



Parts of a Drill (Fig 2)

The various parts of a drill can be identified from figure 2.

Fig 2



Point

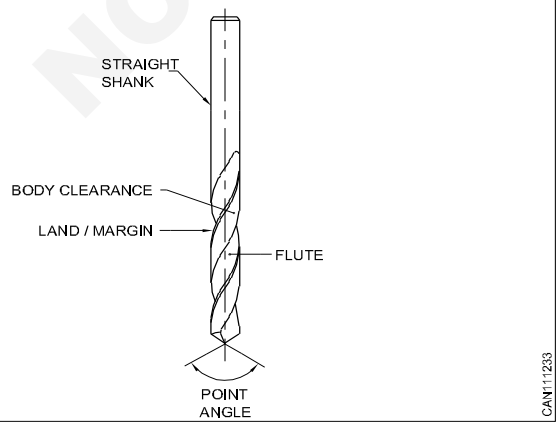
The cone shaped end which does the cutting is called the point. It consists of a dead centre, lips or cutting edges, and a heel.

Shank

This is the driving end of the drill which is fitted on to the machine. Shanks are of two types.

Taper shank, used for larger diameter drills (Fig 2) and straight shank, used for smaller diameter drills. (Fig 3)

Fig 3



Tang

This is a part of the taper shank drill which fits into the slot of the drilling machine spindle.

Body

The portion between the point and the shank is called the body of a drill.

The parts of the body are flute, land/margin, body clearance and web.

Flutes (Fig 4)

Flutes are the spiral grooves which run to the length of the drill.

The flutes help

– to form the cutting edges

– to curl the chips and allow these to come out

– the coolant to flow to the cutting edge.

Land/Margin (Fig 4)

The land/margin is the narrow strip which extends to the entire length of the flutes.

The diameter of the drill is measured across the land/ margin.

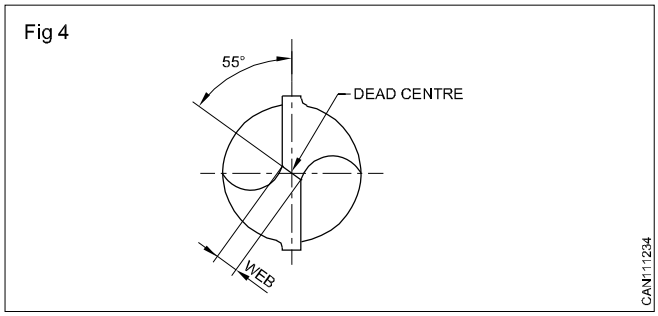
Body Clearance (Fig 4)

Body clearance is the part of the body which is reduced in diameter to cut down the friction between the drill and the hole being drilled.

Web (Fig 4)

Web is the metal column which separates the flutes. It gradually increases in thickness towards the shank.

Fig 4



Portable electrical drilling machine

Objectives: At the end of this lesson you shall be able to
- **identify the different types of portable drilling machines**
- **state the distinctive features of portable drilling machines.**

Description

The portable electric drill is usually the first power tool selected for the home workshop. It may be used "free-hand" for drilling or fixed in a drill stand for accurate vertical drilling, or it may be used as a power source for small bench machines.

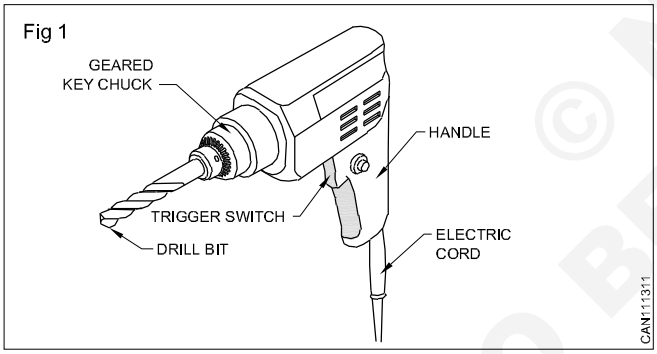
Types of power drills

Drills may be divided into two groups. The difference between them depends on the efficiency of their motors to convert electrical power input into mechanical power output while maintaining sufficient speed and torque (starting and operating) to work correctly under load without over-heating.

Generally the larger the drill, the higher the output which means it can cope with lighter jobs continuously for longer periods and it should drive attachments more effectively.

Electric hand drill (Light duty) (Fig 1)

Fig 1



These are available in different forms. The electric hand drill has a small electrical motor for driving the drill. On the end of the spindle, a drill chuck is mounted. Electric hand drills used for light duty will have, usually, a single speed.

Electric hand drill (Heavy duty) (Figs 2 and 3)

Fig 2

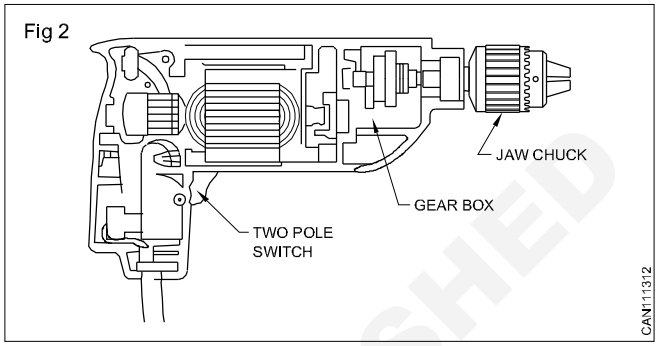
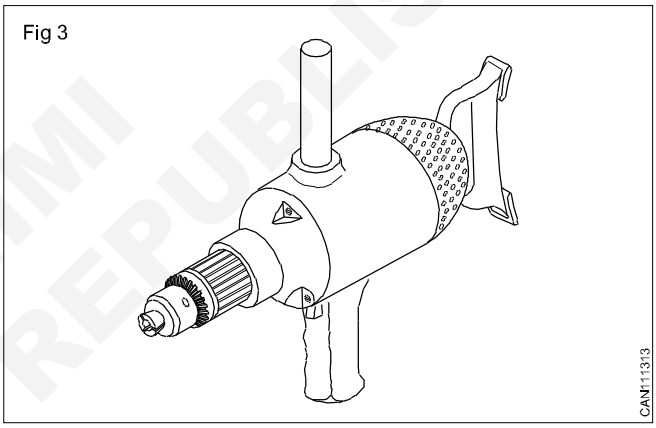


Fig 3



This drill has an additional feature by which the drill speed can be varied through a system of gears. This is particularly useful for drilling larger diameter holes.

Precaution

- Switch - off and remove plug from power
- Switch - off to make adjustments
- Use 3 core flexible leads and three-pin plugs
- Don't use cracked or faulty plugs.

Hand auger

Objectives: At the end of this lesson you shall be able to
- **explain the constructional features of hand auger**
- **list the application of hand auger**
- **state the size of hand auger.**

Description

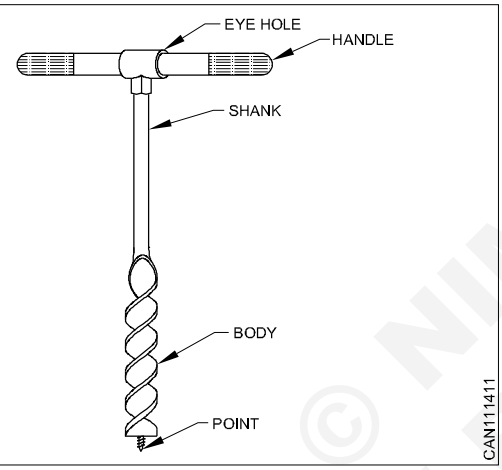
– A hand auger with a twisted shank and threaded point is similar to a twist bit with a long shank and used for boring large, deep holes for bolts etc in hard wood.

– It is available is size ø 6mm to 25mm.

Parts of a hand auger

The various parts of a auger can be identified from Fig 1.

Fig 1



Point

The screw shaped end which does the cutting is called the point.

Shank

This is the driving head being shaped with an eye for fitting a cross bar (or) handle to given greater leverage.

Body

The portion between the screw point and the shank is called the body of a auger.

The parts of the body are twisted

The twisted helps

– To form the cutting edges.

– To curl the wood chips and allow these to come out.

Handle

- Made of hard wood.
- Fitted to eye hole
- The handle help greater leverage.

Application of auger

- Sharpen screw point at a proper angle
- Mark the drill point with centre punch.
- Hold the auger straight
- Drive the handle clock wise with slow speed and high torque operation.

Care and maintenance

- Do not damage the threaded point
- Make sure the handle is properly fitted.

Wood working planes

Objectives : At the end of this lesson you shall be able to
- **name the various types of planes**
- **state the uses of the various planes**
- **state constructional feature of various planes**
- **specify the planes.**

A plane is a hand tool used for smoothing or shaping pieces of wood.

Common types are

1 Jackplane

2 Smoothing plane

3 Trying plane

4 Toothing plane

5 Finishing plane

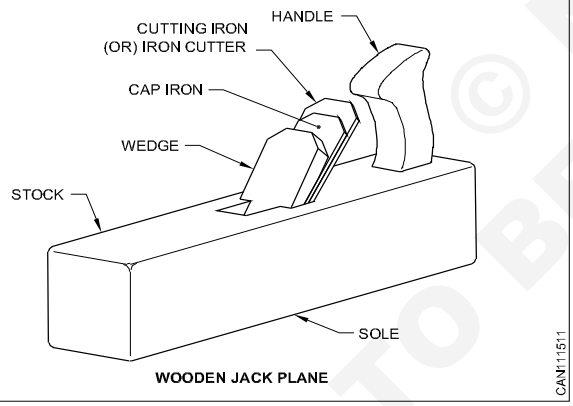
6 Router plane

7 Plough plane

8 Adjustable metal jack plane.

1 Jack plane (Fig 1)

Fig 1



WOODEN JACK PLANE

This plane is used for planing the job to size quickly and truly. Stock is made of wood or steel. Handle is fixed behind the cutting iron.

The size is 375 mm x 66mm x 47mm. The angle of cutting iron is 45° and the cutting iron is sharpened in a curve. The mouth of the plane is big enough to accommodate thicker wood shavings. The cutting iron further projects outside than in other planes.

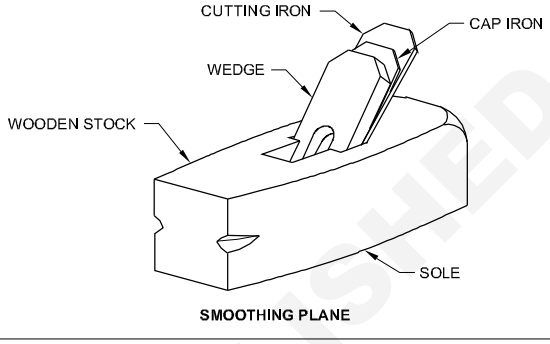
2 Smoothing plane (Fig 2): This is used when the surface has to be planed further to smoothness.

– The size is 240 x 66 x 65mm

– The width of cutting iron is 48mm

– The cutting edge is sharpened slightly oval across the iron. The angle of the cutting iron is 30°. The wooden smoothing plane has no handle.

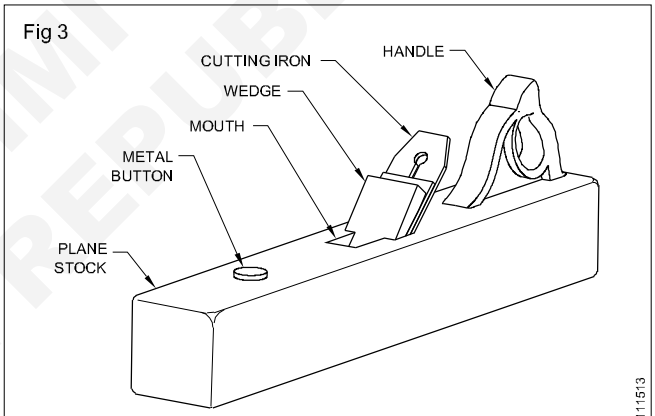
Fig 2



SMOOTHING PLANE

3 Trying plane (Fig 3)

Fig 3

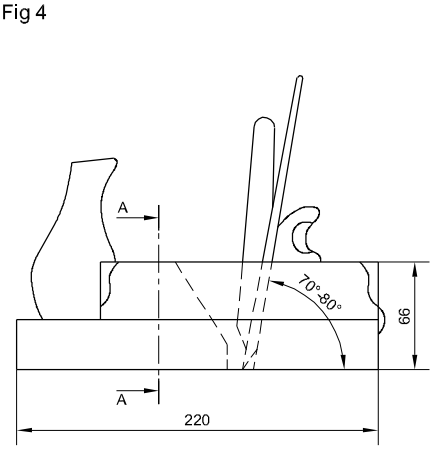


TRYING PLANE

It is larger and longer than other planes. Its length is 600 to 700mm. The blade is 46 to 56mm wide. It has double iron. This is used for producing a true and straight surface. The handle of wooden stock is usually of the closed type.

4 Toothing plane (Fig 4)

Fig 4

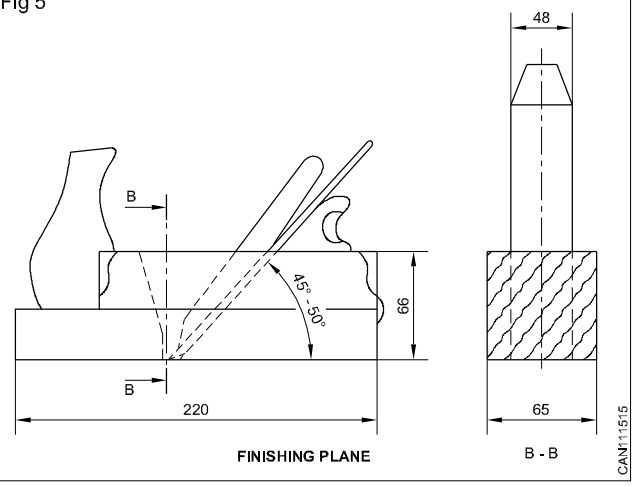


TOOTHING PLANE SECTION A - A

The purpose of this is to prepare a rough gluing surface. The cutting angle is set at 70° to 80°. The cutting edge is a series of teeth formed like 'V'. The plane is used diagonally across the work in both directions and in along the grain.

5 Furnishing plane/Finishing plane (Fig 5)

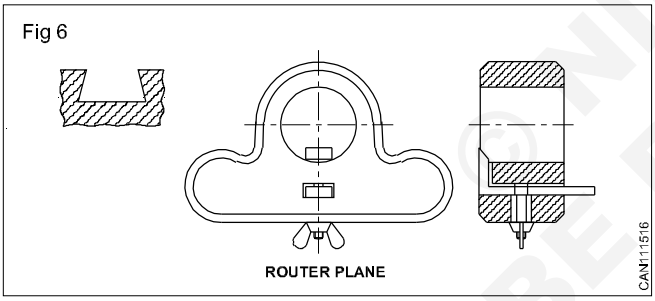
Fig 5



This is slightly smaller than smoothing plane. Its cutting angle is 45 to 50°. It prevents the tearing of wood and gives a good finish. This is also called reform-finishing planes.

6 Router planes (Fig 6)

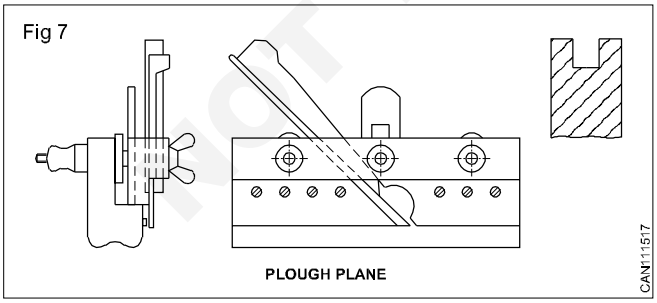
Fig 6



It is used to clean and level grooves and recesses. It is used across the grain. The cutting iron is lowered after each cut until required depth is reached.

7 Plough plane (Fig 7)

Fig 7



This is used to form grooves parallel with grain. The cutting-irons are available from 3mm to 16mm wide. It has no cap iron. The depth of groove can be adjusted by a thumb screw. A guide parallel to the plane controls the distance of the groove from the edge of the work.

8 Adjustable metal jack plane (Fig 8 & Fig 9)

Fig 8

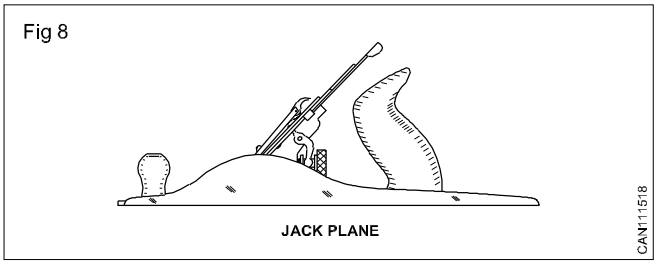
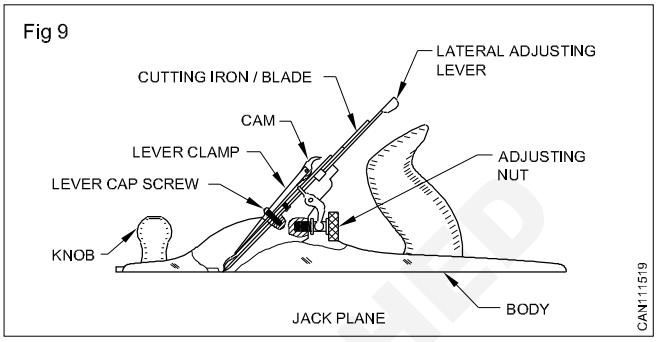


Fig 9



- This is just like wooden jack plane but the cutting iron adjustable.
- This plane is used for planing of timber to bring the size nearer to the required measurements.
- The size is body length 360mm and cutter width 50mm.

These parts are made of different materials as listed below.

Body	- Cast iron
Handle	- Rose wood
Knob	- Rose wood
Cutting iron/blade	- Tungsten steel
All other parts	- Metal

Advantages of adjustable metal bench plane

- Easier to use than wood plane owing to low position of handle.
- Simple adjustments by means of adjustment screw and lateral adjustment lever.
- Cutting iron thinner speeding up grinding and sharpening.
- Body retains shape little wear.

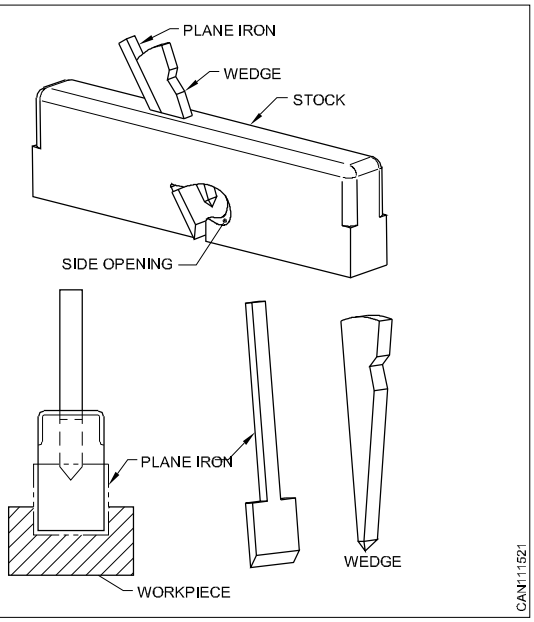
A smear oil or wax on the sole of the plane reduces friction and makes planing easier.

Special planes

Objectives : At the end of this lesson you shall be able to
- **state the purpose and use of special planes**
- **explain the use of rebate plane, compass plane and spoke shave.**

Rebate planes (Fig 1)

Fig 1



Wooden rebate planes are provided with a plane iron of which the cutting part project beyond the stock of the plane, at the left and right side of it.

The shavings pass through the shaped opening at the side of the stock. There is no cap iron. The stock and wedge are made of beech wood. The plane is 20 to 30cm height, 7 to 9cm thick and is available in several width. The plane irons are 10mm to 40mm wide at the cutting edge.

Rebate planes are used for planing and smoothing rebates.

A rebate is a step on the edge of a piece of wood.

Compass plane (Figs 2 & 3)

Fig 2

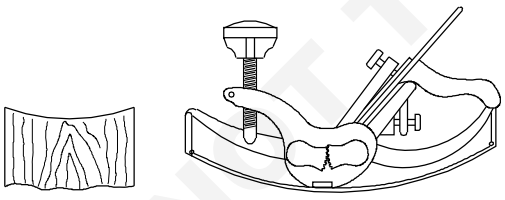
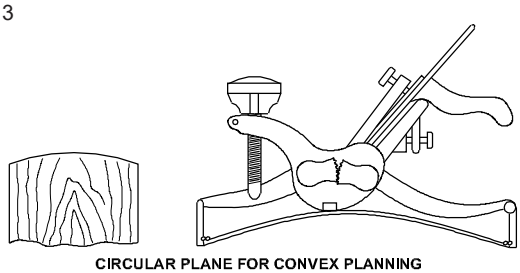


Fig 3



It is often called as circular plane. It is used for planing large curved work either concave or convex. The cutting iron, back iron, cap iron are same as those of simple steel plane but they are held in a metal device. The sole of the plane is flexible and the main adjustment to form the curve is made by raising or lowering both ends of the sole by means of a threaded knob. The cutting iron should be set while the sole is straight and the tension on the sole should be released when the plane is not in use.

Spoke shave (Figs 4 & 5)

Fig 4

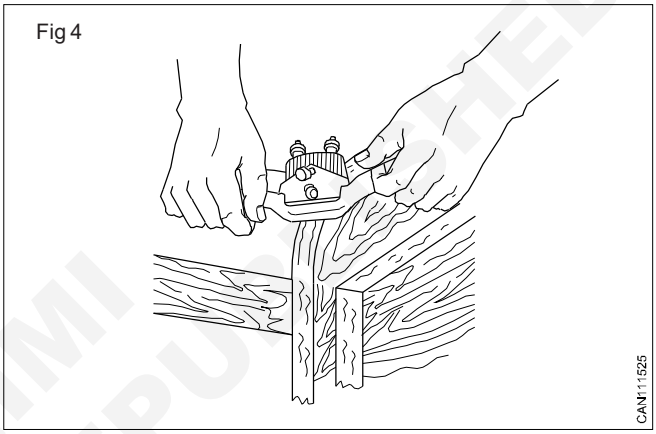
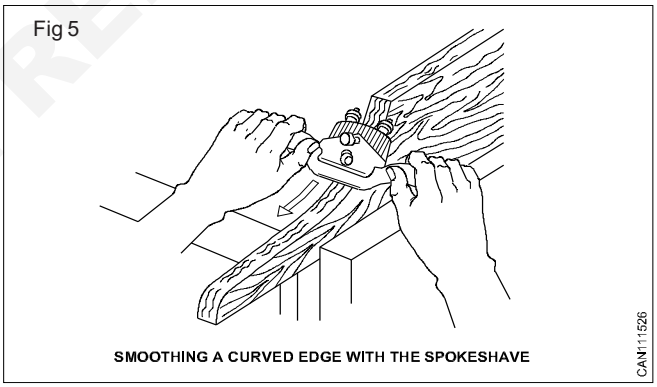


Fig 5



Spoke shaves are used for finishing curved surfaces, they have a blade and cap iron similar to the steel plane and some types are fitted with two adjusting screws for setting the blade.

Convex and hollow planes (Figs 6 & 7)

Fig 6

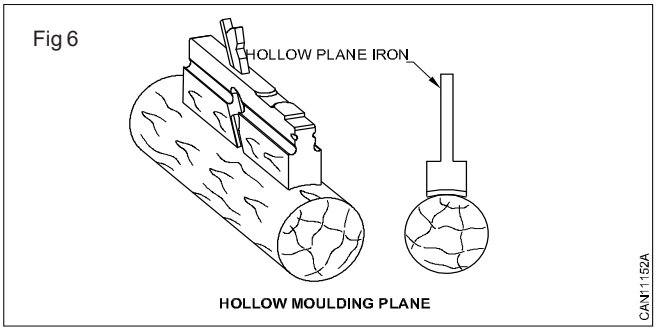
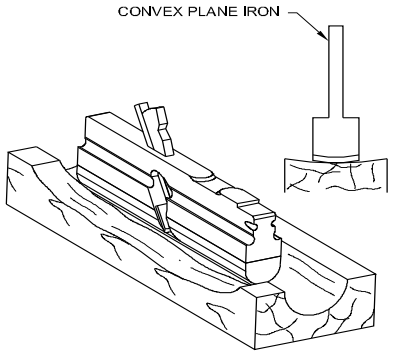


Fig 7



CONVEX MOULDING PLANE

Convex and hollow planes belong to the group of moulding planes. The plane iron is shaped according to the profile to be planed. The sole of the plane stock is shaped correspondingly.

A convex and a hollow plane of the same cutter width is called ' a set convex and hollow'. The cutters of convex and hollow planes do not project side ways beyond the plane stock.

Both plane irons are ground in such a ways that they only cut in the centre part of the cutting edge, this to prevent damaging the work piece by the corners of the plane iron.

Use a hammer tapping against the notch in the wedge while loosening the plane iron. The plane iron is taken out of the stock at the bottom. The plane iron is inserted through the mouth in the bottom of the stock.

Setting a jack plane blade: A jack plane is used to plane the wood to the required dimensions with smooth surface finish.

Setting and adjusting the plane blade is necessary for even and uniform cuts while planing.

Step in setting: The two steps in setting the plane blade are:

- Setting the plane blade to the required depth of cut
- Adjusting the cutting edge of the plane blade parallel to the plane sole or bottom face.

Setting the plane blade to the required depth of cut

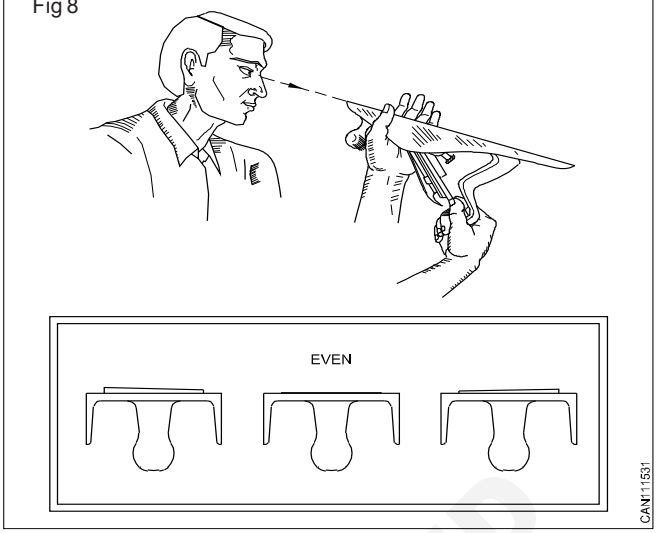
Hold the plane in the left hand keeping the sole of the plane in line with your sight at a convenient distance.

Turn the adjusting nut in an anticlockwise direction to the required depth of cut until the cutting edge of the blade projects above the sole or bottom face of the plane.(Fig 8)

Adjust the plane blade parallel to the sole of the plane: Check whether the cutting edge of the blade is parallel to the bottom face of the plane. If not, move the adjusting lever gently to the left or right until it is parallel.

While setting the plane blade, face the source of light. For protection of the cutting edge of the blade, with draw the plane blade into the plane before keeping the jack plane in the tool kit.

Fig 8



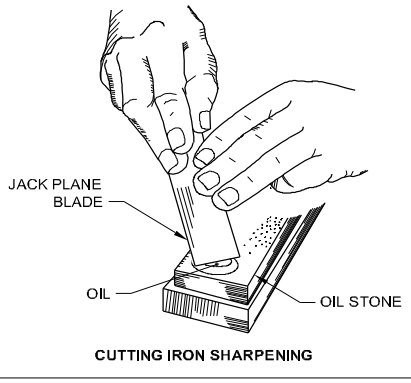
Sharpening of plane blade/cutter

Sharpening of a plane blade or cutter is necessary to produce a keen cutting edge for good surface finish, and perfect planing with minimum effort.

Sharpening and honing

The process of sharpening is carried out on oilstone by rubbing the blade with its bevel down, maintaining a constant and correct angle,25° to 30°. This rubbing is continued until a burr or wire edge is produced. (Fig 9)

Fig 9

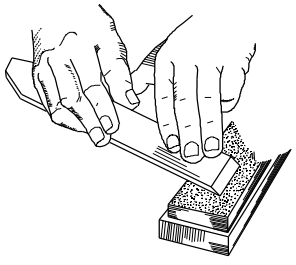


CUTTING IRON SHARPENING

The burr is removed by rubbing the back of the flat face of the plane blade on the oilstone, keeping its bevel up. (Fig 10)

During sharpening, oil is used to minimise the heat caused due to friction and to float off the metal particles from the pores of the oilstone so as to prevent clogging of the oilstone.

Fig 10



Using of marking gauge and mortise gauge

Objective: At the end of this lesson you shall be able to
- **state the using of marking gauge and mortise gauge.**

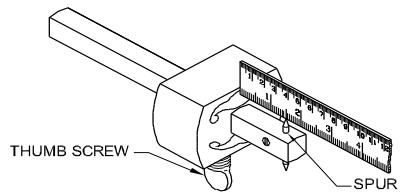
Marking gauge: The marking gauge is used to make an accurate mark parallel to the planed edge or side of a piece of wood for the purpose of obtaining the width, thickness or depth of a groove.

Hold the gauge in left hand keeping the spur up.

Hold the foot rule in right hand and set the required distance between stock and spur. Keep the graduation of foot rule in front. (Fig 1)

Adjust the stock with the help of left hand thumb. and index finger. Now the marking gauge is set. Tighten the thumb screw.

Fig 1



Check the measurement of accuracy.

Mortise gauge: used for marking mortise and tenons and similar joints using paralled lines.

Hold the gauge stock in right hand thumb is behind the spur, the fore finger on the stock and the three other finger on the stem of the tool.

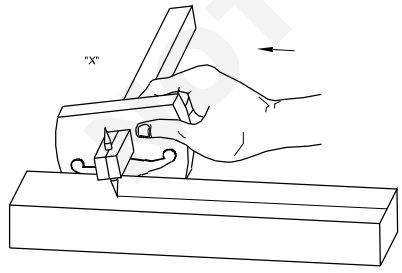
Place one end of the piece against the bench stop and other end in left plan.

Place gauge stock in contact with the face edge of the piece and spur touching the piece lightly in slanting position.

Give forward stroke on the stock near the end. (Fig 2)

Hold the piece in left hand and complete the gauge mark.

Fig 2



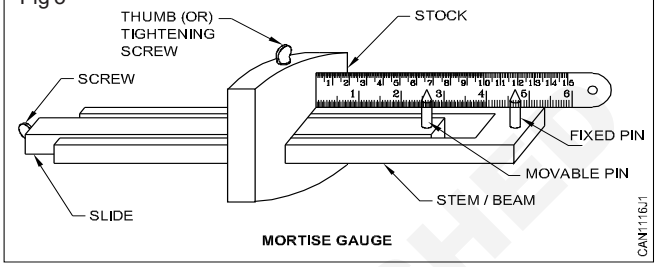
Check the gauge mark with foot rule.

The mortise gauge is used to make an accurate mark parallel to the planed edge or side of a piece of wood for the purpose of obtaining the width, thickness or depth of a groove.

Hold the mortise gauge in left hand keeping the spur up.

Hold the foot rule in right hand and set the required distance between stock and spur. Keep the graduation of foot rule in front. (Fig 3)

Fig 3



Adjust the stock with the help of left hand thumb. and index finger. Now the mortise gauge is set. Tighten the thumb screw.

Check the measurement of accuracy.

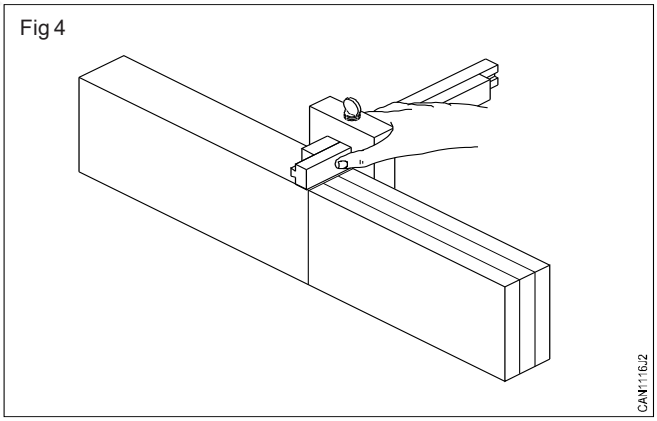
Hold the mortise gauge stock in right hand thumb is behind the spur, the fore finger on the stock and the three other finger on the stem of the tool.

Place one end of the piece against the bench stop and other end in left plan.

Place mortise gauge stock in contact with the face edge of the piece and spur touching the piece lightly in slanting position.

Give forward stroke on the stock near the end. (Fig 4)

Fig 4



Precautions

Do not use a long spur for gauging.

Do not see the distance by keeping the rule flat.

Do not press spur while gauging.

Keep the stock face rubbing against the straight edge.

Do not put the spur at right angles with the face.

Checking flatness and twistness of surface, using winding strip

Objectives: At the end of this lesson you shall be able to
- **state the necessity for checking flatness and twistness and use of winding strip**
- **explain the constructional features of a winding strip.**

Necessity for checking flatness and twistness

- The planned wood must be free from twist and up and down.
- Before selecting the wood inspect the wood without twist and is should be flat.
- To find the up and down in the wood winding strip are used.
- Good wood without twist and up & down used for preparing good joints.
- The furniture legs will sit properly in the floor.
- It the wood is good the door & window can be closed properly without clearance.

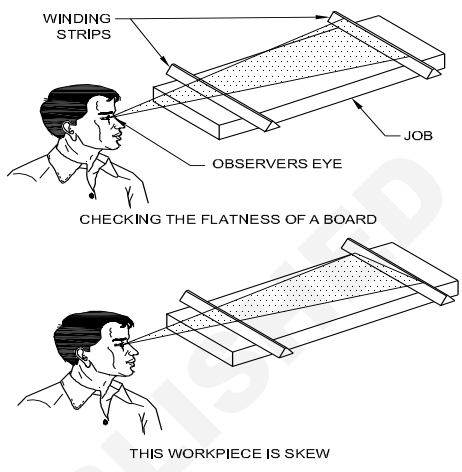
Winding strip is a pair of perfectly straight pieces of timber, with parallel edges. Usually they are about 375 mm long and 35 mm wide and 20 mm thick.

For testing the job for flatness, one stick is placed across one end and the other stick is placed across the other end of job.(Fig 1)

The top edges of the sticks are sighted and if they are not parallel, the surface is said to be uneven, or they are said to be `in winding'.

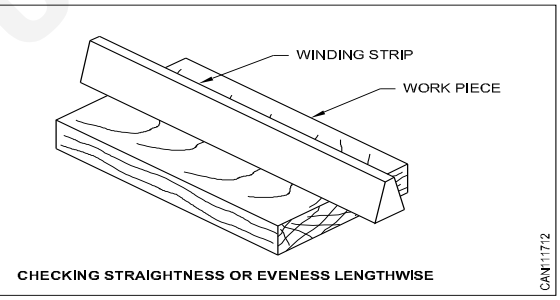
Again if the high levels of the job are planed the winding strips are placed on the job and the tops of the strips coincide then the level is said to be 'out of winding' and is perfectly flat.

Fig 1



To check the surface for wrinkles or unevenness breadth wise or lengthwise winding strips are used. (Fig 2)

Fig 2



Sharpening and grinding angle of cutter

Objectives: At the end of this lesson you shall be able to
- **state the grinding angle and sharpening angle of plane cutter.**

Grinding (Fig 1): The process of removing the wearing away of worn or gapped cutting edge of the cutting tool to produce a new grinding bevel.

This is done by holding the plane blade at a constant angle of 20° to 25° to a rotating abrasive wheel.

Sharpening (Fig 2): The plane blade is held at a constant angle of about 25° to 30° (5° greater than the grinding bevel) to the stone and rubbed back and forth to produce a sharpening bevel.

Fig 1

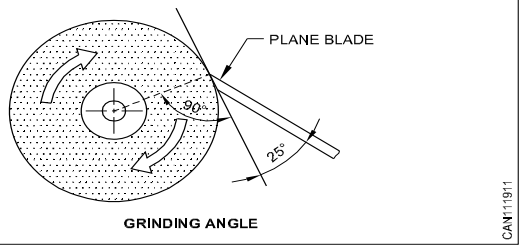
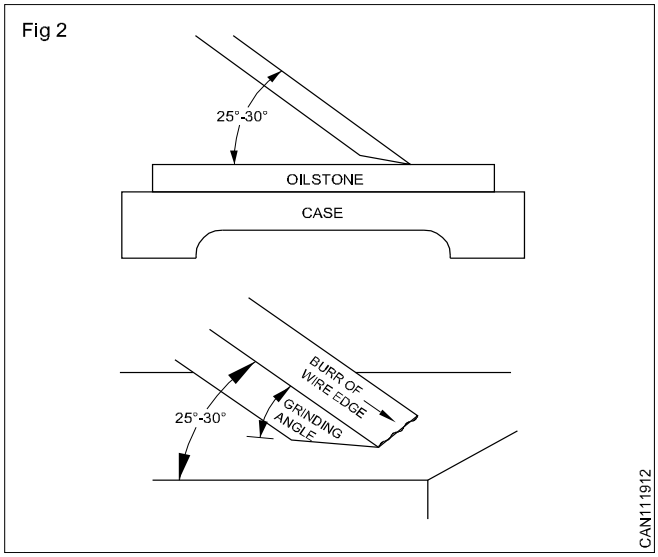


Fig 2



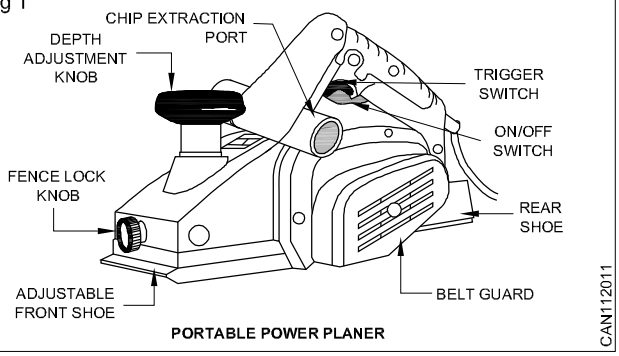
Portable power planner

Objective: At the end of this lesson you shall be able to
- **state the use of power planner in wood work.**

A power tool is a power driven light machine tool which is portable by hand while working. Like most hand tools, it is taken to the job. Portable power tools have an added advantage over machine tools as they do not require floor space for installation and use.

The portable power planners used for make sure the surface to be smooth planned in face, Grain or side grain (Fig 1)

Fig 1



PORTABLE POWER PLANER

It is important that the planner should always be planing in the same direction as the grain of the wood (along the direction of the grain)

The proper feed rate will depend on the type of material being cut and depth of the cut

Power planes are available in sizes 50-125mm .Maximum width of cut the plane will make at one pass over the wood, (ie) the width of the sole which equals the length of the cutting blades.

Generally two cutting blades are bolted to a cutter block which is revolved at high speed 12000 to 15000 rev/min. by gears or belts connected to an electric motor mounted on the body or the plane. Depth of cut (up to 6 mm) is regulated by a star wheel or knob which sides the front portion, “front shoe”, of the sole on an inclined plane.

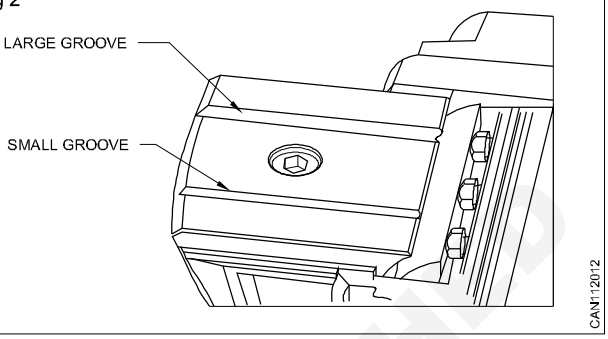
Most planes are fitted with a fence to guide the plane when squaring, bevelling or mitring edges and ends. Bevel gauge can be fixed to either side 135° to the sole. The front shoe has a rebating groove machined along on edge for 9 mm wide by 9 mm deep wider rebates may be produced by making two or more passes of the plane

Front shoe

- The shoe can easily be adjusted to the depth of the cut.

The V-Grooves in the front shoe allow for quick and easy chamfers, creating a sloping edge along the corner of the workpiece. There are two V-grooves, a large and a small groove (Fig 2) to meet the needs of your particular project.

Fig 2



Rear shoe

- The rear shoe is not adjustable
- This shoe supports the board after it is planed.

Depth adjustment knob

- The cutting depth of a planner is determined by the height difference between the adjustable front shoe and the cutting edge of the blade.
- This knob retracts the front shoe to adjust the width blade is exposed
- This knob determines the amount of material that will be removed, to adjust the cutting depth.

Chip extraction port

- Used for wood planing adjust extracted through chip extraction port.

Safety precaution

1 Make sure the cutter bolts are tightened

2 Check electrical and mechanical parts.

3 Secure the job firmly so that both hands can guide and control the plane

4 Keep the fingers above the sole of the plane - keep the lead behind the plane

5 Allow the motor to attain full speed before operating-plane with grain.

6 Do not force the plane to cut rapidly - a fast forward movement produces a rippled surface due to rotating cutters.

7 When starting a cut press the front shoe of the plane on the work. when cutting starts transfer the holding pressure to the rear handle. Make sure the cutters have stopped revolving before putting the plane down.

Different type of chisels and uses

Objectives: At the end of this lesson you shall be able to
- **name various types of chisels commonly used**
- **state the uses of various types of chisels**
- **specify the chisels.**

Chisel are used for shaping and finishing the parts of wood joints. They are also used for shaping different profiles in wood work. The size of the chisel is determined by width of the blade and type.

All chisels consist of four main parts

1 The handle

2 The blade

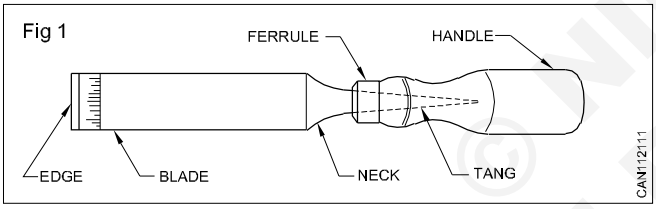
3 Tang

4 Ferrule

The blade of a chisel is made of forged tool steel The cutting angle is 25°.

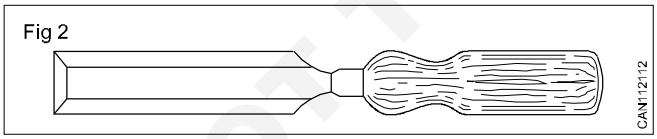
Types of chisels

1 Bench firmer chisel (Fig 1)



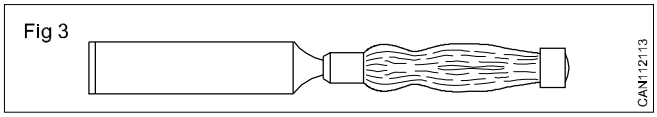
This is used for general chiselling purposes. Strongly made, it can be used for light chiselling with a mallet. The blade is rectangular in section. The handle is made of beech or ash. It has a brass ferrule. Tang is fixed inside the ferrule. It is available from 3mm to 50mm.

2 Bevel edge firmer chisel (Fig 2)



It is more convenient for lighter works and paring works, and in place were ordinary firmer chisel cannot be used such as cleaning up corners and joints. Bevel edge firmer chisel has two edges bevelled along its length which makes it lighter and the edges thinner. size varies from 3 mm to 50mm.

3 Registered firmer chisel (Fig 3)



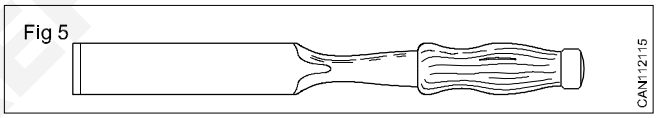
It is used for heavy work such as mortising. The use of mallet is necessary here. It is stronger than ordinary firmer chisel. It has a thicker blade and iron ferrule, at both ends of handle. A leather washer is provided between the shoulder of the blade and the handle to act as shock absorber when the chisel is hit by the mallet.

4 Paring chisel (Fig 4)

It is most suitable for all paring work such as finishing off joints. It has an extra long thin blade with bevelled edges. It should never be used with a mallet. The handle is made of beech and octagonal in section.

Size varies from 3mm to 50mm.

5 Socket firmer or socket mortise (Fig 5)



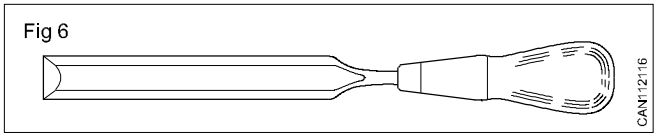
It is used for extra heavy work, the blade is thicker and stronger than other chisels. It is able to withstand the blows of the mallet, and level out the cover of mortises. The ash handle provided with ferrule is fitted in socket in the blade. Size varies from 3mm to 50mm.

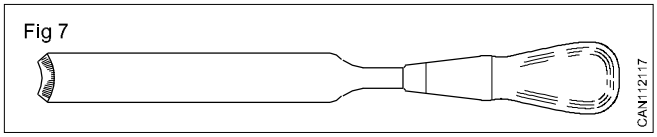
Gouge chisel

Chisels are blades of circular section called as Gouges or Hollow chisels.

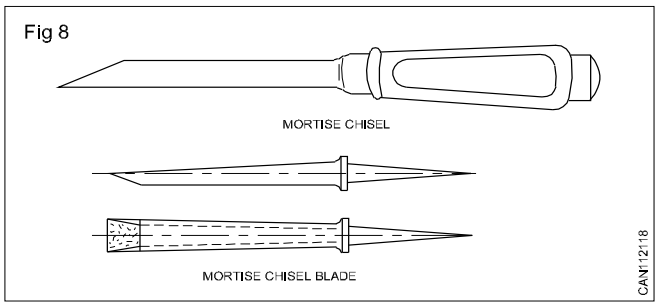
According to the position of the cutting bevel on the blade, there are two main types

Inside bevelled gouge (Fig 6) outside bevelled gouge. (Fig 7)





Mortise chisel (Fig 8)



The mortise chisel is designed to with stand hard, rough wear and the thickness of the blade permits the leverage necessary to clear the mortise and keep the blade true.

It has strong handle and the blade is fitted into it by a tang as with the socket and tang chisel.

Common sizes of mortise chisels are 3,4, 5, 6, 8, 10,12, 14,16, 20 mm in width.

The chisel blade is ground slightly taper from the face towards the back and from the cutting edge towards the handle to avoid friction.

Mortise chisels are used to mainly for chopping mortises and are driven with heavy blows of the mallet.

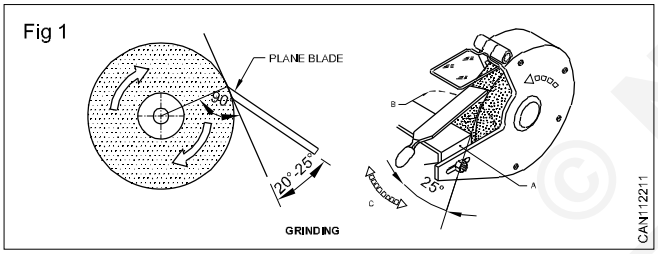
The test mortise chisels have a tough leather washer between the shoulder of the tang and the handle to help absorb the shock of repeated blows.

Necessity of grinding and sharpening in cutting tools

Objective: At the end of this lesson you shall be able to
- **Explain the necessity of grinding and sharpening in cutting tools.**

When cutting tools are manufactured and put to use they are sharpened for better cutting action. The necessity of grinding the cutting tools into re-sharpen the worn out cutting edge due to long use, by use of abrasive wheel and the process is referred as grinding.

Grinding (Fig 1)

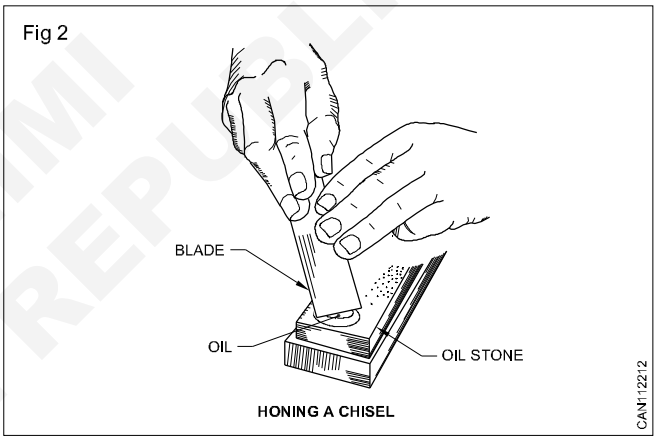


This consists of wearing away the worn gapped cutting edge of the cutting tool to produce a new grinding bevel. This is done by holding the cutting tool at a constant angle of 20° to 25° to a rotating abrasive wheel. Care must be taken to prevent the cutting edge being overheated by friction, and thus softened, during the grinding process.

Honing or sharpening (Fig 2)

It is an admitted fact that no good job can be done with a blunt or badly sharpened chisel. Hence the sharpening technique should also be known to the man who uses the chisel.

This process is carried out on an oilstone, the object being to produce a keen cutting edge by means of the fine abrasive from which the oil stone is made. Oil (neats-foot oil or olive oil) is necessary on the stone to reduce friction and float off particles of metal which would otherwise clog the pores of the stone.



The cutting tool is help at a constant angle of about 25° to 30° (5° greater than the grinding bevel) to the stone and rubbed back and forth to produce a honing bevel, while producing the honing bevel, a burr or "wire edge" is formed on the face of the face of the tool,

Placing the cutting tool perfectly flat on the stone, bevel up and again rubbing back and forth a few times. Drawing the edges across the corner of a piece of scrap wood helps to remove the burr.

These operations are repeated until purr has disappeared the sharpened edge may be tested against your finger nail.

Oil stone

Objective :At the end of this lesson you shall be able to
- **state the different types of oil stones**
- **explain the uses of oil stone slips.**

To put a keen cutting edge on cutting tools a process called "HONING" always carried out after grinding. Honing or sharpening stones are divided into

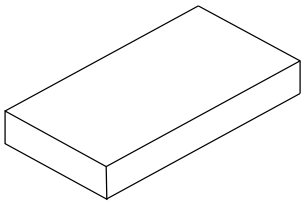
1 Natural oil stones

2 Artificial oil stones

3 Slip stones

Natural oil stones (Fig 1)

Fig 1



NATURAL OIL STONE

CAN112221

Natural oil stones are quarried (Mostly in United States of America) and can be obtained. Usually in two grades hard and soft grained.

For natural oil stones, oil should be used for fine grained stones out of two "WASHIA" and "ARKASAS" oil stones.

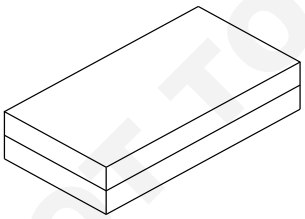
ARKASAS produces the keen cutting edge and is most expensive.

Soft oil stones

The soft stones has fairly coarse grit. Water should be used for all course grained.

Artificial oil stones (Fig 2)

Fig 2



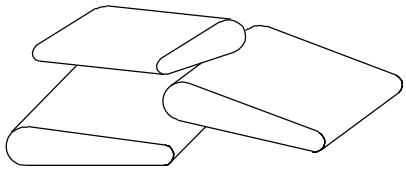
ARTIFICIAL OIL STONE

CAN112222

Artificial oil stones are usually made in three grades coarse, Medium and fine they are made from "CARBORUNDUM" or "CORUNDUM" the combination stone is made up with COARSE on one side for wearing down quickly and fine grade on the other side for producing keen cutting edge.

Slip stones (Fig 3)

Fig 3



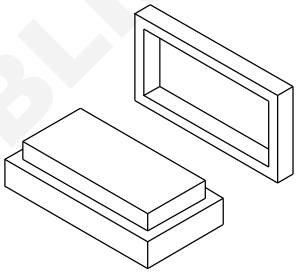
SLIPS FOR CURVED TOOLS

CAN112223

Oil stones slips or slip stones are pieces of oil stones of various shapes used for sharpening tools with curved and shaped cutting edges which cannot be honed on the flat surface of an ordinary oil stones.

Oils (Fig 4)

Fig 4



ARTIFICIAL OIL STONE IN A CASE

CAN112224

Oil of non drying qualities should be used during the sharpening process to prevent clogging a glazing of the stone by floating of the particles of steel. Oil also prevents over heating, by friction. Neats- foot oil or olive oil extract from the feet of cattles generally used on oil stone. If allowed to dry they will become hard and brittle and they will become glazed smooth more readily. It kept in a dry place. It is advisable to keep them oiled and in a covered box (Fig 4). Any irregularities or globe may be removed by grinding on the side of grind stone or by rubbing down with a wet sand stone. Brick or "Emery" powder mixed with water on a hard flat surface they may be cleaned with "KEROSENE" striking tools.

Striking tools - Hammers and mallets

Objectives: At the end of this lesson you shall be able to
- **state the uses of an carpenter's hammer**
- **identify the parts of a carpenter's hammer and state their function**
- **name the type of carpenter's hammers**
- **specify the carpenters hammer.**

Hammer

A carpenter's hammer is a hand tool used for striking purpose while

1 punching

2 striking

3 pulling

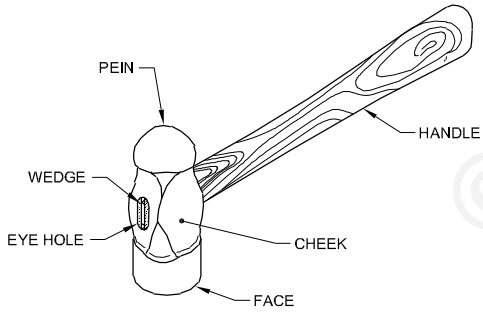
– The major parts of a hammer are a head and a handle

– The head is made of drop-forged carbon steel

– The wooden handle must be capable of absorbing shock.

Parts of Hammer head (Fig 1)

Fig 1



1 Handle

2 Face

3 Pein

4 Eye hole

5 Cheek

6 Face

Face

The cheek is the striking portion slight convexly is given to it to avoid digging of the edge.

Pein

The pein is the other end of the head.

It is used for shaping and forming. Work like riveting and bending the pein is of different shapes like. (Fig 2)

1 Ball pein (hammer)

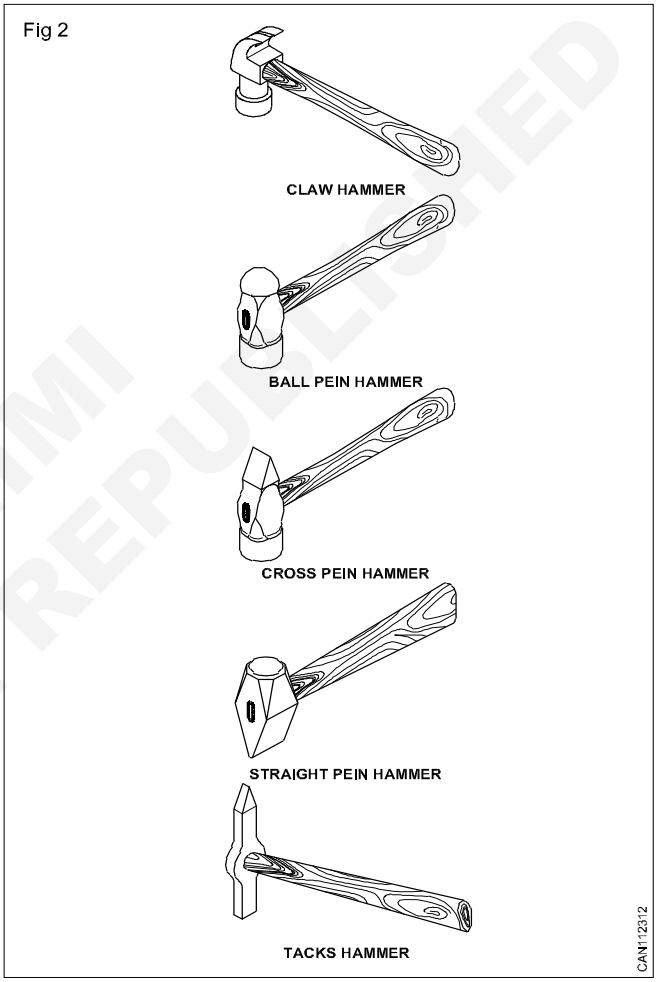
2 Cross pein (hammer)

3 Straight pein (hammer)

4 Claw (hammer)

5 Tacks (hammer)

Fig 2



Eye hole

An eye hole is meant for the handle. It is shaped to fit the handle rigidly. The wedges fix the handle in the eye hole.

Cheek

The cheek is the middle portion of the hammer-head.

The weight of the hammer is stamped here.

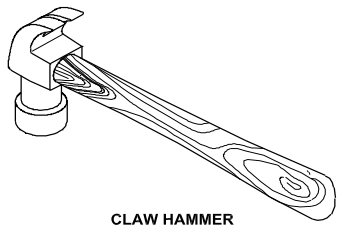
The portion of the hammer-head is left soft.

Specification

Carpenter's hammer's are specified by their weight and the shape of the pein. Their weight varies from 125gms to 1500gms.

Claw hammer (Fig 3)

Fig 3



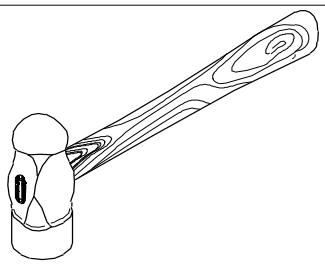
CLAW HAMMER

CAN112313

It is made of cast steel and carries the shirking face at one end and the claw at the other. The face is used to drive the nail into the wood and other shirking purposes and the claw is used for extracting the nails out of the wood. Its size is designated by its weight and it varies from 0.25kg to 0.75 kg.

Ball pein hammer (Fig 4)

Fig 4



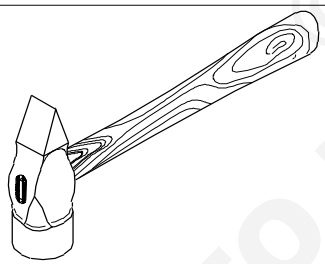
BALL PEIN HAMMER

CAN112314

It is made of cast steel and weight of about 110 gm to 910 grams. It is also called as engineers' hammer. One side of it is in the shape of ball and hence the name it is also used for riveting.

Cross pein hammer (Fig 5)

Fig 5



CROSS PEIN HAMMER

CAN112315

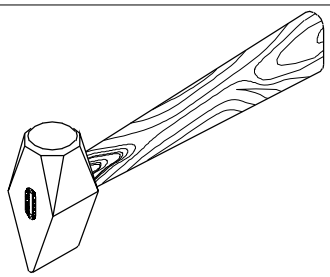
The head part of this hammer is across the handle and hence the name. It is used for all light works.

Due to this magnetism nails and screws are taken easily and is used to hammer or strike very thin nails. Some times it is called as pin hammer. It is weight is 100gms.

Straight pein hammer (Fig 6)

The hammer head is straight to the hammer handle. The bottom part of the head is large and tapering towards end side. It is used in riveting and to extend metal frames. Its weight is 110gm and varies up to 900gms.

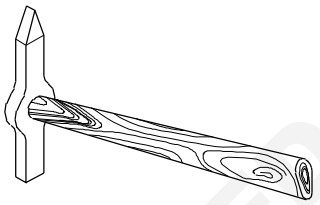
Fig 6



CAN112317

Tack hammer (Fig 7)

Fig 7



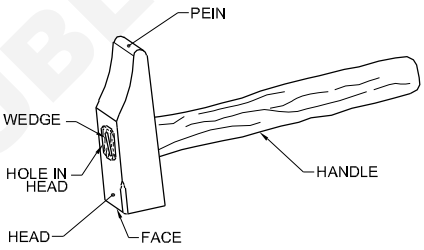
TACKS HAMMER

CAN112318

It is lesser in weight than all other hammers. The hammer head is straightly fitted to the handle of hammer. It has slight magnetic properties.

Carpenters' hammer (Fig 8)

Fig 8



CAN112316

The hammer head has a rectangular or oval hole which is tapered on the inside. The shape of this hole offers a good hold for the handle when wedged.

The handle must firmly be secured in the head to prevent accidents. The wedge is driven diagonally into the end of the handle. The wood splits and is pressed against the inner wall of the eye hole.

In carpenter shop it is called as warrington hammer. To extend the iron frames, for bending and for other works it is used. Its weight varies from 220gms to 910gms.

Precaution

Make sure the handle is properly fitted. Select a hammer with correct weight suitable for the job.

Check the head and handle for any cracks. Ensure the face of the hammer is free from oil and grease.

Check the wedge from eye hole.

The mallet

Objectives: At the end of this lesson you shall be able to
- **state the constructional feature of mallet**
- **explain the use of mallets**
- **state specification of mallets.**

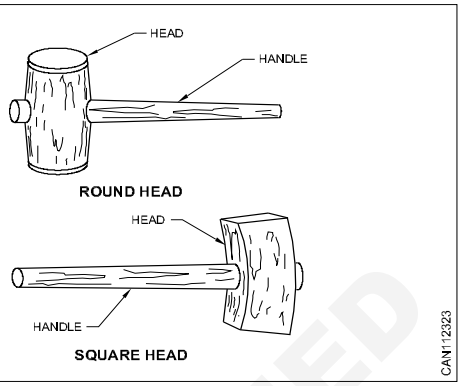
The mallets are made of hard wood and it is used in place of hammer. But the difference is head only. (Fig 1)

Mallet are used for driving wood chisels and for adjusting wooden planes. It is used for assembling and dismantling wooden works and for adjusting stop dogs in the work bench.

The handle is made of beech or ash with straight grained fibres. The head is made of hard wood with twisted fibres. This prevents splitting of the wood.

A special type of mallet is made of 'Ligno stone' which is made of special wood that is treated with heat and high pressure.

Fig 1



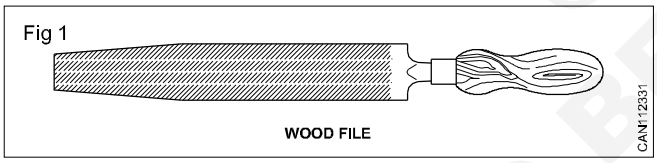
Files - Types, uses

Objectives: At the end of this lesson you shall be able to
- **explain the types and uses of files**
- **brief the parts of file**
- **state the classification of files.**

Files and rasps are used generally in the wood working trade for shaping and forming irregular pieces and curves, for which plane cannot be used.

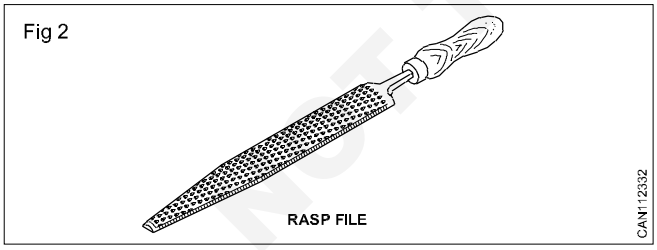
File: The wood file is used for smoothing roughly prepared surfaces. (Fig 1)

Fig 1



Rasp: The rasp is used for quick removal of much wood. (Fig 2)

Fig 2



Difference between a rasp and file is (1) The teeth for a rasp are completely separated from each other. (2) The rasp is used for roughening and for quick removing of a thick layer of wood.

Parts of a file (Fig 3)

1 Blade

2 Handle

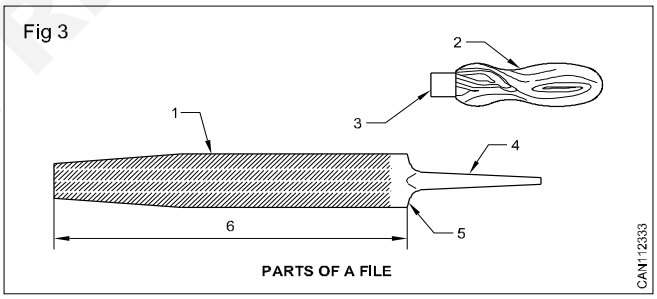
3 Steel ferrule

4 Tang

5 Shoulder (heel)

6 Length on inches

Fig 3



The file is a tool consisting of a blade of steel with fine cutting teeth on its surface.

This surface is hardened.

The tang is hammered out a point, which is not hardened.

The tang is fastened into the handle.

The handle is made of beech or ash and provided with steel ferrule.

The ferrule avoids the handle from cracking.

Classification of files

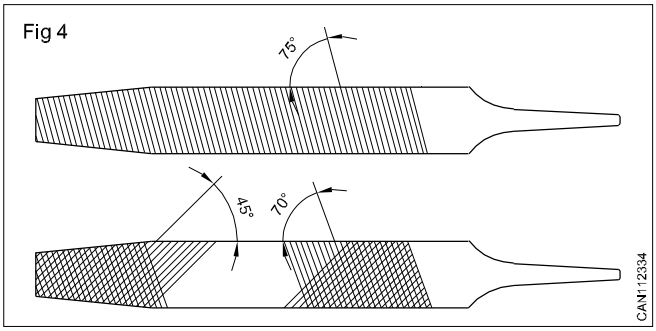
a) Teeth patterns

b) Coarseness

c) Shapes

a) Teeth patterns (Fig 4)

Fig 4



The way the blade of a file is toothed is called cut "Single cut" means a series of cuts, all running parallel at angle of about 75° to the axis of the file.

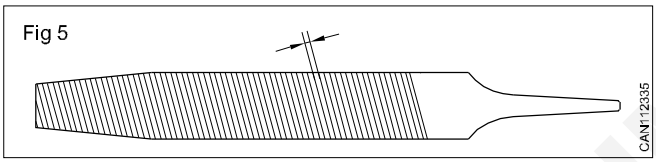
"Double cut" consist of two series of cutting teeth.

The first series of teeth put on a double cut file is called "overcut' which makes an angle of 45° to the file axis.

The second series of teeth over the first series is called "input which various an angle of 70° to the file axis.

Coarseness (Fig 5)

Fig 5



The coarseness of a file is defined by the distance between the teeth.

The nearer the rows of teeth, the smoother the file.

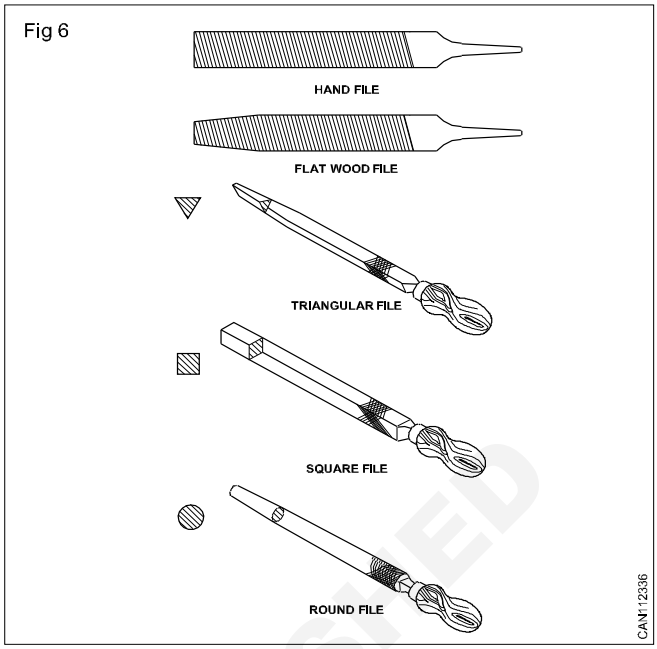
The designation for the cut is ranging from

– Coarse cut
– Bastard cut
– Second cut
– Smooth cut

Files and rasps should always be provided with handles. If a handle gets damaged, it should be replaced as soon as possible.

File shapes (Fig 6)

Fig 6



Hand file: The hand file has a rectangular cross sectors, parallel in width throughout its length, and tapering in thickness towards the point.

It is generally used as a coarse double cut wood file.

It is used on wood which has been rasped first.

Flat file: The flat file is shaped like the hand file, except for its tapering width.

Both files are double cut.

According to the shape, one distinguished round, triangular, square, half round, flat and hand files.

Rasps are of similar shapes.

Files, generally in use by the carpenter are

– the wood rasp
– the coarse hand file
– the smooth wood file.

They are used in this successive order.

Care and maintenance of files

Objectives : At the end of this lesson you shall be able to
• **write the care and maintenance of file.**

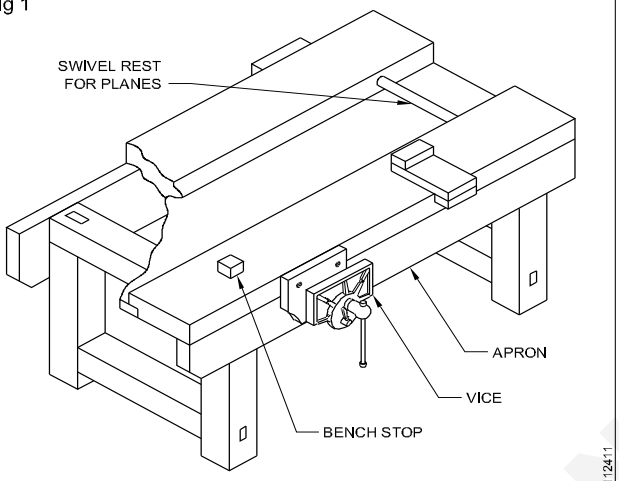
- Do not use the file having the blunt cutting edge.
- Remember that files cut on the push stroke. Never apply the pressure on the pull stroke, or you could crush the file teeth, blunt them or cause them to break off.
- Prevent from pinning.
- Give our files teeth a light brush with oil during long storage.
- Normally do not apply any oil while filing.
- Files should be stored separately so that their faces cannot rub against each other or against other tools.

Work bench, bench stop and bench hook

Objectives: At the end of this lesson you shall be able to
- **state construction feature of work bench**
- **explain the uses of work bench**
- **brief the function of bench stop and bench hook.**

Work bench (Fig 1): It is a heavy table of rigid construction made of hard wood. Two or four carpenters vices are fitted on the opposite sides to hold the jobs. One jaw of the vice is secured to the table and the other is kept movable.

Fig 1



WORK BENCH

Shelves or racks can also be provided on the table.

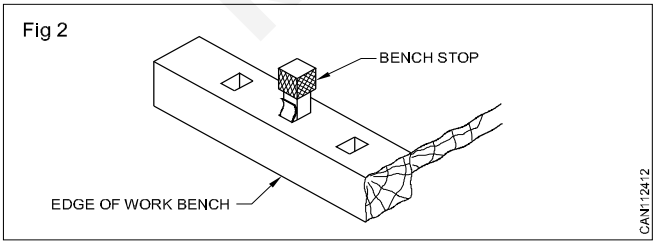
The length is 120cm to 180cm and width 90cm for single man work bench and the width is 120 cm for double man work bench.

The bench is mostly useful to cut and saw the woods, to plane the woods, ripping tenons, chiselling out wastes and for all other wood working purposes.

The tool well is in the middle for the work bench and is slightly in lower level to accommodate the working tools.

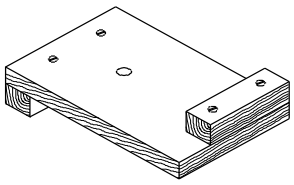
Bench stop (Fig 2): To avoid slipping while planing operations a bench stop is fixed which can be raised or lowered. Bench stops are made of wood pieces and has teeth at its one end. It is used for supporting the work during wood working operations.

Fig 2



Bench hook (Fig 3): One side of the plywood or wooden plank edge a small wood piece is fixed is and other side edge another wood piece is fixed with the help of dowel pin joint and glue is used.

Fig 3

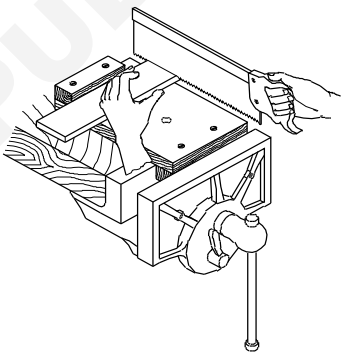


BENCH HOOK OR EARTHING BOARD

It is used to hold the job while sawing or chiselling and at the same time protecting the work bench and surface from damages.

Using a tenon- saw and a bench hook (Fig 4): Position the bottom rail of the bench hook against the edge of the bench or hold it in the vice.

Fig 4



THE USE OF BENCH HOOK WHEN SAWING SMALL PIECES

Place the timber against the top rail of the hook, the cutting mark just clear of the edge.

Grip the timber and the top rail together. Use the thumb to act as a guide for the saw at the start of the cut.

Keep your thumb clear off the saw teeth.

Swivel rest is provided to keep the planes when it is idle and not in use.

Apron is the longer piece of wood nailed on the longer side of the work bench for rigidity.

The level of the work bench surface would be uniform and even.

Care should be taken to see that while nailing sawing and chiselling there would not be any marks left on the surface.

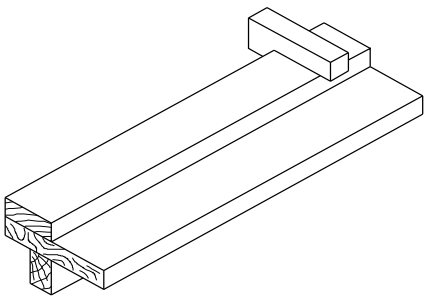
Shooting board, planing trough and mitre box

Objectives: At the end of this lesson you shall be able to
- **state the uses of shooting board**
- **brief the use of planing trough**
- **explain the use of mitre box.**

Shooting board

A shooting board is uses to plane the end side without breaking the edges. (Fig 1)

Fig 1



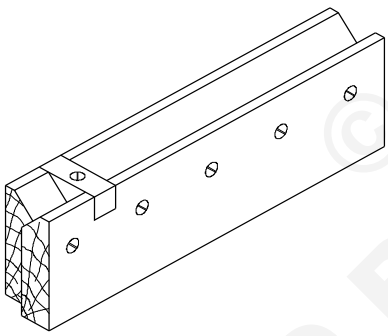
SHOOTING BOARD

CAN112431

The procedure is to hold the part to be planed is fixed in the shooting board and is held in carpenter's vice. Then it is planed smoothly without breaking the edges.

Planing trough (Fig 2)

Fig 2



PLANNING TROUGH

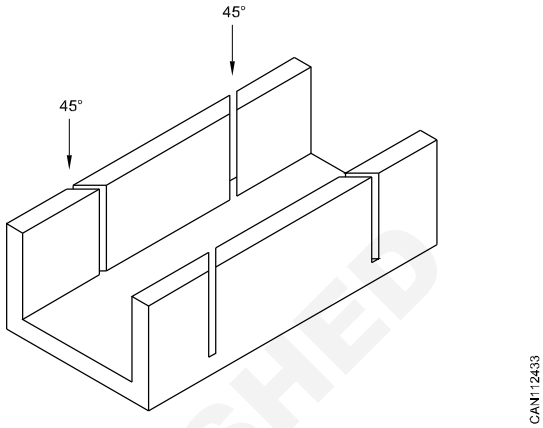
CAN112432

Two wooden planks planed at an angle of 45°at end screwed at the ends. There is a block kept at one end. Door frames are held in this and then planed. Similarly square wooden blocks are held in this and planed to round them.

The mitre box (Fig 3)

The mitre box is built up of three piece of wood, one forming the base and two parallel sides. It has saw kerfs in the sides at 45° to the left and to guide the saw in cutting mitres (Cutting 45° angle).

Fig 3

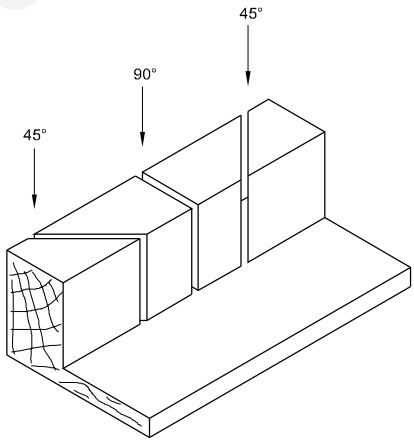


CAN112433

The mitre block (Fig 4)

This is used to mitre small sections of wood accurately. It is made of two pieces of wood with 3 cuts in the piece. 45° cuts left and right and 90° cut in the centre to help in sawing accurately square.

Fig 4



CAN112434

Seasoning of timber

Objectives: At the end of this lesson you shall be able to
- **define of seasoning of timber**
- **state the various types of seasoning of timber**
- **state the advantages and disadvantages in seasoning of timber.**

Seasoning : Seasoning is the process of drying out the sap and moisture in the cell cavities and cell walls of the timber approximately, equal to the average humidity of situation where it is used.

Advantages of seasoning

1 To decrease the volume and weight of timber and thereby to lower the cost of transport and handling.

2 To improve strength, hardness and stiffness of timber

3 To improve the resisting power of timber so that it is less liable to attract by insects and fungus.

4 To improve the working qualities of timber so that it easily works under saw or plane during conversion.

5 To maintain the size and shape of the timber articles even after leaving the hands of carpenters and joiners.

6 To make timber fit for receiving treatment of paints preservatives varnishes, polish etc.

7 To reduce the tendency timber to crack warp bend or shrink.

8 To allow timber to burn readily.

Types of seasoning: Seasoning is of two types

1 Natural seasoning

2 Artificial seasoning

Natural seasoning

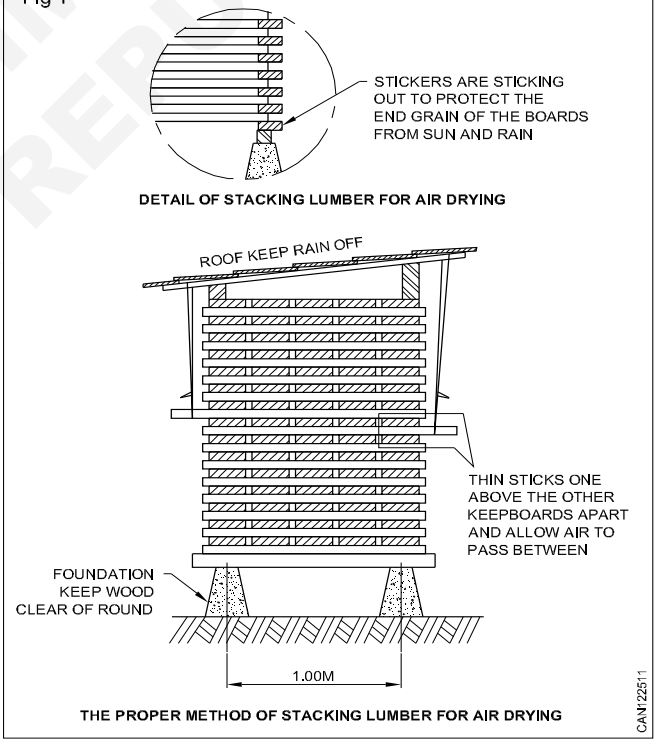
Water seasoning: In this process the timber after felling in the form of logs of suitable sizes it totally immersed in a running stream of water for a period of 3 to 4 weeks. The thicker end of the log is kept pointing upstream. The sap in timber is then washed away by water. The log is then kept out in the free access of air to dry out timber is thus seasoned.

Advantages : It is a quick method and renders timber less liable to warp and crack. It also removes organic materials contained in the sap of timber.

Disadvantages : It reduces the elasticity and durability of the timber and makes it weak and brittle.

Air-drying or Air seasoning (Fig 1): Air-dying reduces the moisture content of lumber to a minimum of 15 percent. Wood is often stacked for air drying when it is to be used for exterior purposes. It may be air-dried and then sent to a kiln. In both air and kiln drying, space is left between layers of wood for proper air circulation. It consists of piling the boards or planks carefully in the open air by putting stickers crosswise between each layer of boards. The stack must be roofed to protect it from sun and rain. One of the most important and effective measures for wood protection is seasoning. Seasoning starts immediately after the cutting of green trees. At first liquid or free water (in practice commonly called “Sap”) is removed or it evaporates. However, the disadvantage of shrinkage in the course of seasoning is more off-set (balanced or compensated) by a remarkable number of advantages, increase in resistance to blue stain and wood-destroying fungi, reduction in being attacked by same types of insects, reduction of warping, twisting, splitting and bending, reduction in weight (reducing transport costs), increase in stiffness, mechanical strength and hardness?. Seasoning is therefore utmost importance for the economical utilization of wood.

Fig 1



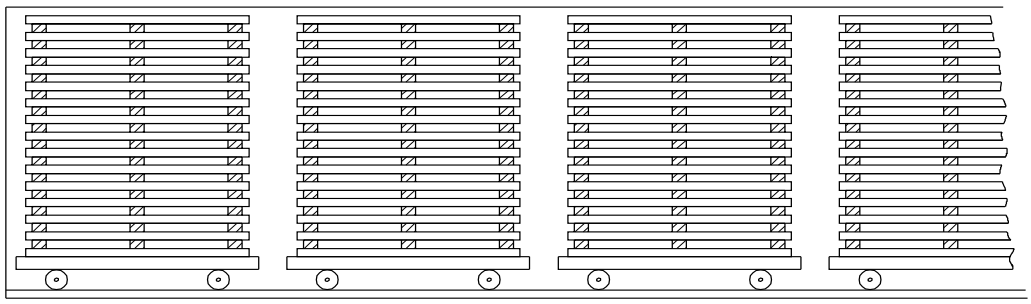
Advantages: This method of seasoning is very simple cheap and requires no supervision.

Disadvantages: The rate of drying is slow and it is difficult to exercise control over temperature and humidity and hence desired seasoning quality not attained.

Progressive kiln (Fig 2) : Progressive kiln is similar to an assembly line. A car load of wood enters the kiln and goes through each of several drying compartments or stages of

drying. The most modern kilns scientifically control heat, moisture, and air circulation, using special instruments. As the drying procedure continues, this condition is gradually reversed. Moisture is decreased and the heat is increased until the correct moisture content of the wood is secured. The wood is allowed to cool before removal to the area where it is stored until it is used.

Fig 2



PROGRESSIVE KILN IS SIMILAR TO AN ASSEMBLY LINE. A CARLOAD OF LUMBE ENTERS THE KILN AND GOES THROUGH EACH OF SEVERAL DRYING COMPARTMENTS, STAGES OF DRYING

CAN122512

Kiln seasoning or kiln drying

Compartment kiln: Dry kilns are of two types, compartment and progressive kiln. After lumber is sawn, it is usually seasoned (dried) in kilns. It is stacked or piled and enters the compartment kiln. In this type of kiln it usually remains in one location until it is dry. Generally flat piling is used in dry kilns and as a rule, the boards are piled length-wise. The stickers can be made of any kind of dried lumber. They should be planed to an uniform thickness about 22mm to 25mm. The stickers should be spaced carefully to prevent warping.

The first treatment in the dry kiln is steaming. Steaming at about 95% relative humidity is the usual practice at the start of kiln drying. This process heats the lumber and relieves it of any stresses set up by casehardening during air-seasoning.

Advantages: Very quick method of seasoning and it reduces the shrinkage.

Disadvantages: It is an expensive method.

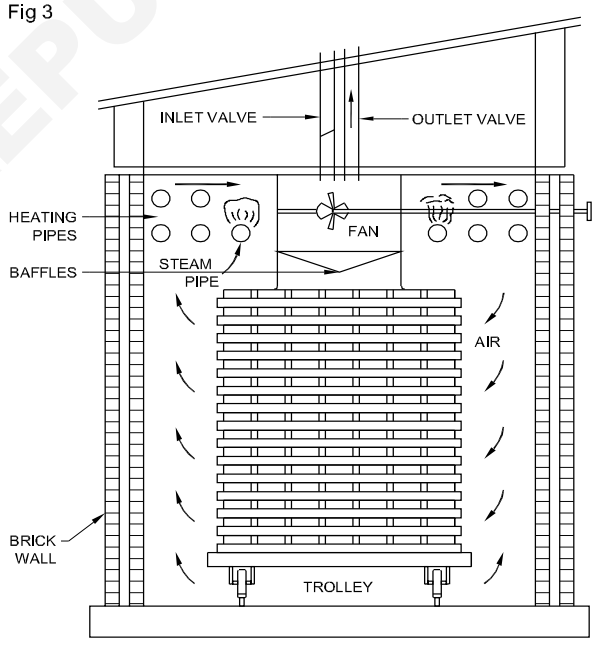
It effects strength and elasticity of timber.

Boiling or steaming method of seasoning: In this method timber is immersed in water and the water is then boiled for three to four hours. In steam seasoning timber is exposed to the action steam spray. Thus the timber is dried out slowly and seasoned.

Kiln seasoning (Fig 3): It is also called as hot air seasoning. In this method timber can be seasoned to any moisture content and hence is commonly adopted for rapid seasoning of timber on a large scale. The timber is stacked inside the chamber and the hot air is forced free. For free circulation for about 3 days. The sap and moisture content are dried out. The process of drying out can be carried either in stationary kilns or in progressive kilns. This method of kiln seasoning gives a well seasoned timber as it controls air circulations, relative humidity and temperature.

Disadvantage: This method is expensive. This can be used for small pieces of timber requires skilled supervision.

Fig 3



CROSS SECTION OF DRY KILN

CAN122513

Moisture content in timber

Objective: At the end of this lesson you shall be able to
- **state the determination of moisture content in timber.**

Determination of moisture content: Moisture content of wood can be determined by using an Electric moisture content meter, or perform an MC experiment by observing the following procedures.

Select a board from the wood to be tested. About 60cm from the end of the board, saw off a piece 8 to 15mm long. Weigh the sample as accurately as possible, and record the weight. Place the sample in an electric oven. Heat it

up and dry it for about 30 minutes. Weight the sample, record its weight and return it to the oven for approximately 15 minutes. Continue weighing the sample periodically until the weight is constant. The MC can be calculated by using the following formula.

$$MC = \frac{W - D}{D} \times 100 = \%$$

MC = Percentage of moisture (moisture content)

W = Wet wood

D = Dry wood

Example: $\frac{21g - 18g}{18g} = \frac{3}{18} \times 100 = 16.7\%$

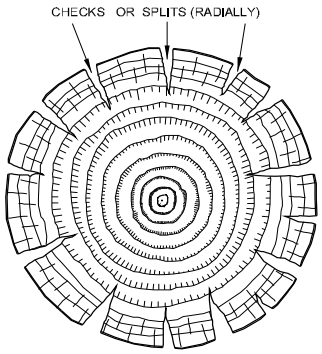
MC = 16.7%

Shrinkage of timber and their effects

Objectives: At the end of this lesson you shall be able to
- **define the shrinkage of timber**
- **state the effects of shrinkage.**

Shrinkage of timber (Fig 1): Shrinkage takes place during the process of drying or seasoning of the timber.

Fig 1



EFFECT OF SHRINKAGE ON A LOG

CAN'22521

All timber will shrink regardless of the type or the method by which is seasoned.

The wood will continue to shrink until its moisture content equals that of the air surrounding it.

There are two stages in drying of green timber.

First stage : The removal for the "Free water" from the cell cavities

Second stage : The drying of the combined moisture from the cell walls.

During the second stage wood shrinks.

No shrink occurs during the removal of the free water.

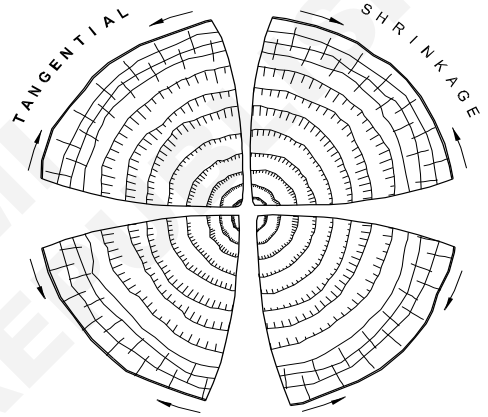
When the moisture is drawn from the cell walls, the cell wall themselves become smaller, consequently the board become smaller. Just as a piece of bread or orange peel will shrink when dried in an oven.

The cells do not shrink to any extent in their length hence there is very little shrink in the length of the board when it is dried.

Similarly, the medullary rays do not shrink very much in their length and as they run across the timber (quarter sawn board).

They tend to prevent the layers of growth rings from shrinking towards the centre or pitch. Therefore most shrinkage takes place in the direction of the growth rings, at right angles the medullary rays. This is called tangential shrinkage. (Fig 2)

Fig 2



DIRECTION OF SHRINKAGE

CAN'122522

Tangential shrinkage is about double radial shrinkage and about one hundred times as great as longitudinal shrinkage.

The sap wood containing more water.

It will shrink more than true wood.

Effects of shrinkage: The outer surface of the log is in contact with the air. They dry more quickly and therefore shrink before the inner layers of wood.

This causes stresses to set up round the outer layers which will cause splitting or surface cracks.

Break down the log into commercial sizes as soon as possible after felling.

Boards become 'cup' or curve (B) away from the centre or heart due to the length of the growth ring being greater on the side away from the pith or heart.

The shrinkage is mostly in the direction growth ring (tangentially).

This defect can be overcome by placing weights on the stacks during drying.

Square and round tangential cut and radial cut boards also can change in the shape.

Characteristics of wood, physical and mechanical properties of wood

Objectives: At the end of this lesson you shall be able to
- **state the characteristics of wood**
- **define the physical and mechanical properties of wood.**

Characteristics of wood

The characteristics depend on the visibility and arrangements of the elements. Characteristic feature of each species of timber vary accordingly.

The arrangements and the types of cell together with the presence of varying quantities of chemical substances. such as starch, sugar, gum, resins, oils, colouring matter etc., give the different kinds of timber their special characteristics .

Physical properties

Shape : Which grow outward (e.g.,) sal, Teak etc., Another group grow inward (e.g.,) Bamboo, coconut, palm etc,

Colour : Trees are variation in colours, depends on the substances and chemicals in the cells and cell walls.

(e.g.,) Ash tree - whitish yellow, silver wood - ivory colour etc,

Weight : Though the solid wood size (Volume) may be the same but their weight varies depends on their density (e.g.,) mango tree - light weight, maruthu - heavy weight

Smell : All trees have different smell

(e.g.,) Sandal wood have sweet smell.

Structure : The structure of timber should be uniform, hard and compact. A timber should have sufficient hardness (I e)., resistance against penetrates.

Non conductor : The timber should after sufficient resistance against fire, so that it does not easily ignite. It is used in fire protection of buildings, as timber is bad conductor of heat and electricity.

Light soft wood

This wood usually have thin walled cells.

Figure

Figure is a term usually applied to timbers which posses unusual or attractive design in texture, grain and colour.

Figure may be due to

The natural arrangement of the wood elements (Cell etc).

Method of conversion may give growth ring figure or medullary ray figure.

Grain variation and irregularities such as wavy grain.

Irregularities in the tree such as knots, burls etc.,

The texture and grain of the wood depends up on the size and direction of the various cells.

Texture

It refers to the size and quality of the cells; eg. fine, medium coarse, uniform and uneven etc.

Grain

It refers to the direction of the cells eg. straight, sloping, diagonal interlocked and wavy grain.

Weather resistance

A good timber should posses adequate resistance against weathering effects such as alternate drying and wetting.

Alternate heating and cooling because of temperature variations, wind effect etc.

Mechanical properties

Durability

Depends largely upon the nature of the chemicals present in the cells and cell walls which are destructive to fungus growth and insects attack.

Strength

The timber should be strong enough to with stand loads whether being applied slow by or suddenly.

Depends upon the types of cells and cells structure.

It should posses enough strength in direct compression and traverse direction.

Density

Depends up on the cell structure, size of the cells, thickness of walls and the amount of chemical substances present in the cell cavities such as gums and resins.

Hardness

A good timber should be hard. i.e it should offer resistance when it is penetrates by another body.

Depends up on the size of the cells and cell thickness of the cell walls.

Hard woods have small thick walled cells closely packed together and filled with resinous material

Fire resistance

Timber is a bad conduct of heat.

The timber should offer sufficient resistance against fire, so that it does not easily ignite and it helps in fire protection of buildings.

Elasticity

The timber should be capable of regaining its original shape where load causing deformation is removed.

The property is important when timber is to be used for bows, carriage shafts, sports goods, wooden beams and wooden floors.

Workability

The timber should be easily workable and should not clog the teeth of saw.

It should also be capable of being easily planed or made smooth.

Toughness

A good timber should be capable of offering resistance to shocks due to vibration, should not deteriorate due to mechanical wear.

Quality of good timber

Objective: At the end of this lesson you shall be able to
- **state the quality of good timber.**

Working qualities refer to the ease or difficulty of sawing, planning, chiselling, carving, shaping, bending, turning, gluing, and nailing.

These are influenced by the density, texture, grain, hardness and toughness of the wood and the presence of material such as crystals of silica in the cells, or oils. Working Qualities also include the ability of the timbers to take finishes such as paints, stains, fillers, polishes etc.,

- It should be well seasoned, the surface should not clog the teeth of saw when cut.
- It should be hard, durable and resistant to atmospheric effects.
- It should be tough, elastic and regain its size and shape when the force causing temporary distortion is removed.
- It should have uniform colour.
- It should be from the heart of a sound tree with straight fibres.
- When freshly cut it should give a sweet smell.
- It should have bright appearance with silky lustre when planned.
- When struck together it should give a clear sound. The decayed timber emits dull sound.
- It should not have any natural defects such as shakes, knots and splits etc.
- It should resist the attack of fungi and other insects.
- When a nail is driven into it, it should not split.
- It should have firm adhesion of fibres and compact medullary rays.
- It should be easy to work and take good finish.

Classification of wooden joints

Objectives: At the end of this lesson you shall be able to
- **state the various classification of joint used in wood work**
- **state the uses of joints.**

The most common forms of joints are the majority of joints used in wood work were designed years ago to perform certain duties and by experience their proportions have become standard to maintain a maximum of strength with the parts they connect. Variations of these joints are occasionally necessary and designed to suit special jobs.

Lengthening joints

These joints are used for joining small lengths of wood pieces end-to-end to obtain large lengths many lap, butt and scarf joints come under this category.

Widening joints

These joints are used for joining wood pieces along their edges in order to obtain increased width. Rebate, butt, tongue and groove are quite commonly used for this purpose.

Framing joints

These joints are used to connect wood pieces at desired inclinations and commonly employed in frame work. This category includes, mortise and tenon, bridle, rafter, mitre, lap dovetail, notched and scarf joints.

Box joints

These joints enable joining of wooden planks and scantlings at desired inclination so as to obtain box shaped structures and wooden cases. Lap rebated open and secret dovetail, corner having mitre haunched mortise and tenon and corner locking joints are commonly used for this purpose.

Circular joint

These joints are used for connecting wood pieces to form a hollow cylindrical structure. The joints commonly used for this purpose are butt, hammer head key, blind mortise tenon scarf and dowelled joints.

Some common joints

Dowel joint

Dowels are thin small round sticks made from hard wood and are employed in various ways. Some common uses of dowels include their use as reinforcements for butt and mitre joints as a substitute for mortise and tenon joints in small articles in securing loose parts to a product and as strengtheners to circular, square and irregular forms. While making a dowel joint it should be ensured that the locations in the dowel holes in the two mating part are in perfect alignment.

Grooved joints

Many types of grooved joints are used in wood work. In some other the grooves run parallel to the grains and in other across the grains called 'dadoes'. some of the grooved joints are concealed and some are open. A common example of this is tongue and grooved joint, which you can easily notice in filling of door panels. Other grooved joints include rebate and spline joints.

Mitre joints

These joints can be readily noted on the corners of picture frames. Their use facilitates such joints at which no end grains of the wood pieces are visible. Apart from glueing, these joints are usually strengthened by means of dowels, nails or hard wood splines etc.

Different types of joints

Objectives: At the end of this lesson you shall be able to
- **state meaning of half lap joints**
- **explain various types half-lap joints**
- **state the uses of half lap joints.**

Half lap joints

– A half lap joint consists of half the thickness cut away from one component and half the thickness cut away from the other.

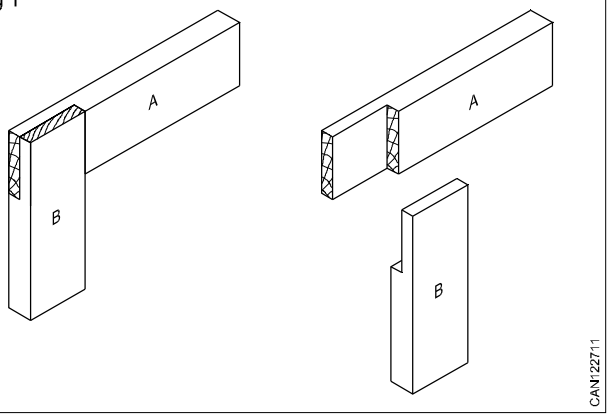
– **Corner half lap joint**: In flat frame construction, leg and rail construction for lengthening posts, when building sheds, the corner half lap joints is stronger than the tee-half lap.

– Half lap joints are frequently used to connect two wooden pieces such as boards, frames where an even surface is required.

– When the intersecting member cross each other at centre they are known as centre half lap joint or cross half lap joint.

– When it is fixed at the ends it is known corner half lap joint. (Fig 1)

Fig 1



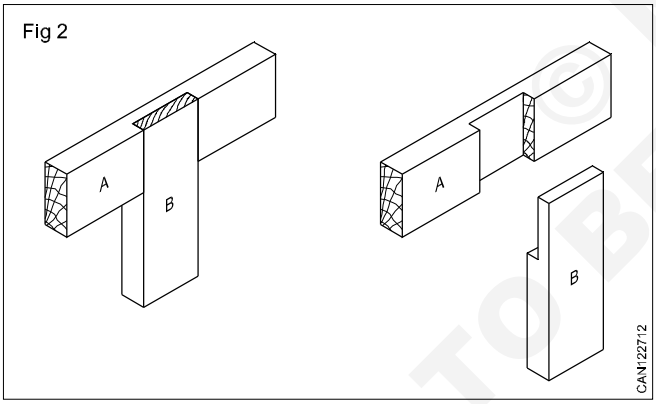
– If it is in dovetail joint it is called half-lap dovetail joint.
– Dove tail joints are always stronger and offer greater resistance to tension.
– Half lap joints are glued and if needed are reinforced by means of concealed screws.
– It is to be noted that a halved joint is always lapped but a lapped joint is not always halved.

Tee-half lap Joint

It is used in frames where the end of a rail meets another piece some distance from the end both faces of the pieces finishing flush.

The joint is used in cabinet frames and where a strong joint is not required. (Fig 2)

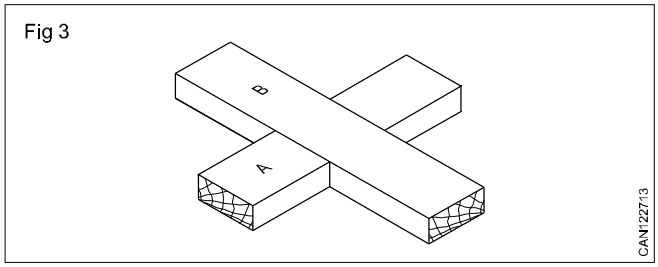
Fig 2



Cross half-lap joint

It is used where the members cross each other and the faces of the pieces are required to be flush as in diagonal stays of tables and chairs, and frames of cheap panelled doors. (Fig 3)

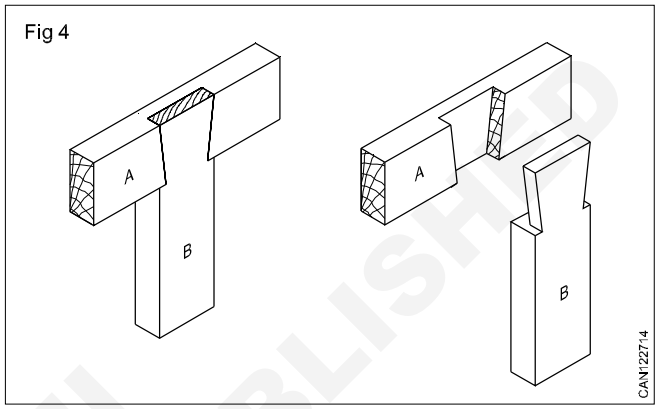
Fig 3



The dovetailed half lap

It is used for connecting the ends of cross rails in frame like construction where an outside strain occurs. This joint can be separated in only one direction. (Fig 4)

Fig 4

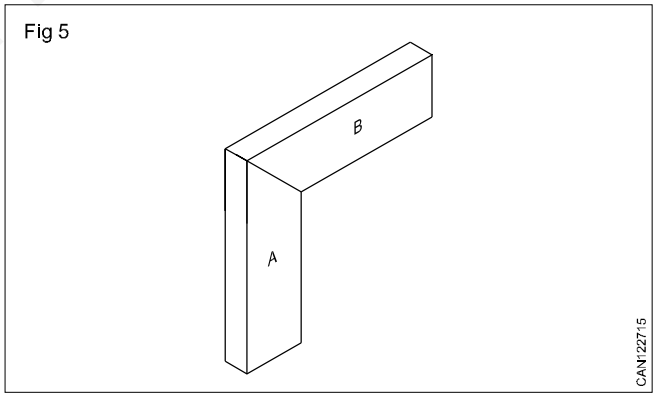


Mitre half lap joint

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 5)

Fig 5



Mortise and tenon joints

Objectives: At the end of this lesson you shall be able to
- **state the various types of mortise and tenon joints**
- **identify the types of mortise and tenon**
- **state the uses of mortise and tenon.**

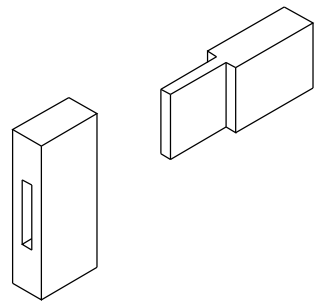
The most common and strongest form of framing joint. There are many forms of mortise and tenon joints. These are mainly used parallel frames of doors, carcasses of cabinets and for joining rails to leg of table and chairs.

The main parts the tenon cut on the end of the member generally called rail, then the mortise, a recess or hole cut in the edge of the second member called the stile, into which tenon fits . The tenon is usually glued into the mortise.

Common mortise and tenon Joint

They are used in same thickness and where a rail meets stile some distance from the end. The tenon is the full width of the rail and passes through the stile. Wedges may be used to strengthen the joint. The thickness of the tenon is usually about 1/3 the thickness of the timber depending upon the size of the mortise. As a general rule the width of the tenon is limited to six times its thickness as wide tenons may buckle when wedged and split the stile. (Fig 1)

Fig 1



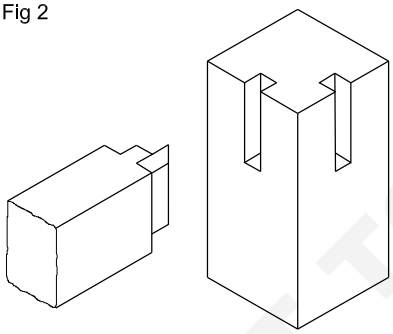
THROUGH MORTISE AND TENON

CAN122721

Haunched mortise and tenon

It is used where the rail meets the stile or leg at the end. To prevent the teneon from slipping out of the end of the mortise, the tenon is cut narrower and the mortise reduced to suit. A small portion of the base of the tenon is left the full width of rail to form a haunch which fits into a recess called a haunching. The length of the haunch is usually equal to the thickness of the tenon and its purpose is to prevent the rail from twisting. (Fig 2)

Fig 2



HAUNCHED MORTISE AND TENON

CAN122722

Barefaced mortise and tenon joint

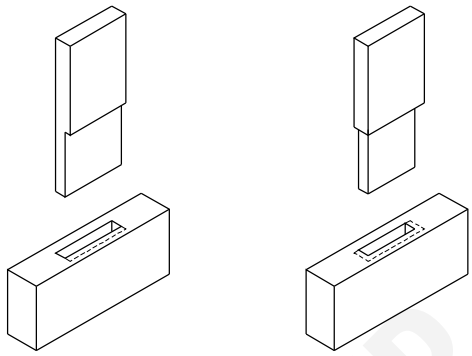
This joint is used where the rail is of thinner material than the stile or the leg of ordinary table. The tenon has only one shoulder and is approximately half the thickness of the rail.

When two rails meet the adjacent faces of the table legs etc it is necessary mitre the ends of tenon so that each tenon is cut as long as possible. (Fig 3)

Stub mortise and tenon or (stump)

When the tenon does not pass right through the material it is know as stump or stub tenon. It is used in high class cabinet work, so that the end grain is not seen on the edge of the stile. The length of the tenon is usually only about 2/3 of the width of the stile, depending upon the required strength for the joint. The mortise is cut to suit added strength may be obtained by using fox wedges. (Fig 4)

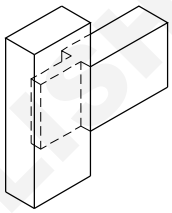
Fig 3



BAREFACED M&T (HAUNCHED)

CAN122723

Fig 4



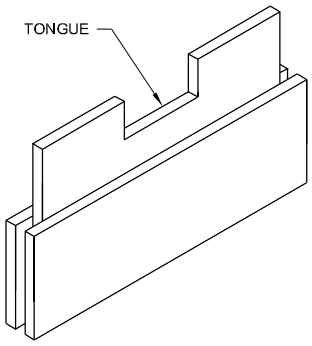
STUB MORTISE AND TENON

CAN122724

Double mortise and tenon

Where the joining rail is wide, it is usual to divide the width of the rail in to two tenons so that the width of each tenon does not exceed 6 times its thickness. A haunch is used on the outside tenon for top or bottom rails and a tongue is usually left between the tenons to prevent the rail from warping and light showing through if the stile sinks. (Fig 5)

Fig 5



DOUBLE MORTISE AND TENON

CAN122725

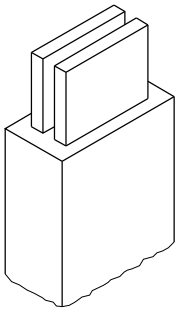
Twin mortise and tenon

These are used on very thick timber where a very strong joint is required. The thickness of the rail is divided into five parts to produce two tenons side by side. (Fig 6)

Compound tenon

It is used where the timber is wide and thick as in the middle rails of some doors, where lock is mortise in the stile. It consists two double tenons side by side. (Fig 7)

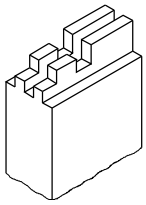
Fig 6



TWIN TENONS

CAN122726

Fig 7



COMPOUND TENONS

CAN122727

Uses of joints

Objective: At the end of this lesson you shall be able to
- **state the uses of framing joints, angle joints and lengthening joint.**

Framing joints : These joints are mostly used with windows, doors, table, chair and photo frames etc.

The four corners of the wooden frames are cut and joined together, by either bridle, mitre, dovetail or notched & scarf method.

Joints used in frame-like constructions, where the members are usually jointed end to edge, with their edges at right angles

Angle joints : These made in the corners of two wooden planks or in between a long wooden plank, the corners are joined with 90° angle, (e.g) Book shelf, cup board, lengthening box.

These joint generally used for fixing together pieces. which have their faces at right angles and edges flush.

- Corner angle joints chiefly used in box like construction, such as solid cabinets, boxes, drawers etc.
- Housed joint - consists of sinking the end or edge of one member into a trench or groove in the face of another member used chiefly for fixing shelves or divisions in book cases, cabinets, treads of step ladders, stairs etc.

Lengthening joints: These are made when the sufficient wooden pieces are not available to increase their length. These are made with lap and scarf joint (e.g) Beam.

These joints are used for joining small lengths of wood pieces end - to -end obtain large lengths. This joint is generally used for building construction roof table legs , rails, banner and frames.

Preservation of timber

Objectives: At the end of this lesson you shall able to
- **state the necessity of preservation**
- **explain the types of wood preservatives**
- **state the application of different types of preservation.**

Necessity of preservation

In order to prolong the life of wood constructions it is necessary to apply some form of protection or preservative.

The timber may be coated with the preservative or it may be impregnated (i.e. saturated) with it.

As timber is mainly used for two classes or work. External and internal, the preservatives required may be divided into two groups.

1 Preservatives suitable for protecting wood used for posts, poles, railways sleepers, bridges

2 Preservatives required to protect the wood work of walls, ceilings furniture etc.,

Preservatives for external wood work

To lengthen the life of timber used for external work it is necessary to coat or impregnate the wood with a solution which will reduce its liability to insect attack and decay (Fungus growths)

These preservatives are divided into

a) Oil preservatives

b) Water soluble preservatives

c) Mechanical preservatives

a) Oil preservatives

i) Coal for creosote/creosote oil black or brownish oil produced by the distillation of coal tar.

Good protection from termites and decay provided the oil penetrates deeply and evenly into the wood in sufficient quantity

Easy to apply and does not evaporate quickly

If several coats of oil are applied hot with a brush or spray it will give satisfactory results.

Used for fencing posts, telegraph poles, floor joists and wall plates.

ii) Tar

Used for the same purpose as creosote oil

Less effective and less poisonous to fungi and insects.

More difficult to apply and does not penetrate very far into the wood

Commonly applied either hot or cold with a brush or swab.

iii) Chemicals in oils

10z to 1 pint turpentine or kerosene solutions of :

Zinc or copper naphthlenate; trichlor or pentachlor phenol; para or orthoichlor benzene.

These solutions are suitable for internal and external wood construction

iv) Patented or proprietary preservatives

Following preservatives have been found to give good results: Novoleneum peterleneum and jodelite.

b) Water solution preservatives

These are chemicals which are soluble in water.

When applied to the wood assist in preventing decay and the action of insects. They will leach out when exposed to moisture

(i) Zinc chloride

Available in solid form or highly concentrated solution

Added to water to make a dilute solution containing 2% to 5% zinc chloride.

The preservative is cheap and easy to handle.

It is excellent for use against fungi.

Use large quantity of solution for effective against termites.

Zinc chloride is liable to be washed out of timber used under wet condition.

ii) Sodium fluoride has similar properties to zinc chloride, but more expensive

It is a white powder, soluble in water to about a 4% solution.

iii) White arsenic

Dissolved in water

Very effective preservative against termites.

Poisonous to human beings and animals.

It must be used with caution.

iv) Mixtures

Where both termite and fungi attack may be encountered it is advisable to use either zinc chloride or sodium fluoride and arsenic.

There are several methods of impregnating the wood with the solution.

The most effective involves the use of pressure chamber which the force the preservative in the pores of the wood under heat and pressure.

Another method consists of placing the seasoned timber in a tank of hot preservative for some hours and then immediately removing it to a tank of cold preservative. This method is commonly used and gives satisfactory penetration.

c) Mechanical preservatives

This term applies to preservatives more or less coverings over the wood, such as:-

i) Sheathing

Timbers that are continuously in contact with water, such as the bottom of boats, wharf piles and pontoons are some times protected from marine bores and pests by covering the wood with sheets of copper or muntez metal.

Small explosive charges have been effective in eradicating the torpedo or ship worm from wharf piles.

ii) Charring

This method consists of charring the outside of the post or pole by means of an oil blow torch or oxy-acetylene torch.

The latter type of torch is to be preferred, as it produces a fine textured and harder char.

The coating of charcoal will not support fungi growth and therefore protects the wood beneath.

2 Preservatives for internal wood work

Timbers used for walls, ceilings furniture etc generally require some form of protection against changes in moisture content in the air, dust and soiling due to continual handling by persons, also to prevent attacks of furniture borers and beetles.

All timbers are affected by changes in atmospheric conditions it swells when the air is damp and shrink when it is dry. The expansion and construction of wood can be greatly reduced if a protective covering is applied to exclude the moisture changes in the air.

External and internal walls and ceilings are usually painted; the articles of furnitures are generally stained and given some form of transparent coating to protect the timber.

The latter method also prevents the wood from being soiled and allows the natural grain figure to be seen.

The preservatives for the above purpose are more in the nature of the timber finishes and are explained under wood or timber finishes.

Different type of housing joints and uses

Objectives: At the end of this lesson you shall be able to
- **state the definition of housing joint**
- **identify its purpose and uses**
- **state the types of housing joints.**

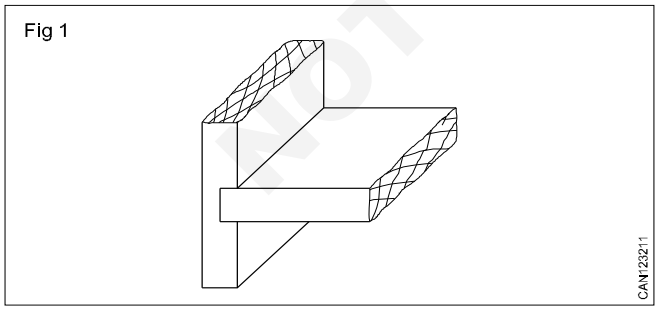
The housing joint consists of sinking the one end or edge of one member into a groove or trench in the face of another member. It is mainly used in fixing shelves or divisions in book-cases, cabinets, treads of step ladders, treads of stairs etc.,

Types of housing joints

Full housing joints (Fig 1):

The whole end or edge is fitted into an enough trench and the joint is visible on both sides of edges.

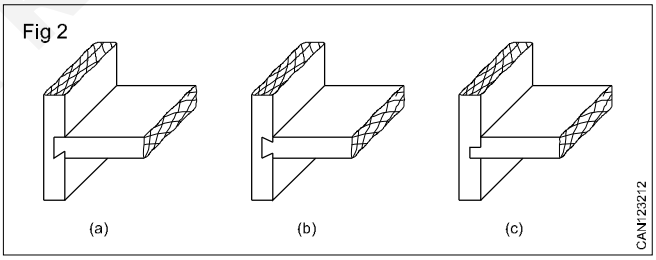
Fig 1



Dovetailed housing joint (Fig 2)

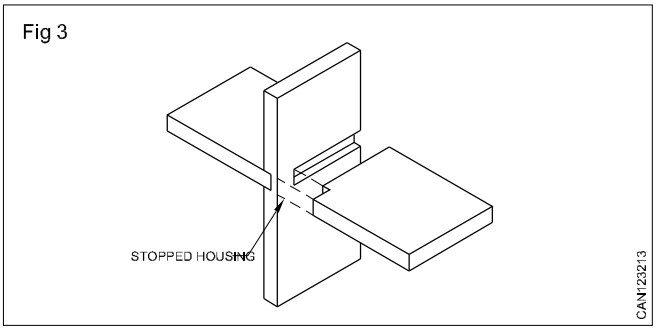
Wherever a stronger joint is required it is used. The end of the shelf is dovetailed on one or both sides and fitted into dovetailed trench. The depth of the trench is about 1/3rd thickness of the plank.

Fig 2



Stopped housing joint (Fig 3): 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.

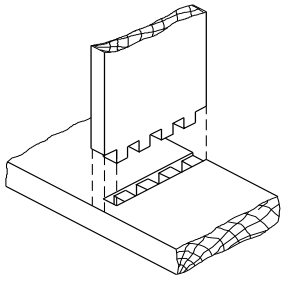
Fig 3



Car case pinned joint (Fig 4)

This joint is generally used in car case construction for fixing partitions, where all the member are of solid plywood. The end of partition piece is divided into a number of short tenons which fits into suitable mortises in the top and bottom pieces. Tenons may pass through the bottom to be wedged, making the joint stronger. The mortised pieces is slightly trenched to improve fitting.

Fig 4



CARCASE PINNED JOINT

CAN13214

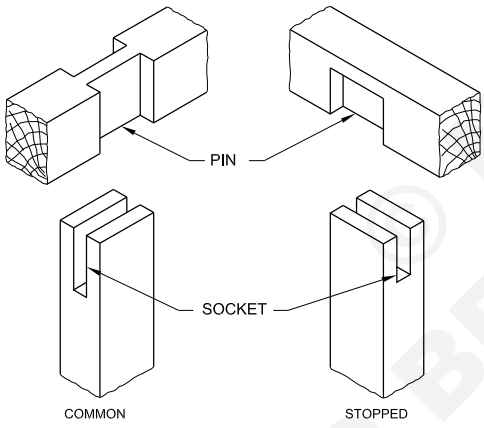
Bridle joints, types and uses

Objectives: At the end of this lesson you shall be able to
- **state the various types bridle joint**
- **explain the uses of bridle joint.**

These joints are sometimes used in place of mortise and tenon joints where a stronger joint than a halving is required. Here instead of tenon an open slot or socket is cut in the end of the rail to fit over a pin produced by trenching both sides of the stile. The pin and sockets are usually 1/3rd the thickness of timber.

Common or Tee-bridle Joint (Fig 1)

Fig 1



TEE BRIDLE JOINT

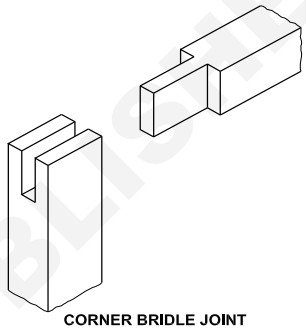
CAN123221

In place of common mortise and tenon joint where one member meets the other some distance away from the end. Some times seen on small tables and stands where a leg meets the middle of rail. Pins can be used to strengthen the joint. It is required to hide the end grain the pin is not cut the whole width of the timber and the socket is shortened.

Corner bridle joint (Fig 2)

Some times it is called the open mortise and tenon joint. It is used as a substitute the haunched mortise and tenon at the corners of frames.

Fig 2



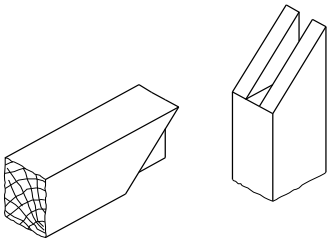
CORNER BRIDLE JOINT

CAN123222

Mitre corner bridle joint (Fig 3)

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 3



MITRED BRIDLE JOINT

CAN123223

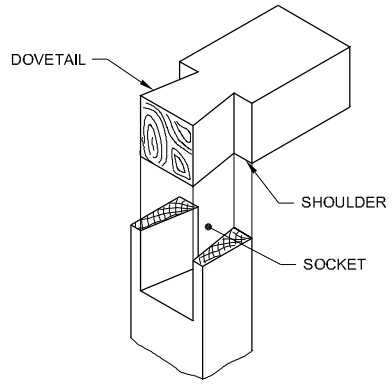
Dovetail joints and their function, uses

Objectives: At the end of this lesson you shall be able to
- **state the various types in dovetailed joints**
- **explain the uses of each type and function.**

These are the strongest form of an angle joint used in cabinet work. The joint consist of one or more dovetails cut on the end of one member and a number of projections called pins on the end of the other piece, which are cut to fit into the recesses (pin sockets) on each side of the dovetails and the added amount of gluing surface compared with other angle joints.

Single dovetail Joint (Fig 1)

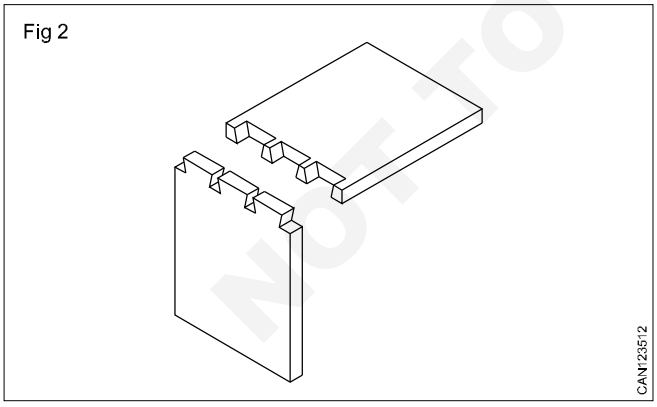
Fig 1



This joint consists of only one dovetail filling into the dovetail socket in the second piece. A very strong joint used for narrow pieces such as brackets top, bottom rails of carcases etc.

Common dovetail joint or through dovetail joint (Fig 2)

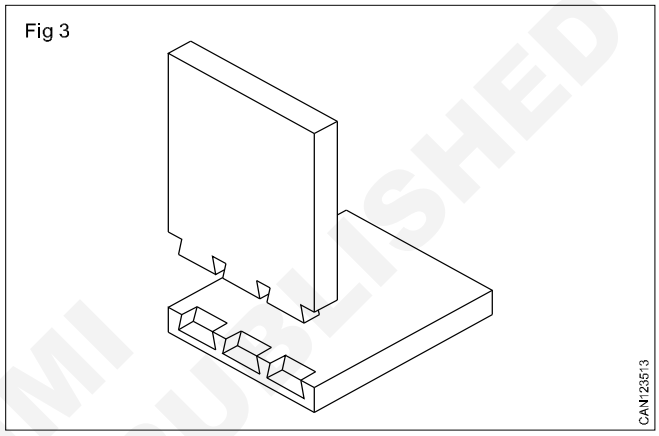
Fig 2



It is the strongest joint. It has two or more details. End grain is seen on both sides of the joint used in making strong boxes, rails of tea trays and in carcase construction etc.

Lapped dovetail joint (Fig 3)

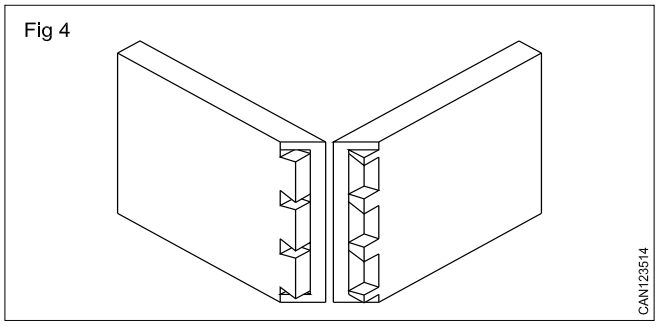
Fig 3



The lap is left on outside of the pins to cover the end grain of the dovetails. The lap is usually from 1/4 to 1/8 the thickness of timber. If a lap is left on both pieces to cover the end grain of the pins as well as the end grain of the dovetails the joint is called double lapped dovetail. This joint used joining the front and sides of table drawers.

Secret dovetail (Fig 4)

Fig 4



In this dovetail joint there is a double lap on both sides of the joint, which is mitred to hide all end grain assembled joint has the appearance of plain mitred used in high class cabinet work and jewel boxes, where appearance and strength are required.

Glues, types and their uses

Objectives: At the end of this lesson you shall be able to
- **name different types of glue**
- **explain the preparation of glue and uses.**

It is essential for the wood worker to know the adhesive power of glue especially, with regard to the weather condition of the places, where he carries out his work how to prepare and apply it.

There are various types

1 Animal Glue

2 Casein Glue

3 Resin Glue

4 Vegetable glue

5 Blood albumen glue

1 Animal glue

Animal glue is a mixture of skin, bone and acid.

Preparation of animal glue

– The animal glue ought to be prepared as follows.

– Break up the glue into small pieces, wash them thoroughly put the pieces into the double boiler glue pot containing sufficient cold water to cover the glue.

– Allow it to soak for about fourteen hours, after which time, a good grade of glue, should have absorbed, most of the water and swollen into a jelly form.

– The more water it has absorbed the better it is. Heat now the glue, stirring well every now and then. When it is ready it should run like thick oil.

Glue loses some of its strength at every reheating. It would be very convenient if the pot could be covered in order to prevent the dust and smoke from getting in.

2 Casein Glue

– Casein glue is a chemical extract from the curds of skimmed milk and other ingredients reduced to a fine light yellow powder.

– A quality for this powder is mixed by pouring in an equal quantity of cold water and stirring the mixture briskly. The glue is thus got ready.

Casein glue should be consumed within 8 hours at most; after this time it losses its adhesive power.

– Casein glue is water resistant. As this glue sets slowly timber glued with it should be left untouched for about 16 hours.

3 Resin glue

Resin glue is a product of certain white powders mixed, with cold water and used like casein glue as explained above.

– It is stain less and water proof and makes a perfect joint. It is used extensively in the manufacture of plywood, in plane and cabinet workers.

4 Vegetable glue

It is made from the starch, obtained from roots, grains and corn of trees by treating the same, with acid and by grinding to a powdered form.

This glue is used cold, but its viscosity is so high that it can be applied only by sponjing machine.

It is therefore not suitable for general wood work. But used only in plywood industries.

5 Blood albumen glue

– It is made by adding an alkali to beef blood and is commercially available in the form of flakes.

– While using, these flakes are dissolved in water about an hour earlier, to form a liquid solution.

– It is a strong bond and is water proof.

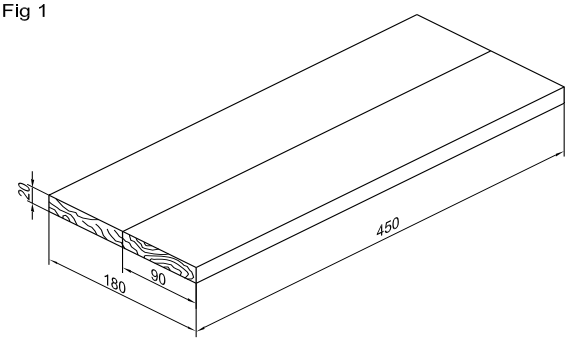
Broadening joint

Objectives: At the end of this lesson you shall be able to
- **state the description of broadening joint**
- **explain the various types of broadening joint and application.**

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 1)

Fig 1

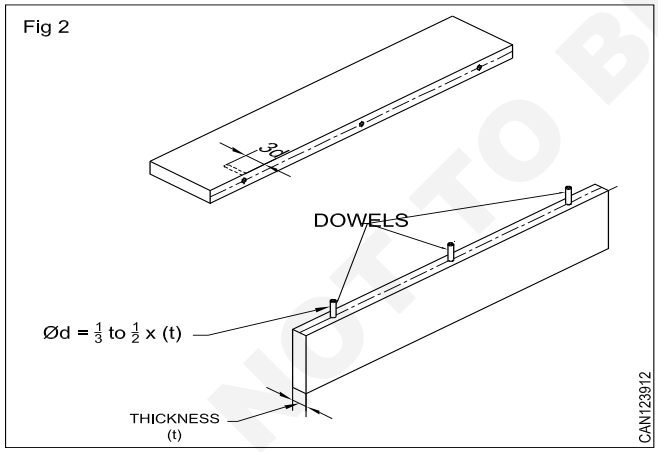


It is used in table tops and cores for veneers (core board).

Cheap constructional work, such as packing cases, corrugated fasteners are often used to hold the pieces together and seldom used in cabinet work.

Dowelled joint (Fig 2): Similar to the butt joint, added strength being supplied by the addition of dowels glued and inserted into holes in each edge and the boards cramped up.

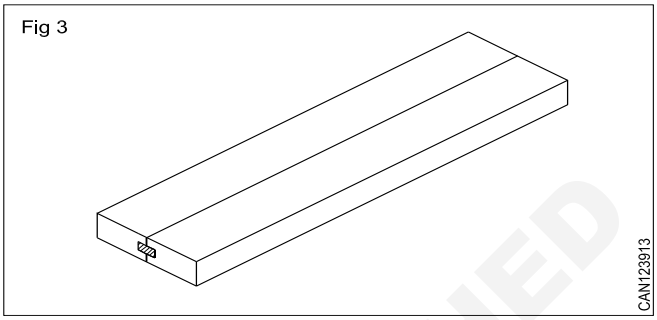
Fig 2



Dowels of diameter equal to 1/3 to ½ thickness of timber inserted to each joint pieces to a depth of 3 times diameter of dowel. This is not suitable for boards thinner than 13mm. This is used for table tops, etc., where a stronger joint than the plain butt joints is required.

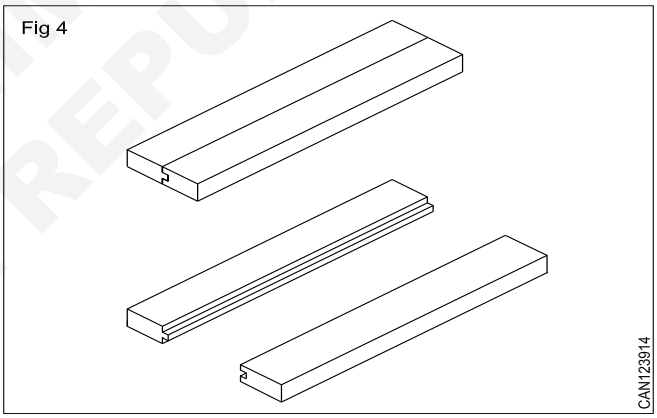
Tongued joint (Fig 3): For joining over 13mm stuff the edges are grooved with a plough plane to about 13 mm deep and a loose tongue glued into the grooves. The grain of the tongue should run across the joint for added strength. The tongue could be plywood.

Fig 3



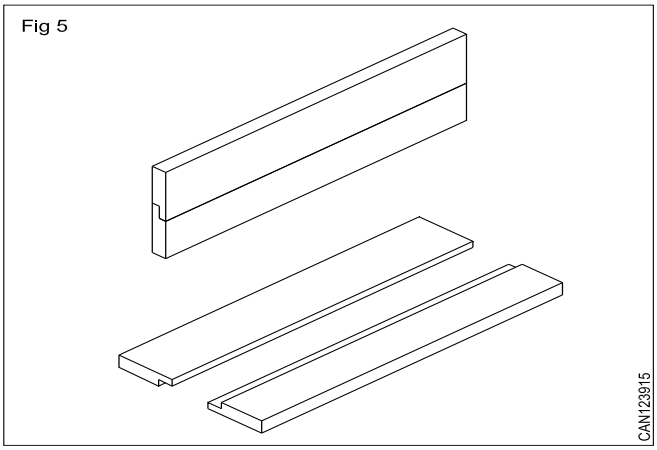
Tongued and grooved joint (Fig 4): A common form of widening joint used in flooring boards and better types of packing cases etc., When worked by hand a pair of planes called matching planes are used one plane producing a tongue and the other a groove into which the tongue fits. It this joint is used for desk tops, etc., glue is necessary to make the joint permanent.

Fig 4



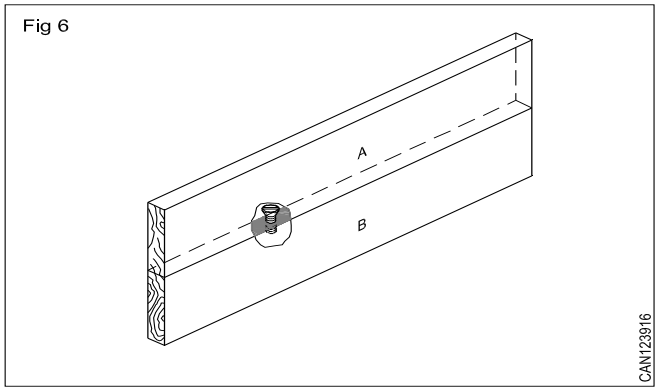
Rebated joint (Fig 5): This joint consists of rebating both pieces, gluing and cramping. The purpose of the rebates being to give extra gluing surface used for corner joints of boxes. cabinet carcases, drawers etc., which are made from solid wood.

Fig 5



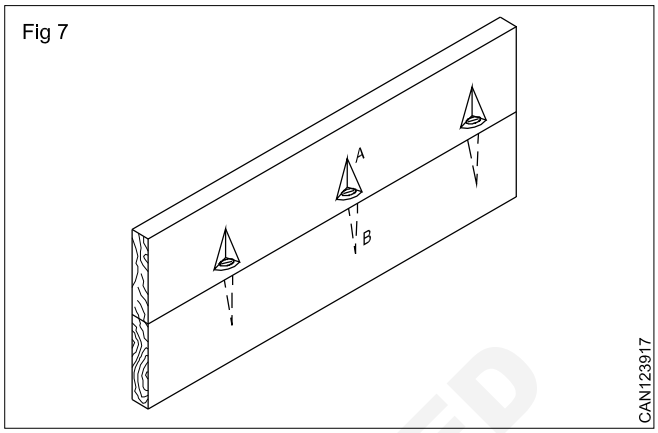
Secret screwed butt joint (Fig 6): This joint are used to strengthen butt widening joints. Useful for joining greasy timbers which do not glue easily. The heads of the screws hold the members of the joint together mechanically and, if necessary, the job can be worked on immediately after assembling.

Fig 6



Pocket screw butt joint (Fig 7): This joint is used in butt joint similar to secret screwed joint instead a pocket is chiselled as shown in Fig 7 in one of the joint piece and screw is driven through the pocket to other piece of joint.

Fig 7



Setting of end side according to annual rings as well as matching the grain stranding

Objective : At the end of this lesson you shall be able to
- **state the setting of end according the grain.**

Description: Widening joints are used to make wider boards by joining narrower ones edge to edge. Whichever jointing method is chosen, care should be taken to ensure the curve of the Annular rings.

As timber dries out, its Annular rings will tend to try and straighten. Reversing their direction in this way minimises the degree to which the widened board will cup or warp.

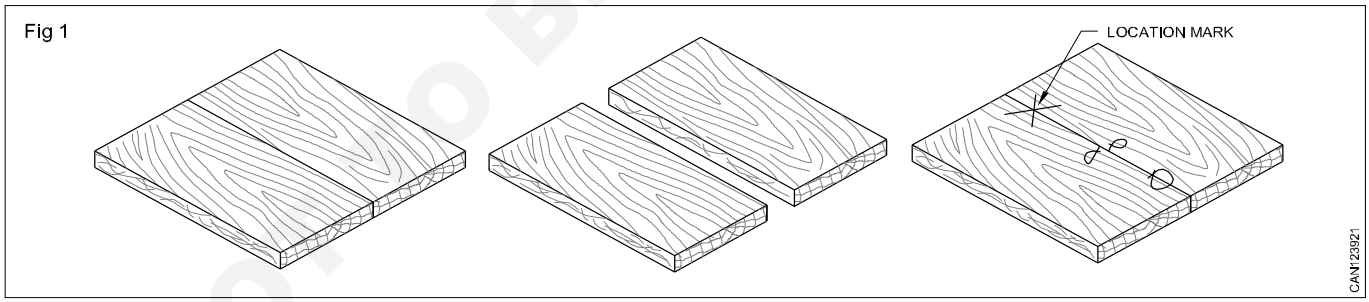
To avoid problem almost completely, choose boards which have been sliced radially from across the centre of the tree, and whose annular rings are therefore close to being at right angles to each face.

Setting of end side

Select edges to be joined (Fig 1): Find the direction of the grain on the sides of the boards (test by planing if necessary) and mark the direction with arrows. This enables the finished board to be planned in one direction.

Place the pieces with the edges to be joined together and make with a distinguishing mark over the joint.

Fig 1



The edges to be joined should be selected so that the pieces are alternately heart side up and heart side down. This reduces the amount to be planed of after gluing should there be any “Cupping of the pieces.

Shooting the edges (Planing): Hold the pieces in the vice with their marked faces together and short the edges with the trying plane. (If one board is narrower than the other they may be ‘G’ cramped together or each edge may be planed separately)

The alignment of the pieces when in position with straight edge.

Test the fitting of the edges by holding to the light. The light should not pass through the joint. The main purpose of joint to show the joint not visible to the naked eye.

Method of dowel application

Objective: At the end of this lesson you shall be able to
- **state the method of dowel application.**

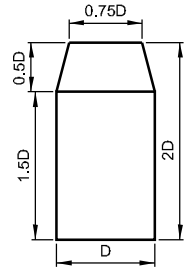
Dowel pins are used to hold the carpenter joints in their proper relative position.

Method of dowel application

Prepare the dowel pin (Fig 1)

- Select the wood.
- Make the dowel pints 1/3 to 1/2 thickness of timber.

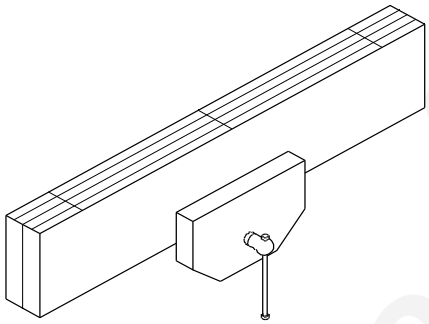
Fig 1



Marking (Fig 2)

- Position of dowel pin.

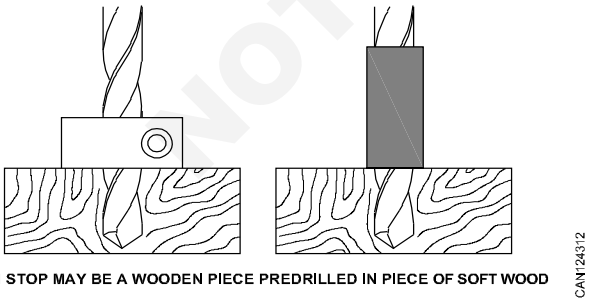
Fig 2



Drilling (Fig 3)

- Drill to the required depth of bowel pin.

Fig 3



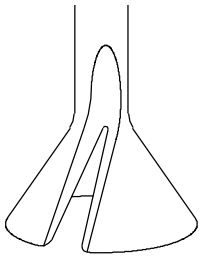
Counter sink

- Counter sink the dowel holes slightly in order to take surplus glue.

Trimmer (Fig 4)

- Cut the dowel pin for the required size.

Fig 4



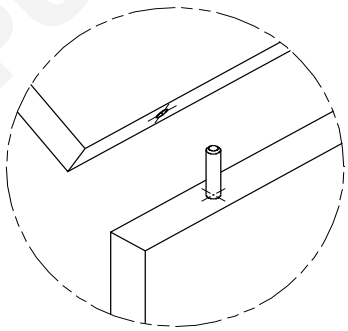
- Slightly level the ends of dowel pins by the trimmer.

Gluing

- Before inserting the dowel pins apply glues in the holes of plank.

Dowel pin Fixing (Fig 5)

Fig 5

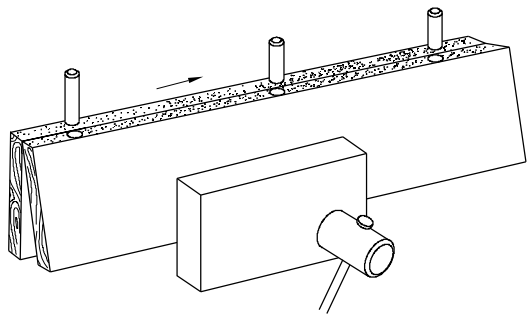


- Insert all the dowel pin in one plank.
- Care should be taken to see that half the height of the dowel pin is upwards.

Assemble the joint (Fig 6)

- Slowly place the other plank so that the dowel pin of the first plank.
- Gently tap it and make a close fitting.

Fig 6



Advantage of adhesives use and their types

Objectives: At the end of this lesson you shall be able to
- **state the advantage of adhesives**
- **explain the uses of adhesive and types.**

Advantage of adhesives

- The adhesives materials allows joint substrates with different geometries, sizes and composition. With the adhesives we can joint wood, glass, plastics, metals, ceramics.
- The use of adhesives eliminates the corrosion.
- The use of adhesives as bonding material does not produce any deformation in the materials, reducing the manufacturing cost and improving the aesthetics of the product.
- Adhesives do not produce any mechanical aggression to the substrate and avoid any damage to the structure of the material.
- Adhesives reduce the product weight.
- Increasing the resistance to impact and fatigue resistance using elastic adhesives, increasing reliability and product life cycle.
- Homogeneous distribution of tension throughout the union.
- Adhesives joint reduce noise and vibration.
- To reduce the manufacturing cost adhesive joints reduces the number of components such as screw, nuts, washers, rivets, etc..,
- Sealing function and protection against corrosion is possible by adhesives.

Types of adhesives and uses

- **Structural adhesives**

  This adhesives can carry significant stresses, and land themselves of structural applications.

  Pressure sensitive adhesives.

  Durable bonds for lightly loaded application.

- **Synthetic rubber adhesives**

  Use in furniture industry.

  Synthetic rubber adhesives.

  Use in ventilated surroundings.

- **Synthetic rubber adhesives (Heat roof adhesives)**

  To bond plywood, mdf, particle board to laminate.

  Use in furniture upholstery and foot wear industries.

  Use in bus body building industries.

- **Instant adhesives.**

  Used PVC door assembling.

Lengthening joints, types and applications

Objectives : At the end of this lesson you shall be able to
- **state the various types of lengthening joints**
- **explain the application of lengthening joints.**

Lengthening joints

Description

These joints are also known as longitudinal joints or spliced joints. These joints are used for joining small lengths of wood pieces end to end to increase the length of wooden member. The method of lengthening depends upon the situation of a member in a framed structure.

These joints are more useful in building works, such as beams.

Types of lengthening joints

1 End half lap joint

2 End over lap joint

3 End bevel lap joint

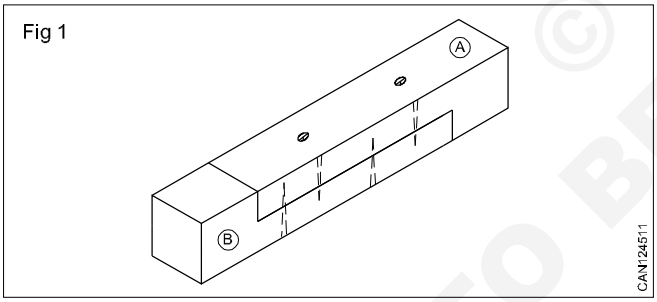
4 Table scarf joint

5 Table scarf joint with wedges

6 Bevel scarf joint.

1 End half lap joint (Fig 1)

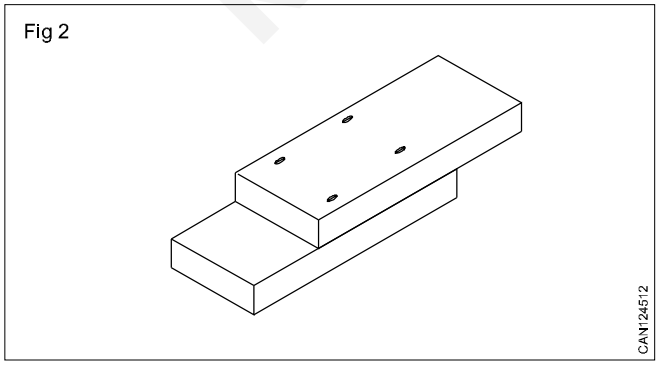
Fig 1



Two pieces of wood are cut half lap and joined. Both sides of wood are joined with screws. The length of the jointed is 4 or 5 times the thickness of the wood. This is particularly used where it supports the load on its bottom /top sides. (e.g.,) beam.

2 End over lap joint (Fig 2)

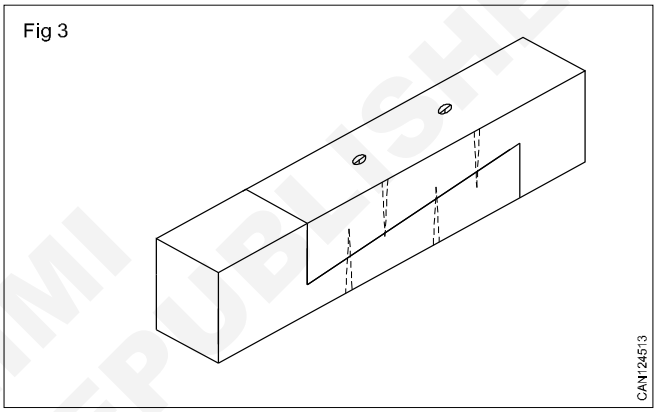
Fig 2



In this joint both wooden pieces are secured one over the other assuring the thick less 4 to 5 times as shown in the Fig no :1. Both pieces are joined with the keep of nail or screws. Adhesives may also be used in case if necessary this joint can be made with less time but less strength can only be obtained.In this joint used only for banner frame.

3 End bevel lap joint (Fig 3)

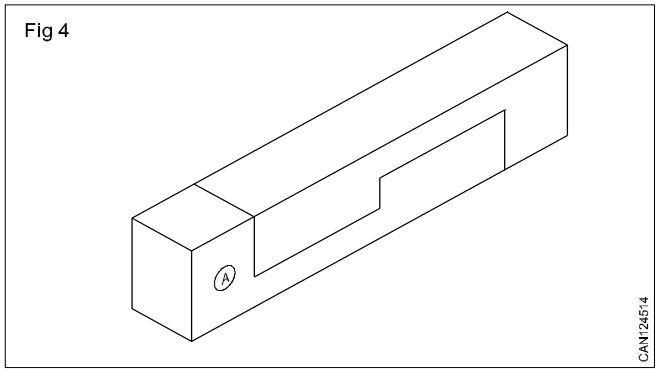
Fig 3



In this joint wooden pieces secured one over the other like end over lap joint But bevel is made for the joint screw in the Fig 2. Joint can be made with screws or nails, like end bevel lap joint. This joint is stronger, than end half lap joint.

4 Table scarf joint (Fig 4)

Fig 4

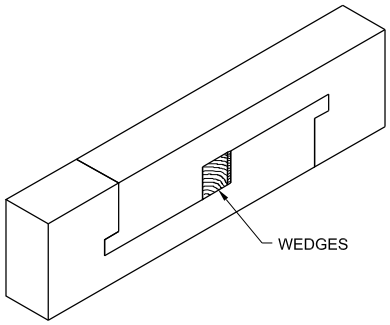


This joint is also made in step by step and is cut and fixed with in metal plates. Since these are weak joints, there has to be supports provided at the bottom.

5. Table scarf joint with wedges (Fig 5)

In this type of joint, the projections are made at the end of one piece and corresponding depressions are formed on the other piece. Two pieces are then secured together by means of two wedges. Such joints give good appearance since the uniform depth of the member, and can also be dismantled when required.

Fig 5

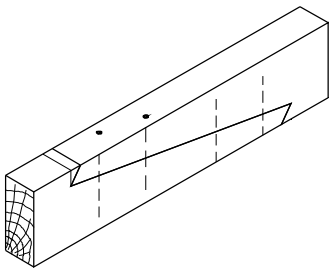


CAN124515

6. Bevel scarf joint (Fig 6)

This joint is used at the edges of thickness. Further additional strength glue can be applied between the joint and secured with nail and screws. Fig 6 metal strips can also be used for the additional strength. This type of joint can be used at where load and impact is applied. Generally this joint can be used on the beams.

Fig 6



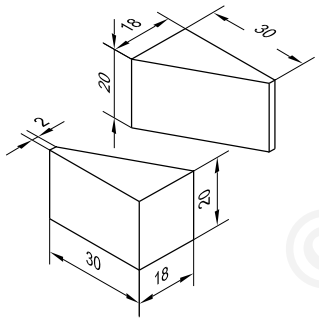
CAN124516

Setting of two taper wedges

Objective: At the end of this lesson you shall be able to
- **state purpose of setting two taper wedges.**

The purpose of setting taper wedges is for table scarf joint and necessarily to be made as per dimensions. (Fig 1)

Fig 1

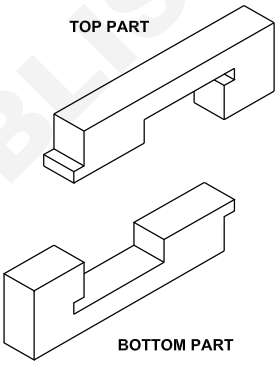


CAN114521

The top and bottom part of joints (Fig 2) should be assembled as shown in (Fig 3) with 20mm gap on joint push the wedges into the gap so that the wider face is levelled to the joint surface as shown in (Fig 3)

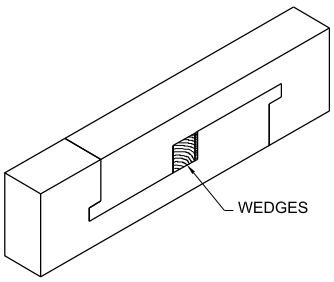
Complete the joints by finishing with smoothing plane.

Fig 2



CAN124522

Fig 3



CAN124523

Advantages of table scarf joints

Objective: At the end of this lesson you shall be able to
- **state advantages of table scarf joint.**

Advantage of table scarf joint

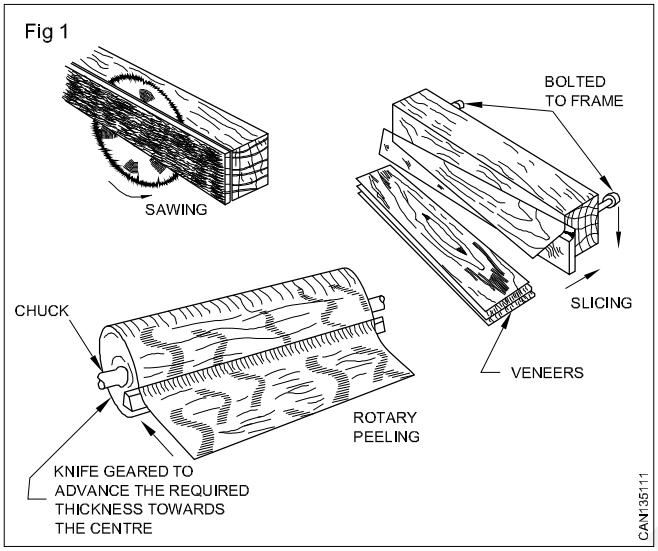
This drive has more strength and It can be separated whenever required. This annex drive is suitable where tensile force is more and can be used where few applied load is heavy. This annex drive is mostly used in making manufacturing of beams

Veneers

Objectives: At the end of this lesson you shall be able to
- **state the details of veneer**
- **state the advantage of veneer**
- **state the types of veneer.**

A veneer is a thin sheet of wood obtained from logs or fitches by rotary peeling, slicing or fine sawing. Fig 1

Fig 1



Veneers are used for decorating furniture manufacturing plywood, making laminated bent and moulded shapes and for surfacing various types of composite boards.

Originally veneer was used for decorative purposes only, being glued to the solid wood of furniture.

The figure veneer is glued to built up block board (core stock) plywood or particle board as a base or core.

Advantages of veneered construction

1 Decorative veneers are about 1mm thick and up to 25mm sheets have almost identical figure markings making it possible to produce a number of matched panels. Therefore it is economical then expensive figured timber.

2 In ordinary circumstances figured timber could not be seasoned successfully, but veneer allow this and use of figured timber with unusual and beautiful effects.

3 Veneer panels are less likely to check and warp. They are more stable and stronger than solid timber.

4 The core of veneered panels are made to any width length and thickness and built up of soft, light, straight grained using cheap timber or composite materials.

5 Bent or curved panels can be readily made from veneers.

Types of veneers

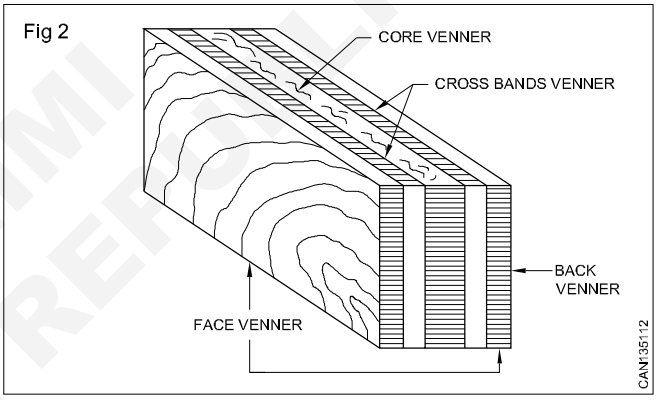
1 Core veneers

2 Cross band or counter veneers

3 Back veneers

4 Face veneers. (Fig 2)

Fig 2



1. **Core veneers :** The core in ply wood is the central ply which form a base or ground to which the face or figured veneers are glued. The thickness of veneers size from 2-6 mm.
2. **Cross - band veneers :** The cross-band veneers strengthen the core and reduce shrinkage and warping. The thickness of veneers size from 1.3 - 1.6 mm.
3. **Back veneers :** The unfigured veneers glued to the back surface of panels. Back veneers should be the same thickness as the face veneers.
4. **Face veneers :** These veneers are glued to the front surface of the panels. The thickness of veneers size from 0.3 to 1.6mm.

Plywood, types and advantage

Objectives: At the end of this lesson you shall be able to
- **state details of plywood and types**
- **explain the manufacturing of plywood**
- **state advantages of plywood**
- **state the application of plywood.**

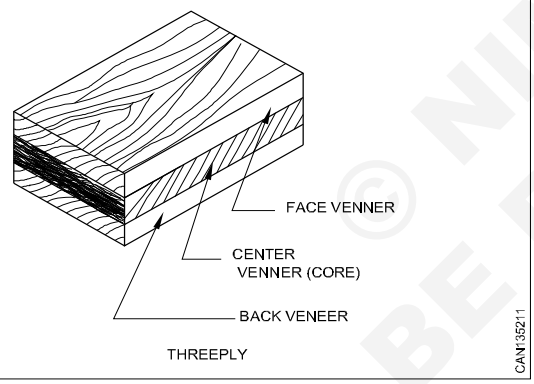
Plywood is an assembled product, when three or more layer of veneers glued together. Central layer is called "CORE" it is usually thicker and inferior wood than the face veneers. The number of ply in plywood is usually odd varying from 3 to 13. The direction of the grain in each layer is at right angles. These layer gives greater strength and stiffness in all directions on plywood. It prevents the plywood from warping and shrinkage.

Types of plywood

Plywood is the name given to an assembly of individual layers of veneers.

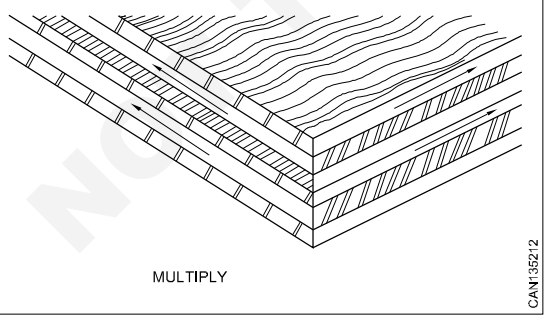
– Three ply consist a face, bottom and a core or inner play.(Fig 1)

Fig 1



– Multiply has a face, bottom with core of three or more ply. (Fig 2)

Fig 2



Manufacturing of ply wood

– Plywoods are made from rotary peeled veneers.

– The veneers are dried to a suitable moisture content for face, core and bottom qualities.

– The two methods of joining the ply for obtaining the plywood are

  – Cold pressing method

  – hot pressing method

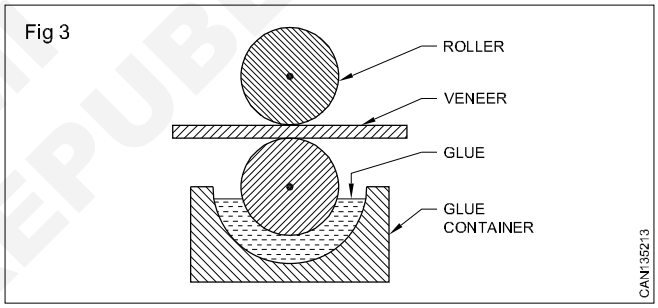
In cold pressing the adhesive are allowed to set at room temperature and no additional heat is provided.

In hot pressing the arranged plies are placed in a hydraulic press of which the levers are heated electrically.

The corresponding pressure and temperature employed are above 7 to 14 kg/sq.cm and 150°c respectively.

Three ply core is passed through automatic liquid glue spreaders and with the grain at right angles to the face and bottom. (Fig 3)

Fig 3



– In Multiply wood, the alternate veneers are glued and laid at right angles to the adjacent plies as required.

Gluing and pressing may have caused uneven moisture content in the boards.

– This is corrected by stacking and re drying to equilibrium moisture contact in a drying chamber or kiln.

– The faces of the plywood sanded or surfaced by a machine and trimmed to size with trimming saws.

Advantages

– Manufactured in very large sizes.

– It is lighter in weight, posses high uniform strength than solid wood.

– It is free from shrink, warp and warping.

– It can be easily worked and bent into shapes and designs.

– Plywood can be satisfactorily nailed or screwed near the edge without damage.

Top veneer can be given fine decorative effects to give attractive appearance. Curved surfaces can be easily built up.

Plywood grade

Objectives: At the end of this lesson you shall be able to
- **state the classification of plywoods**
- **state the sizes of plywood boards as per I.S. (Indian standards).**

Plywood grades

IS: 303 - 1975

1 Boiling water proof

2 Boiling water resistant

3 Warm water resistant

4 Cold water resistant

For the manufacture of boiling water proof and boiling water resistant grades, the spices of timber used are Aini, Birch, Laurel, Mango, Maple, Rose wood, Teak, Sissoo etc.

(Class I grade) IS: 303 - 1975

For warm water resistant and cold water resistant grades, the spices of timber can be from class-I or class II.

Classification of Plywood for general purposes

Classification for general purposes shall be of ten types like AA, AB, AC, AD, BB, BC, BD, CC, CD, and DD.

The type of plywood is designated by two letters.

The first letter designating the quality of face and second letter back.

The surfaces are classified into 4 types A, B, C and D.

Number of defects per square metre as per Table - 1 .

of I.S. 303 - 1975

A - 3 Nos.

B - 6 Nos.

C - 9 Nos.

D - No limit

Thickness of plywoods

Table 1

Board	Thickness in mm
3 ply	3,4,5 & 6 mm
5 ply	5,6,7,8 & 9 mm
7 ply	9,12,15 & 16 mm
9 ply	12, 15, 16 & 19mm
11 ply	19, 22, & 25 mm

Sizes of Ply wood Board (cm x cm)

240×120	180×90
240×90	150×120
210×120	180×90
210×90	120×120
180×120	90×90

Care and maintenance

Plywood should be stored lying flat on closely spaced bearers with a weighted cover on top of the stack prevent buckling. Do not stand sheets on edge.

To prevent the outer veneers chipping, especially when jig or band sawing

- Coat over the lines with shellac - both sides if necessary - allow to dry
- Cover the lines with "sticky" tape -both sides if necessary.
- Sand with the sheet between cheap ply or sides if necessary.
- If cutting two sheets at once, place them together with the faces inside.
- Use a softwood (spurred) auger bit or hole-saw and power drill for cutting holes- support the back firmly with waste ply or wood, "G" cramp if necessary.
- When veneering, glue face and back veneers at right angles to the outside plies.
- Select and order the correct grade of plywood; internal plywood is not recommended for external work.
- For painted external work, full the edges with putty and prime raw linseed oil thinned.

Application of plywood

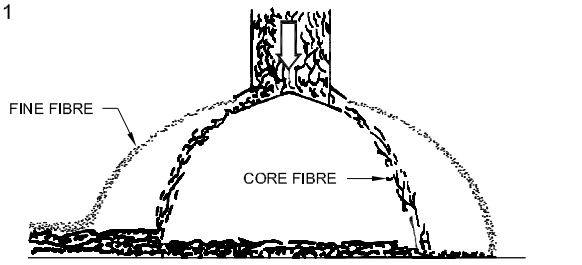
Work	Application
Building construction	For panelling of interior walls and ceiling, flush doors and cup boards.
Furniture construction	Backing of wardrobes, side boards all types of cabinet, drawer bottoms etc.
Coach work	Decorating of railway coaches, trams etc.,
Ship building	Fancy plywoods are used for furnishing and fitting of yachts, skiffs and racing boats.
Aircraft construction	Owing to the strength, durability and lightness, plywood have been found in the construction of aircraft.

Application of hard board, Insulation board, block board and laminated board

Objectives: At the end of this lesson you shall be able to
- **identify the different types of boards**
- **explain the manufacturing process of different boards**
- **state the application of hard board, insulation board, block board and laminated board.**

Hard board (Fig 1)

Fig 1



SCATTERING OF CHIPS AND FIBERS

Hard board, made by breaking wood chips, are reduced to fibres, and water is added to make a soupy pulp.

The pulp follows into a tracing mesh screen where water is drawn off to form a mat.

That mat is then pressed under heat to weld the wood to fibres back together by utilizing aligning the (natural adhesive in used) form them into hard thin, dry board sheets.

The sheet are cut into panels of various sizes as follows.

Thickness of the hard boards (mm)

Board	Thickness (mm)
Medium hard boards	6, 8, 10 and 12
Standard hard boards	3, 4, 5, 6 and 9
Tempered hard boards	3, 4, 5, 6, and 9

Width and length of hard boards (metres)

Width	1.2 metres
Length	1.2, 1.8, 2.4, 3.0, 3.6, 4.8 and 5.5 metres

Uses

Interior work - wall sheeting ceiling, panelling, flush door, sheeting for covering frames furniture carcase drawer bottom and cabinet back.

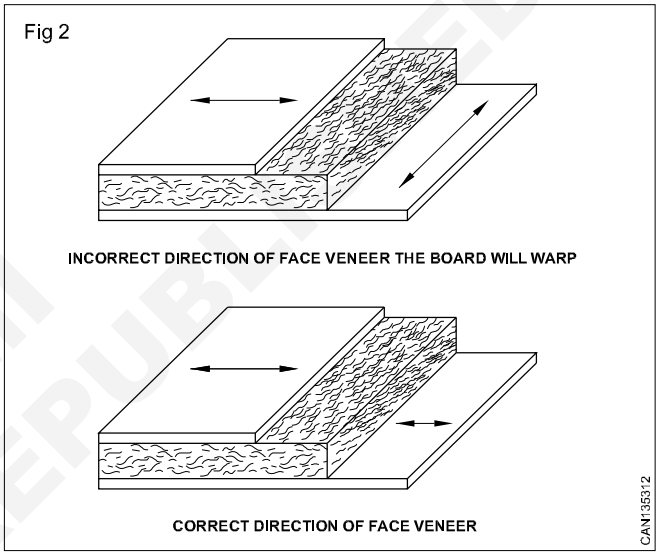
Insulation board (Fig 2)

Sizes available in the market. Thickness range from 12mm to 25mm.

Sheet size 1220 x 2440 is common and many other sizes also available.

The manufacture of insulation board begins by reducing wood chips to wood fibres by steam or mechanical process. Bagasse, a fibrous by product of sugarcane processing is another raw material used. The fibres are combined with water and chemicals using automatic controls. The mixture flows on a board moving screen where it is formed into large sheets of varying thickness by a felting process. The sheets are then dried cut and trimmed to finished sizes.

Fig 2



Uses

Insulation boards are manufactured for uses in building construction where a light weight, rigid panel with good thermal insulating properties is needed.

Insulation boards are made for both interior and exterior use. The interior type is usually a uniformly light coloured product with factory applied paint and is used as wall boards, wall plank and ceiling tile.

Exterior type insulation board is either saturated or coated with sulphate to improve its water resistance and strength when wet.

Exterior insulation board is used extensively as sheathing and roof insulation. It is also used a insulating form board and sound descending board.

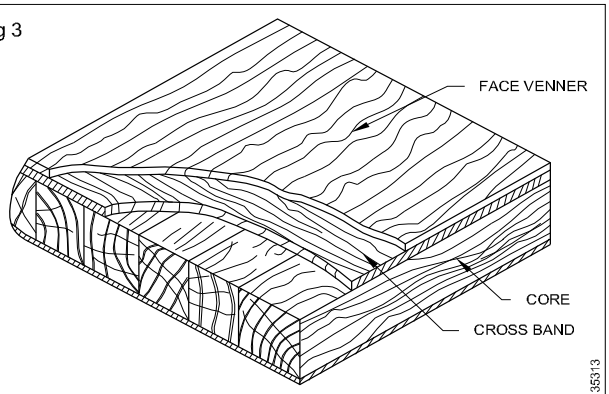
Block board (Fig 3)

Block board are made up of country wood strips of various sizes ranging from 18mm to 38mm in thickness.

They are arranged and glued together to form a slab and pressed in between two outer veneers under heat to weld the fibres together.

And it is seasoned to a moisture content to 12% then cut to size commonly used in market size are 1220×2440mm.

Fig 3



BLOCK BOARD

Uses

Block boards are used extensively for both interior and exterior use.

Exterior may be for rails, buses, and lorry buildings and prefabricated houses.

Interior

For furniture, partition works, panelling work etc.

Dimension

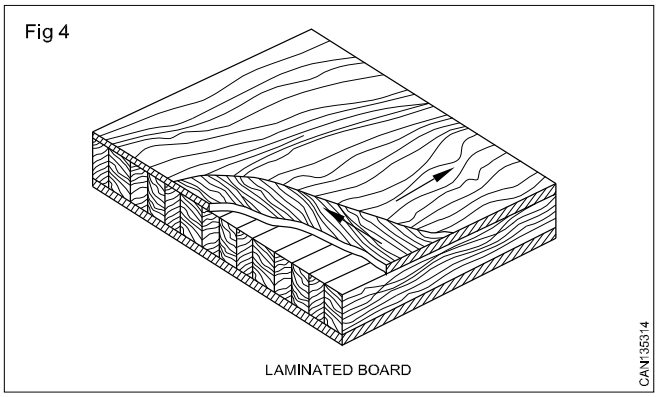
Length 120 to 2440mm

Width 90 to 1200mm

Thickness 18mm to 50mm

Laminated board (Fig 4)

Fig 4



LAMINATED BOARD

Laminated board are used for veneered furniture. They are built up with an inner core made of numerous narrow strips glued to each other. Both surfaces being faced with 2 to 3 mm ply which grain lies at right angle to the core.

The strips forming the core should not be wider than 7 mm. The aim and purpose of laminated boards is to obtain a strong and light board which does not warp and twist and can be used for high class furniture production.

Uses

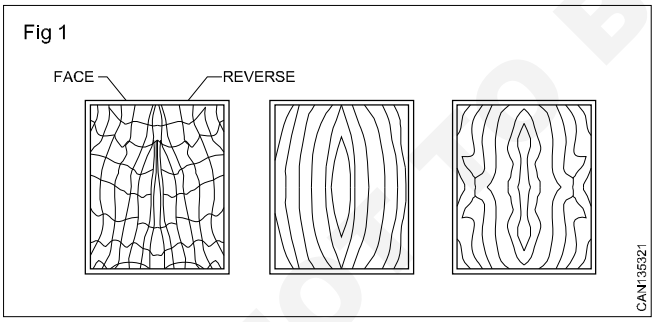
Generally used for high quality furniture and joinery.

Sunmica

Objectives: At the end of this lesson you shall be able to
- **state the manufacturing technique of sunmica**
- **state the uses of sunmica**
- **state the size of sunmica sheets.**

Sunmica (Fig 1)

Fig 1



It is a type of decorated plastic laminated sheet material and is manufactured in India by the Sunmica Institute and trade named as sunmica.

Other companies manufacture under different trade names i.e. “FORMICA” decorated “DECOLAM, “SUNGLASS” etc.,

It is made by gluing together several craft paper impregnated in glue with printed sheet or veneer sheet covered by transparent sheet on top veneers are pressed under controlled high temperature and pressure.

Under the high pressure and temperature, polymerisation takes place and all the veneers are combined together to form a homogeneous solid.

It is a beautiful, strong and durable material which is manufactured in sheets.

Sunmica can be fixed to the wooden or plywood surface or walls with the help of glue.

Sunmica sheets are available in 1 and above upto 6 mm thickness and 274 $\times$ 122 cm and 244 $\times$ 121 cm sizes.

It is not affected by ordinary temperature, light acids, oils and eatables.

Portable power disc sander machine

Objectives : At the end of this lesson you shall be able to
- **identify the parts of the disc sander machine**
- **state the application of portable disc sander**
- **state the care and maintenance of disc sander machines .**

Sanding is a general term applied to the smoothing of work using a coated abrasive.

The preparation of timber surfaces for finishing coats is one of the most important process in the making of any job. A poorly prepared surface cannot be concealed by finishing materials. Proper hand sanding requires a great deal of patience and considerable effort. The use of power sanding tools is less fatiguing and speeds up the work of sanding

Portable power disc sander

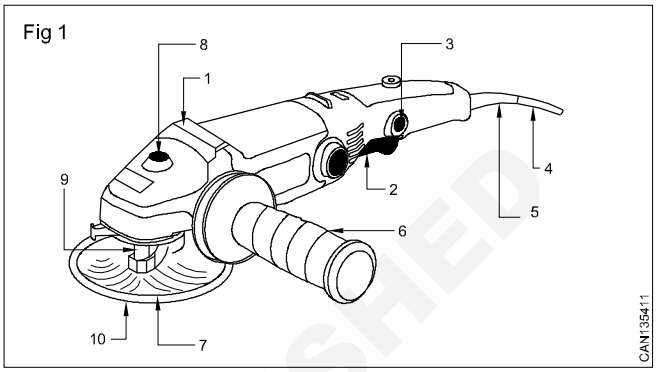
Sanders are chiefly used for smoothing relatively rough surfaces quickly for preliminary rounding of corners and edges and for removing paint etc, They are also useful for removing the bulk of over - lapping waste after applying decorative laminates In use the disc is held at an angle so that only part of the abrasive is in contact with the job; work more or less in line with the grain direction. Care should be taken to apply only a light pressure as the edge of the disc is liable to gouge - in and mark deep swirl marks in the surface. For this reason a disc sander is not suitable for finish sanding flat surfaces - even fine abrasive discs tend to produce an undulating surface with cross - grain scratches

The speed at which disc sanders operate varies with the size of the disc, the grade of grit and the condition of the abrasive High speeds dull or worn paper, loaded paper and too much pressure will quickly burn the wood particularly end grain.

Parts of portable power disc sander

1 Tool rest
2 OFF/ON switch
3 Switch lock
4 Electrical cord
5 Cord strain reliever
6 Handle
7 Sanding disc
8 Spindle lock
9 Spindle
10 Disc sand paper

Fig 1



Application of disc sander

Sanding for flooring for best results use a long sweeping of motion, back and forth with along the surface.

It is useful for removing old paint varnish and polish siding.

Care and maintenance

1 Check for loose clothing - keep slack lead clear of machine and work
2 Observe all electrical safety precautions - leads, plugs, connections etc.
3 Disconnect the motor to fit new abrasives and make adjustments. Use the correct abrasive tool for the job and the correct grade and type of abrasive.
4 Allow the tool to attain full speed before applying to the job
5 Sand parallel with along the grain if possible - cross clear finishes
6 Use the whole surface of the abrasive to give equal wear, possibly. Use light pressure to prevent burning or over loading the motor. Too much pressure may cause dulling of the abrasive and consequent clogging or glazing and stripping of the abrasive.
7 Remove dust while sanding to prevent the abrasive becoming loaded or clogged with dust to avoid burn the work.
8 Remove dust from motor ventilation slots with a jet of air or a vaccum cleaner.

Wooden partition

Objectives: At the end of this lesson you shall be able to
- **state the construction of wooden partition**
- **state the types of wooden partition**
- **state the requirements of partitions.**
- **state the advantages and disadvantages of wooden partition.**

A partition is a thin internal wall which is constructed inside the closed building to divide the space into rooms and areas.

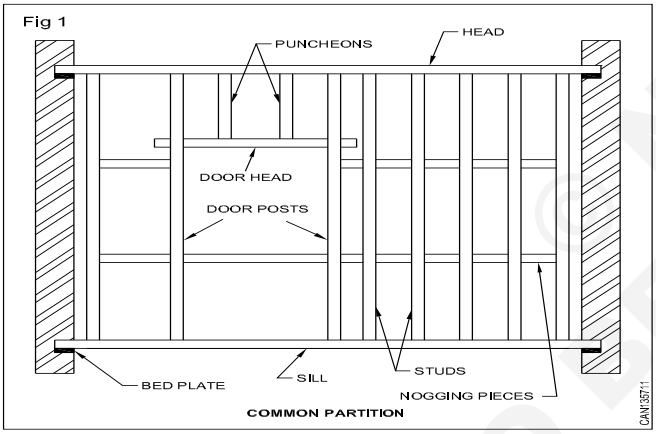
Wooden partition consist of wooden framework properly supported on floor and fixed to the side walls.

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 1): These partitions consist of vertical members called the studs, which are bridged between two horizontal members.



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.

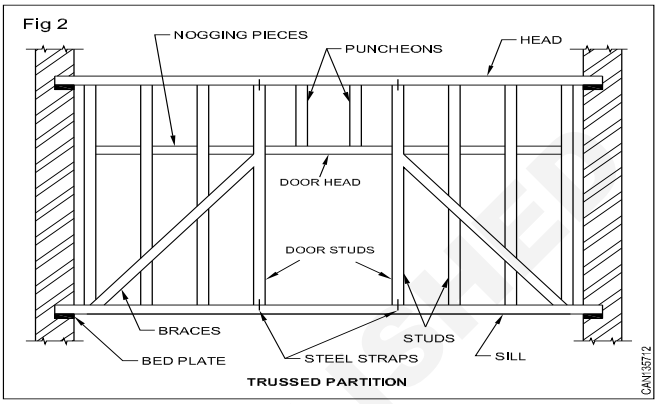
The partition can be fixed either by providing plywood sheets or by inserting wooden panels.

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 2): 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



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.

Advantages of wooden partition

– They are light in weight and therefore can be easily constructed where a base for partition is not available.
– They are cheaper at the place where the woods are available in plenty
– They are rigid and triangulations of framing is adopted to transfer some of the load of the wall.

Disadvantages of wooden partition

– They are likely to decay in damp conditions and easily eaten away by termites.
– They are reducing the use day by day.
- They do not possess fire resisting property.
- They do not prevent the passage of sound to an appropriate extent.

Door frame, door and window panels

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of door frame**
- **state the technical terms used in door and door shutter construction.**

The door frame is an assembly of horizontal piece (head of Jambs) and the vertical piece (post) forming an enclosure to which the door shutters are fixed.

Wooden door frames looks better than the other materials and they can be polished or painted.

The thickness of the wooden frame varies depending upon the size of the door opening.

The same thickness and width of wood be used for the head and the post.

The frame is rebated on its outer edge to receive the door shutters.

The width of the rebating varies from 12 mm to 15 mm while the depth is kept equal to the thickness of the door shutters.

Door shutter

Recommended dimensions for doors

No.	Designation	Size of opening (mm)	Size of door frame (mm)
1	8 DS 20	800 × 2000	790 × 1990
2	8 DS 21	800 × 2100	790 × 2090
3	9 DS 20	900 × 2000	890 × 1990
4	9 DS 21	900 × 2100	890 × 2090
5	10 DS 20	1000 × 2000	990 × 1990
6	10 DT 21	1000 × 2100	990 × 2090
7	12 DT 20	1200 × 2000	1190 × 1990
8	12 DT 21	1200 × 2100	1190 × 2090

Recommended designation for doors - Note

a) 8 DS 20 Denotes a single door (DS) opening having width equal to 8 modules i.e., 800mm and height 20 modules i.e., 2000 mm.

b) 10 DT 21 Denotes a double door (DT) opening having equal to 10 modules i.e., 1000mm are height 21 modules i.e, 2100mm.

A door may be defined as an openable barrier secured in an opening left in a wall for the purpose of providing access to the users of the structure.

A door consist of two main parts called the frame and the shutter.

The door shutter is held in position by the door frame which in turn is fixed in the opening of the wall by means of hold-fasts etc.

A door should have the proper dimensions to allow the movements of the largest object likely to use the door and the tallest person likely to use the door.

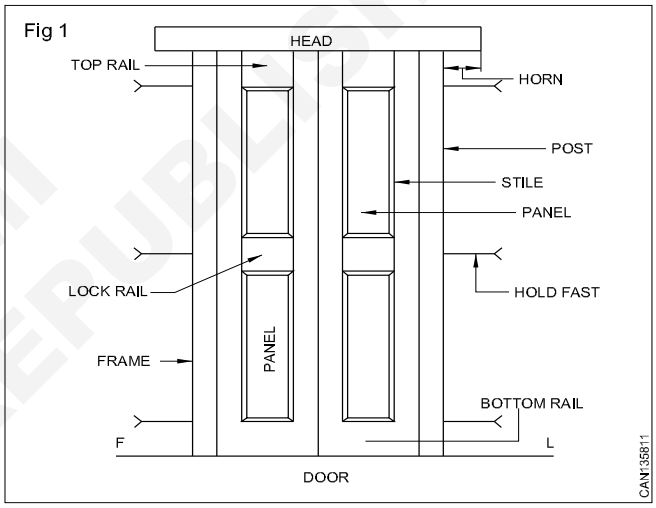
The common width and height relation are...

Height = Width + 1.2 meter

Width = 0.4 to 0.6 of height

Technical terms used in door and the sh**utter (Fig 1):** The definition of technical terms used in connection with doors and windows are as follows.

Fig 1



Frame: A frame consists of horizontal and vertical members forming as an enclosure to which the shutters are fixed.

Stile: The outside vertical members of the shutter of a door or window.

Head: The top or upper most horizontal part of a frame is called the head.

Sill and Threshold: The lower most or bottom horizontal of window frame is called the sill in door frame it is known as threshold.

Top rail: This is the top most horizontal member of the shutter and is called the top rail.

Lock rail: The middle horizontal member of the shutter in doors where the locking arrangements are used.

Bottom rail: The lower most or bottom horizontal member of the shutter.

Intermediate or cross rail: These are the additional horizontal rails fixed between the top and bottom rails of the shutter.

Brieze rail: A rail fixed between the top rail and lock rail is called Brieze rail

Shutter: The openable part of the door or window. This is the entire assembly of stiles, panels and rails.

Panel: The area of shutter enclosed between the adjacent rails

Mullion: The vertical member of a frame which is employed to sub divide a door or window opening vertically.

Horn: Horizontal projection of head or sill.

Sash: This is a special type of frame to carry glass. A sash consist of two vertical stiles and a top and bottom rails. This can be divided vertically or horizontally by providing the bars. These bars are called sash bar or glazing bar.

Transom: This is horizontal member which is employed to sub divide a window opening horizontally.

Louver: This is a piece of timber which is fixed in an inclined position with in a frame

Jamb: The vertical wall face of an opening which supports the frame of the door and window is known as jamb.

Hold fast:: This is generally in the form of a mild steel flat bar of section 30 mm x 6 mm and of length 200 mm. Hold fast are used to keep the door frame and window frame in position.

Rebate: The recess made in the door frame to receive the door shutter is called rebate

Reveal: The external jamb of a door or window opening at right angles to the wall face is called the reveal.

Putty: This is a mixture of linseed oil and white chalk. It is used for fixing glass panels.

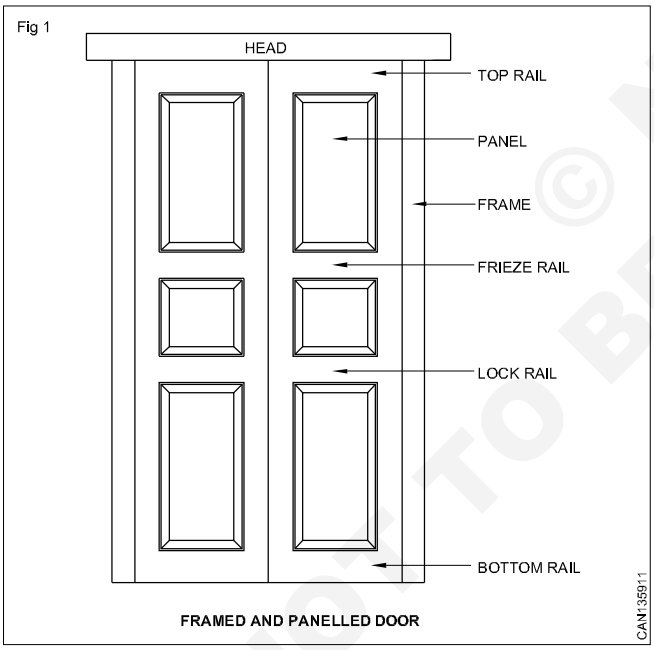
Door and window panels

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of door and window frame**
- **state the types of door and window panels.**

Panel: The area of door and window door. On closed between the adjacent rails.

Framed and panelled door (Fig 1)

Fig 1



FRAMED AND PANELLED DOOR

These type of panelled doors and window are widely used in almost all types of buildings since they are strong and given better appearance than battened doors. This doors consists, of frame-work in the form of vertical members called styles and horizontal member called rails which are grooved along the inner edge of the frame to receive the panels. The panels are made from timber, plywood, block boards, wire mesh, A.C sheet or even glasses. Panelled doors are of various types such as.

Single panelled doors

Two panelled doors

Three panelled doors

Multiple panelled doors

Panelled doors may contain single leaf for small opening or may contain two leaves for wider openings. In double leaf door each leaf has separate frames each hinged to the corresponding jamb post of the door.

Features of framed and panelled door

The styles are made continuous from top to bottom that is they are single pieces.

Various rail (in top rail, bottom rail and intermediate rail) are jointed to the styles at both the ends.

The styles and rails are jointed by tenon and mortise joints.

The bottom and lock rail are made wider than top and frieze rails.

The entire frame is grooved on all the inside face to receive panels.

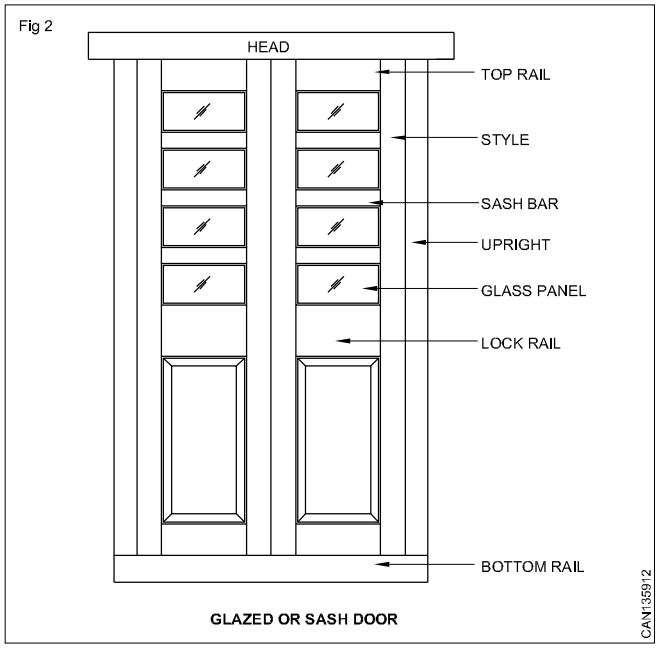
Additional timber beading is provided on one or both the sides to improve the elevation of the door.

The minimum width of the style is kept as 100mm. The minimum width of bottom rail and top rail is kept as 150mm.

If panels are made timbers, its minimum width should be 150 mm and minimum thickness should be 20 mm.

However the maximum area of single panel of timber should not be more than $0.5m^2$.These districtions do not apply to panel of plywood, particles boards on hard board.

Glazed panel or sash door (Fig 2)

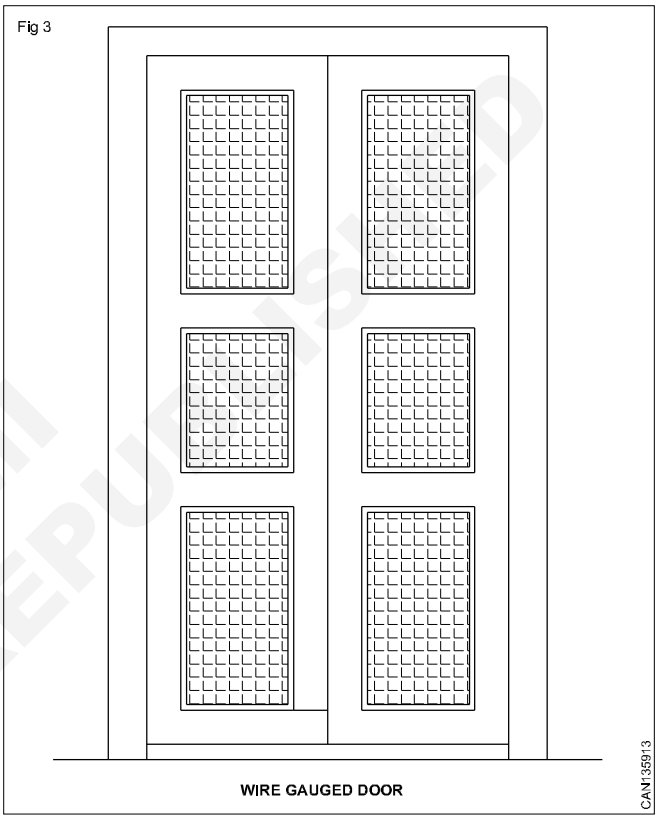


Glazed or sash door are provided where additional light is required to be admitted to the room through the door or where the visibility of the interior of the room required from the adjacent room. Such doors are commonly used in residential as well as public buildings like hospitals, schools, colleges etc. The doors may be within fully glazed or they may be partially glazed and partially paneled.

In the letter case the ratio of glazed portion to the paralled portion kept 2:1 is bottom 1/3rd height is paralled and top 2/3 height is glazed. The glass is required into the rebate provided in the wooden sash bars and secured by rails and putty. Partially glazed doors are sometimes provided with styles which graduals get diminished at clock rail. Improve the elevation or to permit more area for the Glazed panels. Such style which decrease in width at lock level are called diminishing style or gun stock rail or gun stock style.

Wire gauged panel door (Fig 3)

These types of doors are provided to check the entry of flies, mosquitoes, insects etc. Wire mesh is provided in the panels and therefore they permit free passage of air. Such doors are commonly used for refreshment room, hotels, cup-boards containing eatables in sweet shops etc. The door is formed of wooden framework consisting of vertical styles and horizontal rails and the panel opening are provided with fine mesh of galvanized wire gauge. The wire gauge is fixed by means of nails and timber beadings. Generally the door has two shutter is fully panelled and the outer shutter has wire gauged panels.

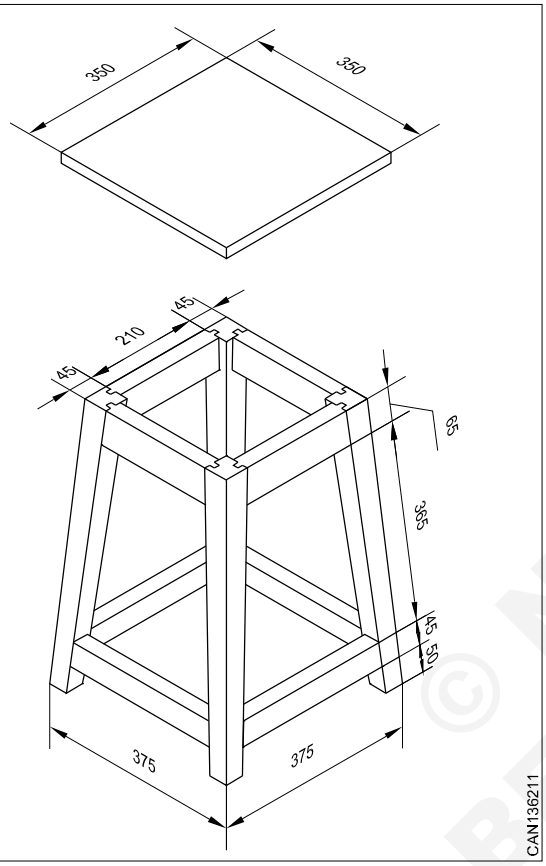


Calculation of timber required for stool

Objectives : At the end of this lesson you shall be able to
- **estimate the materials required for tapered legged stool, kind of wood : teak wood**
- **state the sequence of operation for stool.**

Raw material for stool dimensions in mm. (Fig 1)

Fig 1



Sl.No	Utilization to the stool	W × T × L	No of pieces
1	Leg	50 × 50 x 550	4
2	Top rail	75 × 30 x 250	4
3	Bottom rail	50 × 30 x 400	4
4	Stool top plank	375 × 25 x 375	1

Raw material for stool dimensions in metres

Sl.No	W × T × L	No of pieces	Volume m^3
1	0.05 × 0.05 × 0.55	4	0.0055
2	0.075 × 0.03 × 0.25	4	0.00225
3	0.05 × 0.03 × 0.4	4	0.0024
4	0.375 × 0.025 × 0.375	1	0.00352
	Total volume	-	0.01367m^3

Cost of raw material [estimation of the cost approximately]

The total comes to = Cubicmetre

Teak wood rate/cubicmetre = Rs 45000/-

For 0.01367m^3 = 0.01367 x 45000
= 615.15

Rounded to = Rs 615/-

List out the sequence of operation

Planing to size

Leg, top rail, bottom rail and top plank with jack plane, try square, marking gauge.

Marking

Marking with foot rule, try square, marking gauge and marking knife.

Mortiseing

Haunched mortise, stub mortise with mortise chisel firmer chisel and mallet.

Tenoning

Haunched tenon, stub tenon with firmer chisel and mallet.

Gluing

Apply the joints

Assemble

Leg, top rail and bottom rail.

Cramping

Cramping with “T” bar cramp.

Drilling

Drilling with portable electrical drill machine.

Doweling

Doweling with wooden dowel pegs.

Top plank assemble

Top plank assemble with stool frame.

Finishing

Finishing with smoothing plane and sand paper.

Timber used in furniture work

Objectives : At the end of this lesson you shall be able to
- **state the types of furniture timbers**
- **state the uses of furniture work.**

Sal

It is straight growing up right tree.

It is found in Assam, UP, Orissa, Maharashtra, Andhrapradesh, Tripura, Madhya Pradesh etc.,

The sap wood is pale yellowish and heart wood is brown or reddish brown.

The wood is hard and heavy with an average of 855 kg/m^3

It is coarse textured with inter locked grains.

Uses : It is a valuable timber and recommended for all furniture work.

Teak

It is very valuable timber. It is a large tree with light coloured leaves.

The wood is straight grained and of rich brown yellow color.

Sap wood is pale yellowish and heart wood is golden brown. In India it is found in Madhya pradesh, Maharastra, Andhra pradesh, Kerala and Gujarat, maximum of teak out put is from Madhya pradesh. It is 12% moisture and content suitable for any work, ship building furniture and cabinet making etc.,

Uses : Table, chair, sofa set ,cot, dressing table etc..,

Gamar

It is a fast growing deciduous tree, occurring naturally through out greater part of India at altitudes up to 1500 meters.

The wood is pale yellow to cream coloured in India it is found in Assam, West Bengal, Bihar and Odisha.

It is usually straight to irregular or rarely.

Way grained and medium course textured.

Uses : It is used in constructions, furniture, carriages, sports, musical instruments and artificial limbs.

Pine

It is more durable than other woods that are of equal cost.

It is valuable to the carpentry industry.

The wood is medium weight and relatively soft, white or pale yellow wood which is light weight.

It is strength and elasticity are good.

Uses: It is used in construction of furniture, cabinetry, window frames, paneling, floors and roofing.

Deoder

It has straight tall trunk having short branches and pointed leaves. It is found in altitudes of 1200 to 3000m. The tree has lofty straight trunk with small branches. It is found in Arunachal Pradesh, Punjab, Himalayas, Kashmir and U.P.

The sap wood is white and heart wood is light yellowish brown. The wood is hard and heavy with average weight **545 kg/m^3** at 12% moisture content. It has a medium fine and even texture deoder is a non-porous wood.

Uses :Construction purposes, furniture, packing cases, etc.,

Mahagony

Its colour is shining reddish brown. It takes a good polish it is easy to work. It is durable under water. Its weight after seasoning is about 7200N/mm^3

Uses : Furniture, boats and musical instruments.

Bamboo

It is an endogeneous tree. It is flexible strong and durable. It is found in most of the part of the country.

Uses : Roofing ladder walking sticks and rocking chair.

Kail

It is an ever-green tree.

Kail is similar structure to chir. It is found in foot hills of Himalayas Kashmir, Punjab and Uttarpradesh. The sap wood is white and heart wood is light and pinkish red.

It is closely grained hard and durable.

It is soft and light

Uses : Cabinet making, furniture, packing cases, drawing boards, and show case.

Properties and characteristics of different furniture wood

Objectives: At the end of this lesson you shall be able to
- **state the properties of different furniture wood**
- **state the characteristics of different furniture wood.**

Furniture wood	Properties	Characteristics
Teak	Good strength Not attacked by white ants and dry rot. Durability and fire resistant Golden yellow to dark brown colour.	Easy work ability With its superb stability Excellent structural
Deoder	Very strong Strength and work ability Highly valuable	Important structural timber.
Sal	Hard wood The wood is highly durable and very strong	Light in colour when freshly Wood is cost effective It is resistant to white ants, termites and fung Water resistant
Gamar	Vigorous growth Fruity smell	It is light timber Good capacity to recover from frost injury
Pine	Medium weight Good strength Good elasticity Density timber Soft wood Thermal timber	
Bamboo	Stiffness and elasticity Hardness and durability	It is quick bending.
Mahogany	Durability Colour is typically red, pink or salmon.	Fine to medium texture Straight grain Maintains its Integrity
Kail wood	Light and pinkish colour Hard and durable Closely grained	Soft and light weight

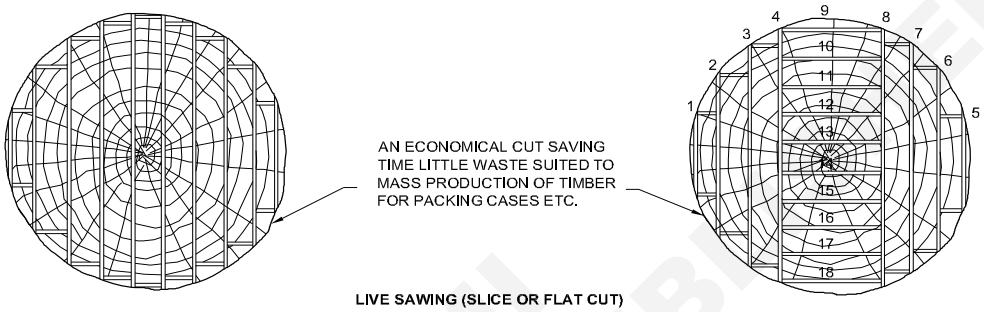
Conversion of timber

Objectives : At the end of this lesson you shall be able to
- **state the type of conversion**
- **state the method of conversion and uses**
- **state the conversion of timber and type.**

The timber is usually cut into commercial sizes to the possible sizes after tree has been felled to minimize shrinkage and damage. "Conversion" is sawing field tree into square edged pieces of timber suitable for use by wood workers, joiners, and cabinet maker's. The newly converted timber is in a green rough sawn state and the methods of converting logs vary according to the class of timber, the quality and sizes of the logs into the market requirements.

Live sawing/Parallel sawing (Fig 1)

Fig 1



It is the simplest and most economical method of cutting up the log into boards by any required thickness by a series of parallel saw cuts.

The growth rings meet the face of the board in any part of an angle of less than 45°.

There is little waste of timber and time.

The log need not to be turned to new positions for sawing.

The chief fault (in their method) lies in the fact that most of the boards WARP.

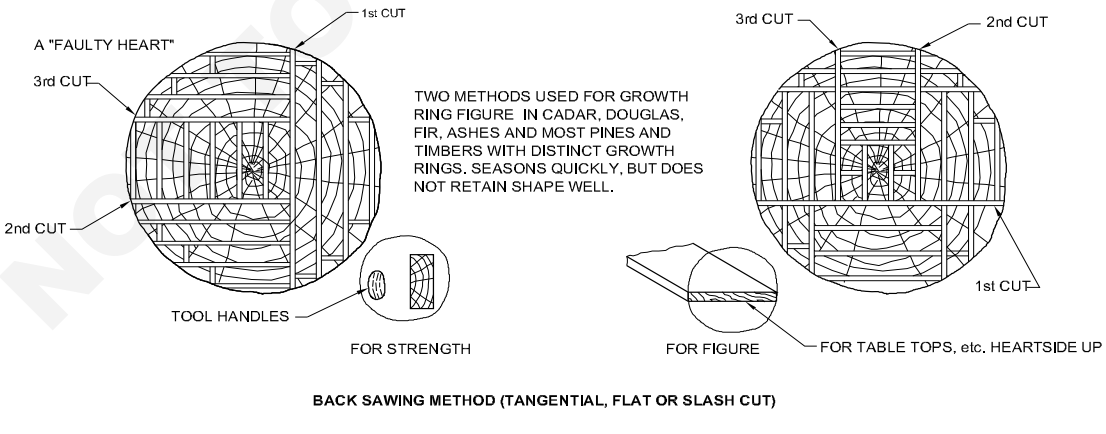
Flat sawn timber from soft wood has a moral decorative appearance than quarter sawn.

The method of cutting joint to obtain the maximum strength.

Used for timber required for constructional work, fence pabing and packing case etc.

Back sawing/tangential cut/slash cut (Fig 2 & Fig 3)

Fig 2



Is a method by which the log is cut so that the width of the board are tangential to the growth rings.

The log has to be turned frequently to new position for sawing to produce the tangential cut.

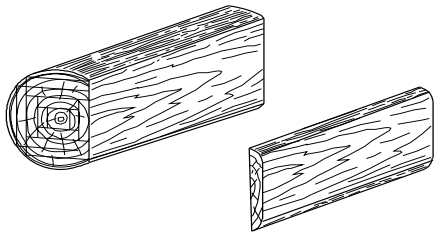
This tangential cut allows for sawing around faulty parts of the log.

There is little waste of timber.

Back sawn board usually season more rapidly than other cuts.

Timber such as red cedar, pine which possess distinct growth rings are usually back sawn.

Fig 3



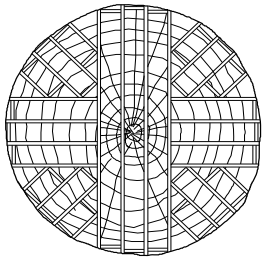
CAN 36713

As there is more strength is in the direction of growth rings back sawn timber is used for floor and ceiling joint, bears hammer and axe handle, ponds, desk and table tops etc.

Back sawn board shrink mostly in width are lively to warp.

Quarter sawing / radial sawing (Fig 4,5 & 6)

Fig 4

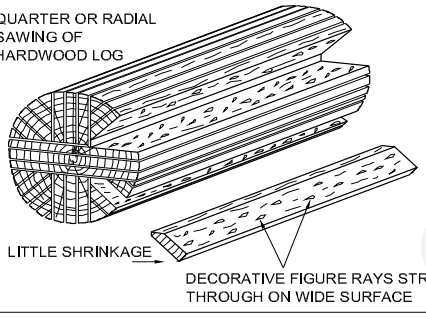


FOR MEDULLARY RAY FIGURE IN OAKS RIBBON GRAIN FIGURE IN QUEENSLAND MAPLE AND WALNUT ALSO FIGURE IN MAHOGANY, BEECH, ASH, EUCALYPTS, ETC., SEASONS SLOWLY BUT RETAINS SHAPE.

QUARTER SAWING (RADIAL CUT)

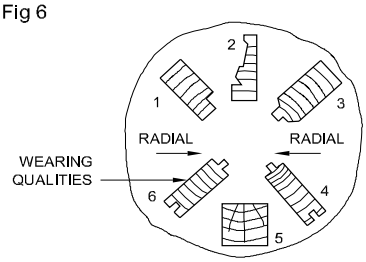
CAN 36714

Fig 5



CAN 36715

Fig 6



QUARTER SAWING FOR PIECES REQUIRED TO RETAIN SHAPE

1. DOOR FRAMES
2. MOULDINGS, etc.
3. WINDOW SASHES
4. FLOORING BOARDS, etc.
5. WOODEN PLANE, STACKS

CAN 36716

Here the boards are cut with their width in the direction of medullary rays.

Quarter sawn boards from timber which have distinct medullary rays (such as oaks) interlocked grain such as maple.

Show decorative figure, which increases the value of the timber for cabinet work.

It is important to have the faces of the boards as nearly as possible parallel to the medullary rays.

Fully quarter sawn boards have their faces within 10^{o} of the medullary rays.

Quarter sawn boards are mostly suitable for mouldings, achitraves sash and door frames. They retain their shape better than cuts and there is less shrinkage in width. Quarter sawn boards do not warp or check to any extent while seasoning.

The great disadvantage is the cost of cutting is higher owing to the fact that there is more handling of the log in turning into new position for sawing.

More time is taken.

More waste for fully quarter sawn stuff.

Advantages and disadvantages of conversion of timber

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

- **know the advantages and disadvantages of conversion of timber.**

Tangential sawing

Advantages

This method is very cheap.

Without much rotation, by a change of position, the logs can be sawn easily.

It does not require any skill while sawing.

This method of sawing is very quick.

Disadvantages

In this method planks will become weak and less durable.

In this method during the seasoning the planks will shrink and warp will be more.

In this method the planks are not possible to polish or paint properly.

Due to non uniformity of timber the planks are easily subject to rots.

Radial sawing

Advantages

The warping and shrinkage are minimum in the planks.

The planks are stronger and more durable.

The planks are sawn parallel to the medullary rays, therefore cracking of the planks are very less.

The wood is uniform in strength.

In this method the number of good quality of planks are more.

Disadvantages

In this method the logs are to be rotated every time.

In this method it takes too much time.

The cost of sawing and the cost of the planks are also too high.

Skilled person is required for sawing.

Design of Wooden wall unit used in bed room, dining hall, library, Office and workshop class room

Objectives: At the end of this lesson you shall be able to
- **choose the furniture for different purposes**
- **design the furniture for different purposes.**

Design of furniture for different purposes are chosen as per

Function

Comfort

Design

Bed room furniture (Fig 1)

Most of us spend about one third of our life in the bed room. Therefore it is important that the environment is pleasant.

A bed room does not necessarily have to be dull as it can be furnished in an exciting and unconventional manner.

Always bear in mind that the mattress will last long, if you turn it regularly from top to bottom.

For cleaning, brush or vacuum cleaner is required.

Furnitures used in the bed room are

1 Cot

2 Bed side table

3 Dressing table

4 Dressing stool

Cot with a good mattress is to sleep well after the day's work.

Bed side table is used for keeping costumes alarm clock.

Dressing table is to dress well and to look neat.

Dressing stool to sit.

Dining hall furniture (Fig 2)

The function of a dining table is known to everybody. However the table may be used on different occasions and for various purposes.

Whether the table is to be rectangular or round all depend on personal taste and space available.

Furnishing of a dining room does not stop at the dining table alone. The choice of chair and cupboards is very important in order to make the dining hall harmonious.

Library (Fig 3)

Library is an institution, obedient to the attitudes and the whims of the community it serves.

The trend in library service for the last decade or so has been to give importance to those users, whose education and background lead them to value information.

Interior furnishing style of a library must be classic and modern with regards to colour, carpeting, furniture and highlighting arrangement. It must be conclusion to user to site and study on write and consult books for a long time.

Library almirah is used for storing books. The doors are sliding type. The user can take the book easily and put back in the same place. Index card cabinet meant for keeping documentation of all the books in the library alphabetical order.

Some of the furniture used in the library are

1 Library almirah

2 Book shelves

3 Table with laminated top

4 Cushioned chairs

5 Index cabinet etc.

Office furniture (Fig 4)

As the office is the place where a great many people spend, most of their working hours. It is important that it constitutes a pleasant environment.

Office table (Fig 4)

This is an executive type table with both side number of draws and cupboard on the right sides to keep files and records.

Office Rack

It is available in various sizes depend up on the use. It is mostly used in offices schools and institutions to keep and maintain the files and records.

Executive chair

The executive chair should be very comfortable either cushioned seat or canned seat.

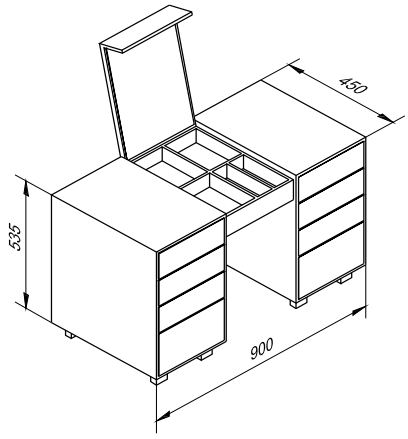
Revolving armed chair with canned seat and back is preferred to sit for a long time in the offices.

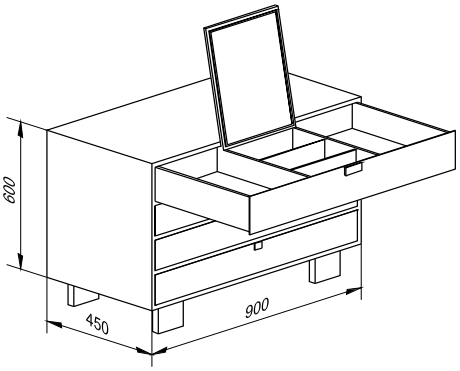
Workshop class room furniture

Classrooms are complex environment, conductive. It is a place where teacher and student interact.

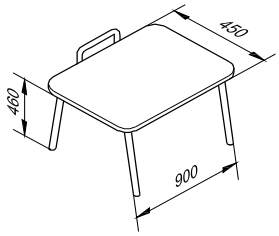
The instructors and students behavior can yield greater insight about effective instructional procedures, and for better learning of student.

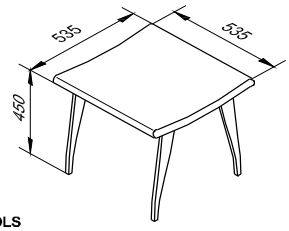
Fig 1

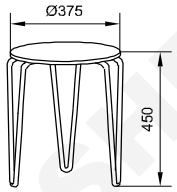




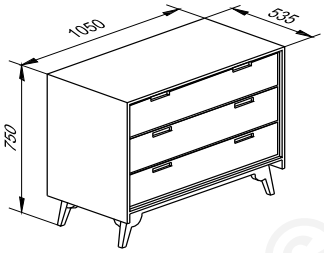
DRESSING TABLES

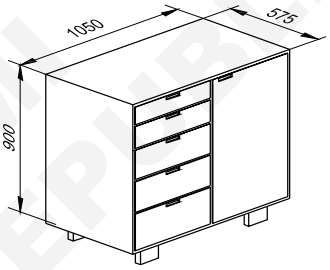




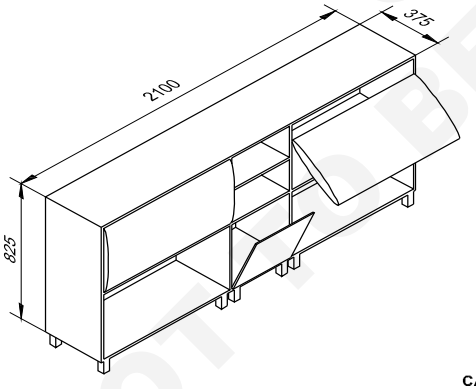


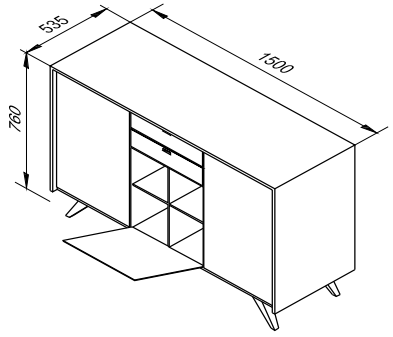
DRESSING STOOLS



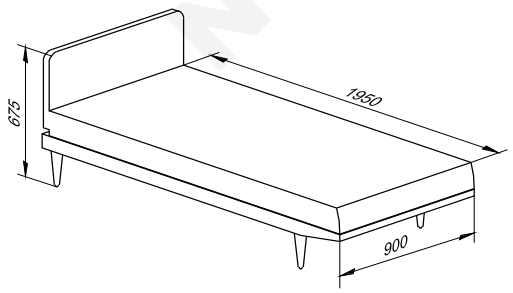


CHEST OF DRAWERS

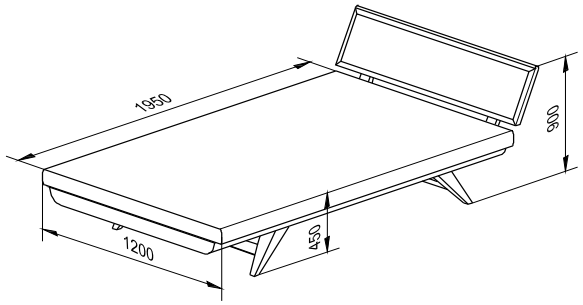




CABINETS



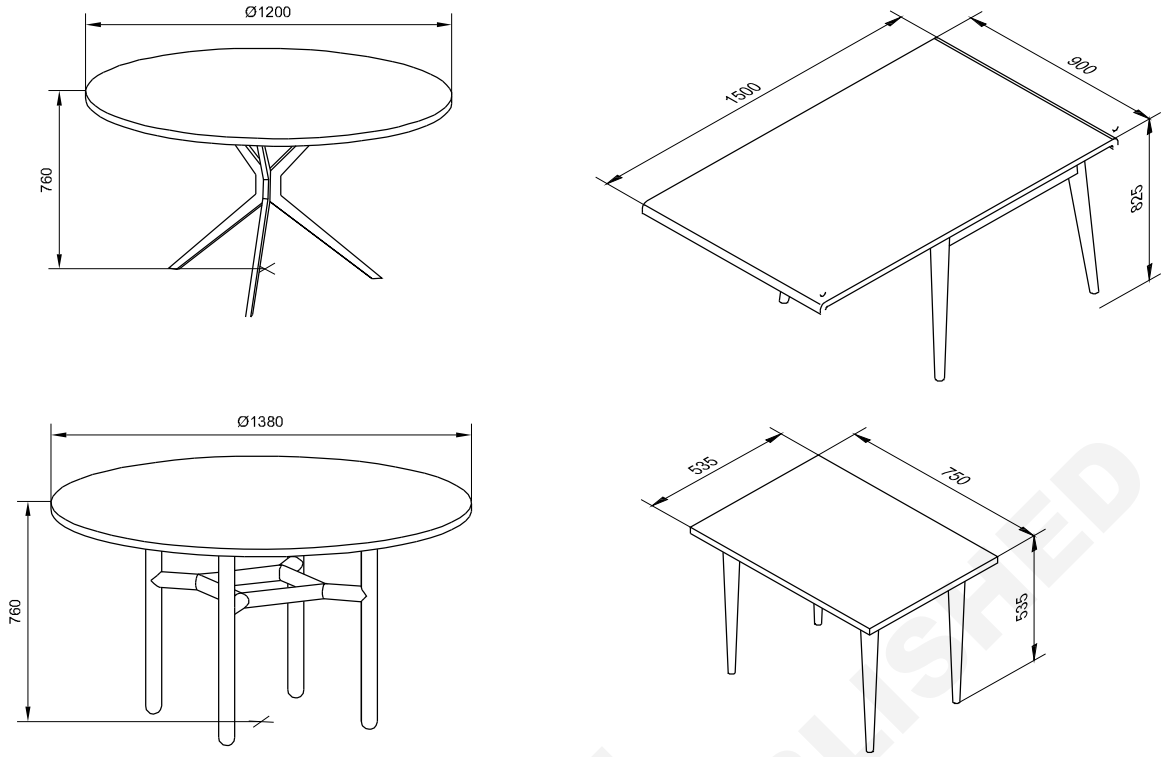
BEDS



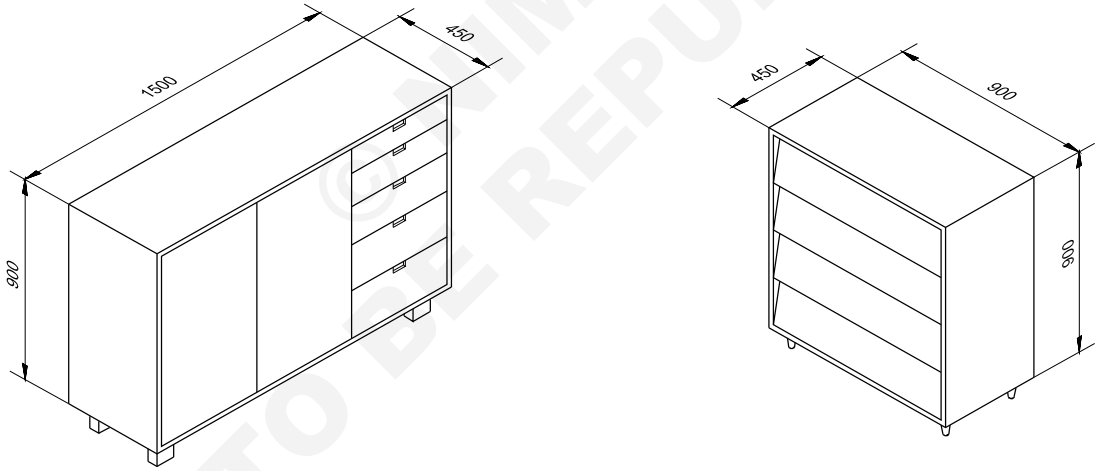
DRESSING, BED ROOM FURNITURE

CAN:36811

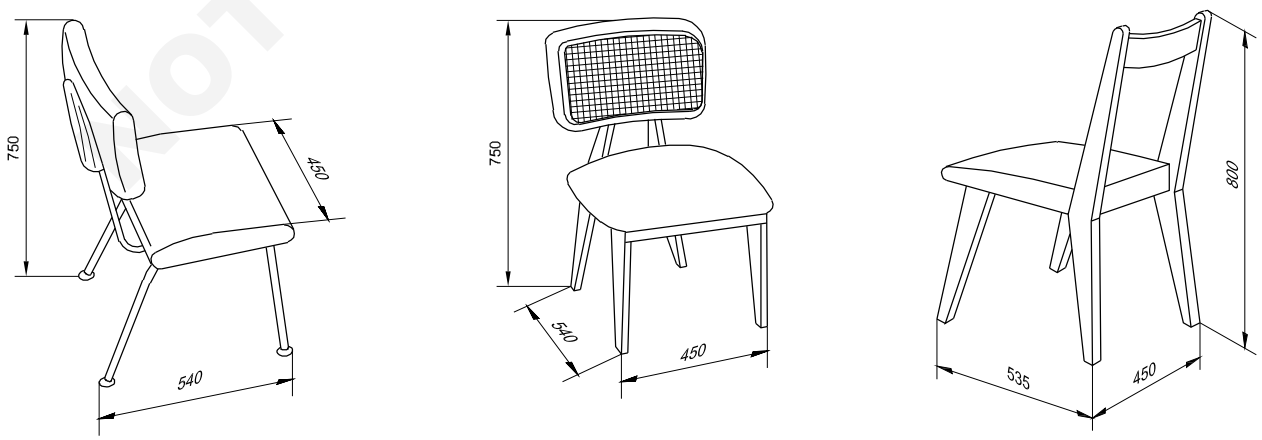
Fig 2



DINING TABLES



CABINETS

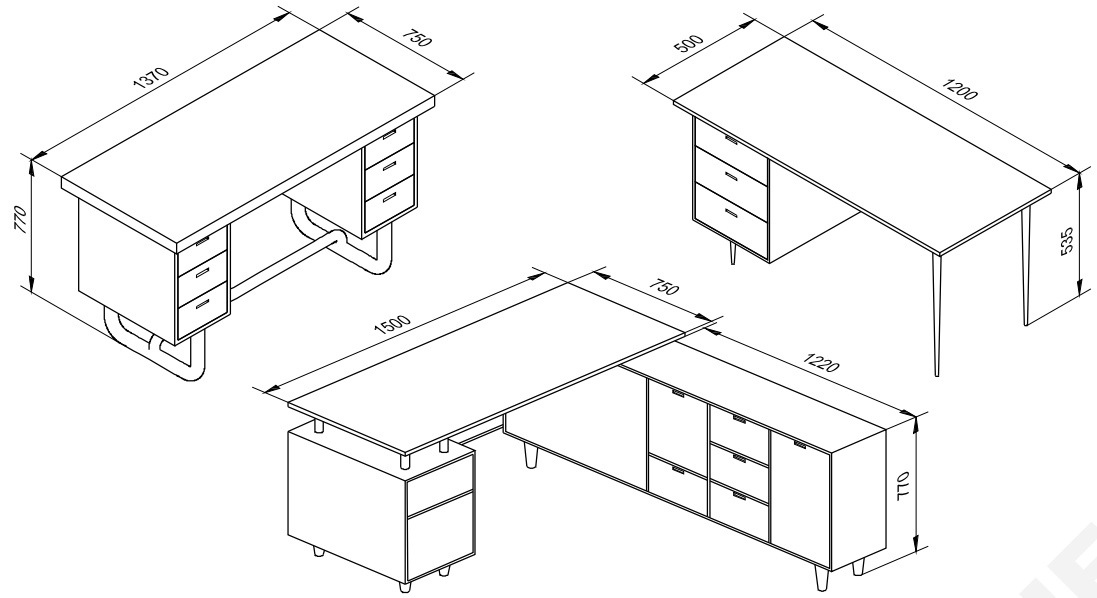


DINING CHAIRS

DINING HALL FURNITURE

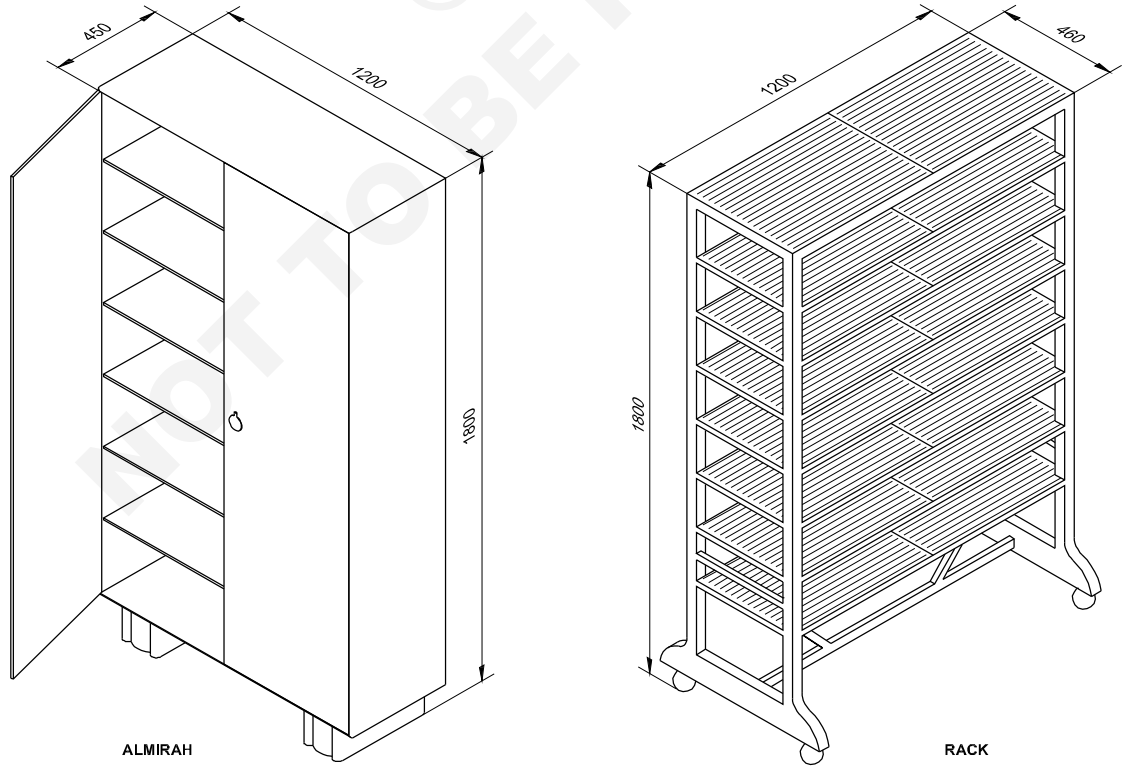
CAN 36812

Fig 3



OFFICE TABLES

OFFICE CHAIRS



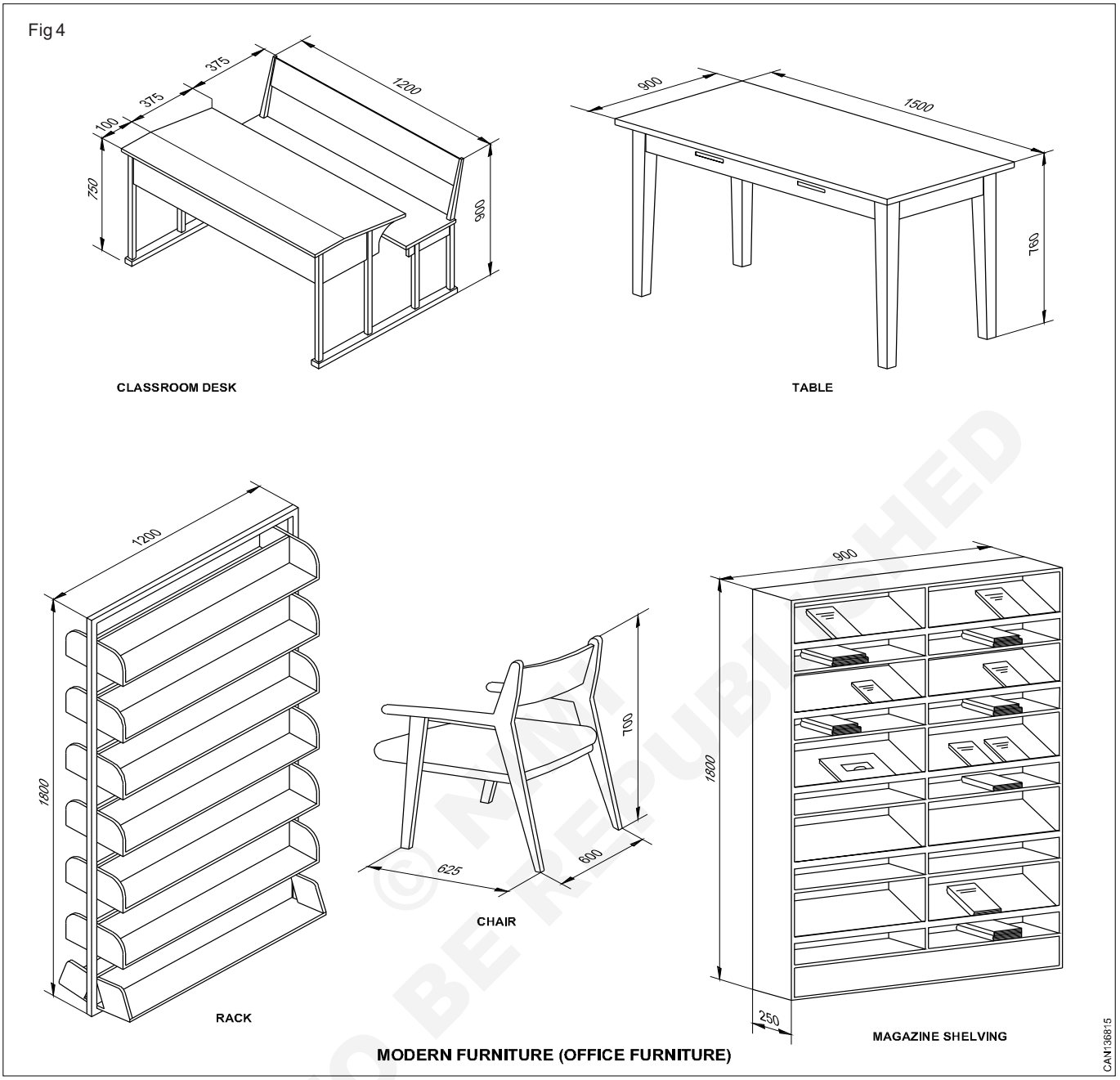
ALMIRAH

RACK

CLASS ROOM, LIBRARY FURNITURE

CAN1368I4

Fig 4



MODERN FURNITURE (OFFICE FURNITURE)

Furniture used in the class rooms are as follows

1 Instructors table & chair

2 Students table & chair

3 Desk or benches

4 Glass board

5 Map stand etc.,

Student table: It is mainly prepared for the students/ trainess for reading and writing purpose. The top surface of the table is finished with sunmica, with polish or by painting. It is also one of the common furniture used in Houses, Offices and Institutions.

Wall Unit: In the office it is used to keep and maintain the files and record safely. In the institution it is used to keep the particulars of trainees admission records and financial information's.

Notice Board

Notice board actually is an information board to given the information about the Institute, selection of trainees, commencement of training, result of trainees , rules and regulation of the Institution, payment of fees, sports and annual days etc.

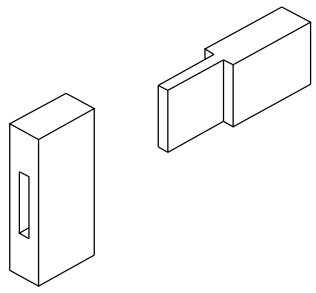
Display board: It is also one kind of board and available in various models and sizes. It is used to display the models, project works done by the trainees. It is a very good information material to display new arrivals to understand by the visitors.

Uses of joint for small table

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)

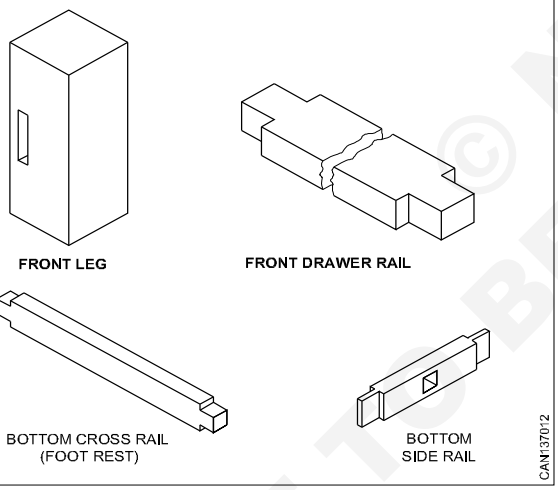
Fig 1



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)

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 3

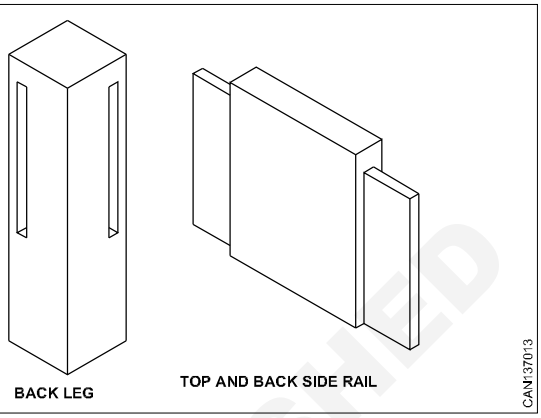
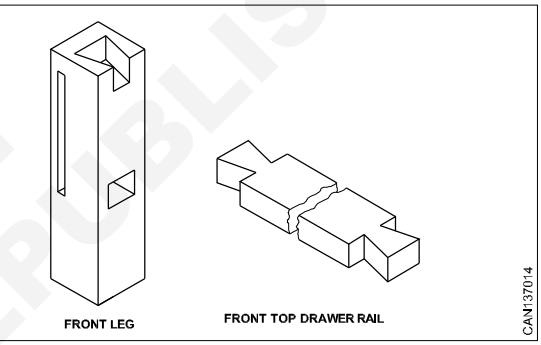
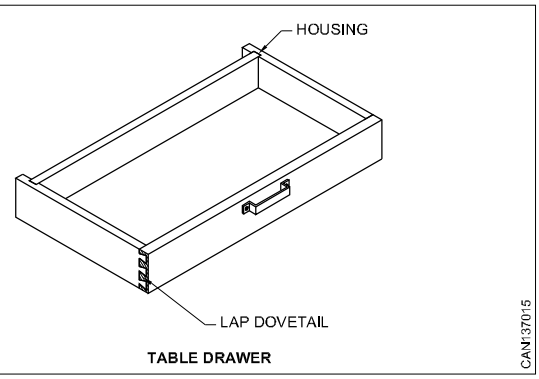


Fig 4



Full housing joint (Fig 5)

Fig 5



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

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.

Manufacturing process of various boards and sheets

Objectives : At the end of this lesson you shall be able to
- **define of MDF**
- **state the types of MDF and the comparison with natural wood**
- **state the advantages and disadvantages of MDF**
- **explain veneered MDF, particle board and FRP**
- **explain about the FOAM.**

Medium density fibre board (MDF) (Fig 1)

Fig 1

Properties : The term MDF has become a generic name for any dry process fibre board. MDF is typically made up of 82%wood fibre, 9% urea-formaldehyde resin glue, 8% water and 1% paraffin wax and the density is typically between 500 kg/m¹ (31 lb/ft³) and 1,000 kg/m³ (62 lb/ft³).

Types: There are different kinds of MDF (sometimes labeled by colour)

- Ultralight MDF plate (ULDF)
- Moisture resistant is typically green
- Fire retardant MDF is typically red or blue

Comparison with natural woods: MDF does not contain knots or rings, making it more uniform than natural woods during cutting and in service However, MDF is not entirely is tropic, since the fibres are pressed tightly together through the sheet. Typical MDF has a hard, flat, smooth surface that makes it ideal for veneering, as there is no underlying grain to telegraph through the thin veneer as with plywood. Also called “Premium” MDF is available that features more uniform density throughout the thickness of the panel.

MDF may be glued, doweled or laminated. Typical fasteners are T-nuts and pan-head machine screws. Smooth-shank nails do not hold well, and neither do fine-pitch screws, especially in the edge. Special screws are available with a coarse thread pitch, but sheet-metal screws also work well. Like natural wood. MDF may split when woodscrews are installed without pilot holes.

Advantages

- Is an excellent substrate for veneers.
- Some varieties are less expensive than many natural woods
- Isotropic (its properties are the same in all directions as a result of no grain), so no tendency to split.
- Consistent in strength and size
- Shapes well.
- Stable dimensions (won’t expand or contract like wood)
- Easy to finish (i.e.paint)

Disadvantages

- Denser than plywood or chipboard (the resins are heavy)
- Low grade MDF may swell and break when saturated with water.
- May warp or expand if not sealed.
- May release formaldehyde, which is a known human carcinogen and may cause allergy, eye and lung irritation when cutting and sanding.
- Dulls blades more quickly than many woods. Used of tungsten carbide edges cutting tools is almost mandatory, as high speed steel dulls too quickly.
- Though it does not have a grain in the plane of the board, it does have one into the board, Screwing into the edge of a board will generally cause it to split in a fashion similar to delaminating.
- Subject to significant shrinkage in low humidity environments.
- Trim (e.g. base boards) comes pre-primed, but this is insufficient for fine finished painting. Painting with latex paints is difficult due to rapid water absorbing most finishes appear uneven and nail holes tend to pucker.

Applications: MDF is primarily used for internal use application due to its poor moisture resistance it is available in raw form with fine sanded surface or with decorative overlay.

MDF is also usable for furniture such as cabinets, because of its strong surface.

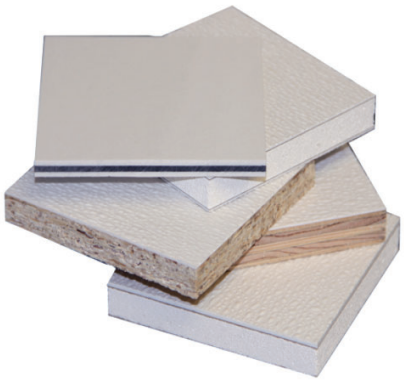
Veneered MDF (Fig 2)

Veneered MDF provides many of advantages of MDF with a decorative wood veneer surface layer. In modern construction, spurred by high costs of hardwoods, manufactures have been adopting this approach to achieve a high quality finishing wrap covering over a standard MDF board. One common type uses oak veneer.

Fig 2

Particle board or chip board (Fig 3)

Fig 3



Particle board production begins with planer shavings, wood chips and logs. Forming machines deposit the wood chips on belts forming then into mats.

Particle mats are cured with heat and pressure then trimmed and sanded to panel size which is commonly 1220mm x 2440 mm. Thickness range from 6mm to 25mm.

Uses

Particle board is extensively used a core stock for wood veneer and plastic laminates. It is also used as siding, floor under layment and for other construction and industrial purposes.

Fire proof reinforced plastic (FRP) (Fig 4)

While the fiberglass reinforcements used in corrosion resistant laminates will not burn, most thermoset resins used as the matrix for "FRP" laminates will support combustion. Even the "fire retardant" resins will burn vigorously when fire is supported by an outside source. The rate of flame spread is some what lower for these fire retardant resins. Fire retardant thermoset resins typically contain halogens or bromine molecules. When combustion occurs, these additives suppress or smother the flame and the laminate becomes self - extinguishing.

Fig 4

When the more common thermoset resins (polyesters, epoxies, vinyl ester, etc) used for fiberglass reinforced plastic composites burn, large amount of heavy, black dense smoke can be generated.

FOAM (Fig 5)

Fig 5

Foam rubber refers to rubber that has been manufactured with a foaming agent to create an air - filled matrix structure. Commercial foam rubbers are generally made of polyurethane or natural latex.

Types of FOAM

1 Polyurethane foam

2 Memory foam

3 Gel foam

4 Reflex foam

5 Latex rubber foam

6 Convoluted foam

7 Evlon

Uses: The foam types are used as sleep comforts, mattress, bedsheets, sofa and topper covers.

Mostly the foams used in furniture linning as seat, backrest and armrest. They are added to improve the comfort and relaxation of body.

Types and uses of hinges

Objectives: At the end of this lesson you shall be able to
- **identify different types of hinges**
- **state the uses of hinges.**

Hinges

Hinges are available in almost countless different shapes, sizes and materials.

The most common materials are steel, brass, and copper.

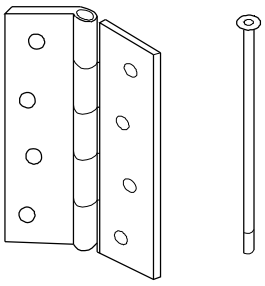
In building construction, we deal only with the most common types of hinges.

Butt Hinges

The ordinary steel butt hinges is cheap and durable and is the most common.

Hinge for doors and casements (Fig 1)

Fig 1



BUTT HINGE

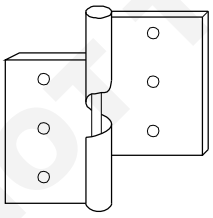
CAN:37111

It consists of two halves called leaves and flaps held together by a pin when doors are shut the two leaves are folded together.

The leaves are usually set into recesses in the door and post.

Rising butt Hinges (Fig 2)

Fig 2



RISING BUTT HINGE

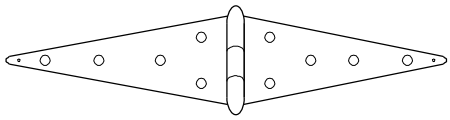
CAN:37112

Such a hinge is provided the helical knuckle joints due to which the shutter is raised by 10 cm being opened. The door is closed automatically. Such hinges used for doors of rooms having carpets etc. They are used in case of ordinary butt hinges.

Strap Hinges (Fig 3)

It is a substitute of garent or strap hinge is also used for ledged and braced doors and for heavy such as for garages, stables, gates etc.

Fig 3

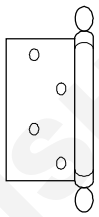


STRAP HINGE

CAN:37113

Spring Hinges (Fig 4)

Fig 4



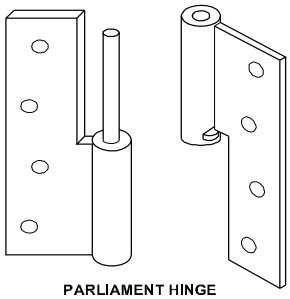
DOUBLE ACTING SPRING HINGE

CAN:37114

Single acting or double acting spring hinges are used for swinging doors single acting hinges used when the door shutter opens only in one direction while double acting hinge is used when the shutter swings in both directions. The door closes automatically due to spring action.

H. Hinges (Parliament Hinges) (Fig 5)

Fig 5



PARLIAMENT HINGE

CAN:37115

The 'H' hinges is similar to the butt hinges. It consist of two leaves. Each with a knuckle. The pin is set permanently into the knuckle of one leaf. The H. hinge is installed in the same way as the butt hinge.

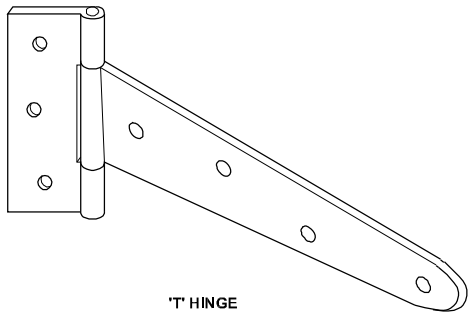
"T" Hinge (Fig 6)

'T' hinges are mostly used for long and heavy doors gates and battened doors. They are available in different sizes. The hinge consist of a long mild steel strap which is fixed to the out side of the door and a cross bar which is hinged to the strap and altered with screwed to the post of the door frame.

Band and hook Hinge (Fig 7)

The band and hook hinge is closely related to the 'T' hinge. It consist of an iron strip called the band which drops on to a pin called hook which is attached to the frame of the door or window.

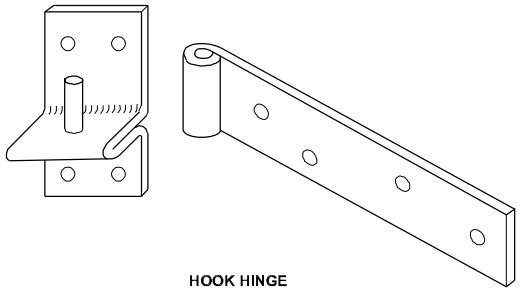
Fig 6



'T' HINGE

CAN137116

Fig 7



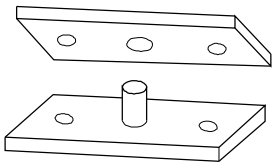
HOOK HINGE

CAN137117

Pivot Hinge (Fig 8)

For windows, we some times use pivot hinges. This consist simply a plate with a pin which fits into a hole in another plate.

Fig 8



PIVOT HINGE

CAN137118

European or Frameless hinges (Fig 9)

Fig 9

The most popular choice for full-overlay and inset doors, although they are usable on face-frame cabinets as well.

Offer ease of installation and can easily support heavier doors.

Adjust to align and level cabinet doors.

Types of door locks and their uses

Objectives: At the end of this lesson you shall be able to
- **state the different types door locks**
- **explain the constructional feature of door locks and uses.**

Door locks

There are many kinds of locks available for doors and casements.

When the door opens towards you with the hinges on the left at is left handed door.

If the hinges are on the right the door is said to be right handed.

Some types of locks can be used on only one type of door either right or left handed.

We have to know whether the doors are right or left handed before we order the locks.

The most common types of locks are...

– mortise lock

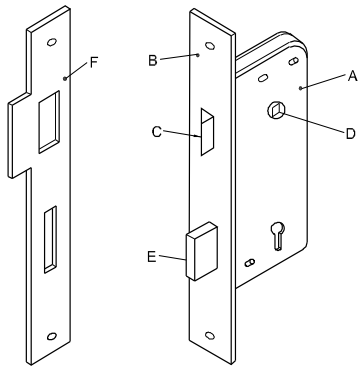
– rim lock

– pad lock

Mortise locks (Fig 1)

Mortise locks consist of a stock (a), face plate (b) and latch bolt (c) moved by the handle. The handle fits into the bush (d) and there is lock bolt (e) moved by the key.

Fig 1



MORTISE LOCK

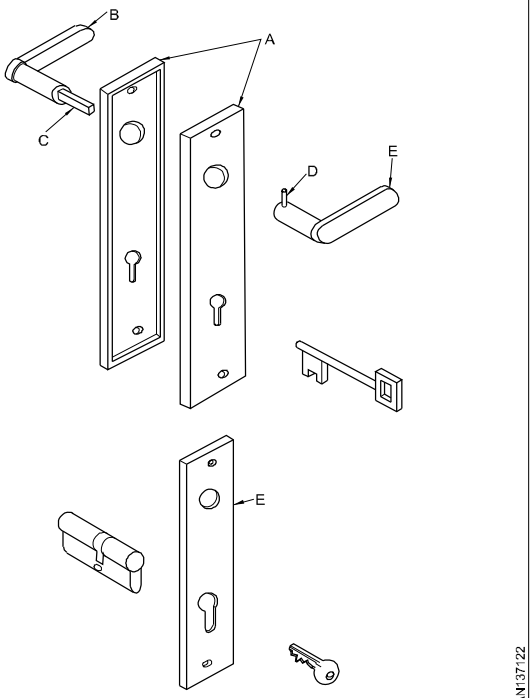
CAN137121

The two bolts fit into holes in the striking plate (f) which is attached by screws to the door post. The mortise lock fits in to a mortise in the edge of the door.

The stroke should fit tightly against the sides of the mortise so that the door itself faces the strain not the screws which only hold the lock in position. Mortise locks can only be installed in doors which are thick enough to receive a mortise. They are different to force open, since they are inside the door.

Door furniture for mortise locks (Fig 2)

Fig 2



The door furniture consists of two leaf plate (a) two hands (b) and a spindle (c) The spindle is permanently fixed in one handle and secured in the other by a pin (d) The handle with the pin should always be inside the door so that the pin cannot be loosened from the out side.

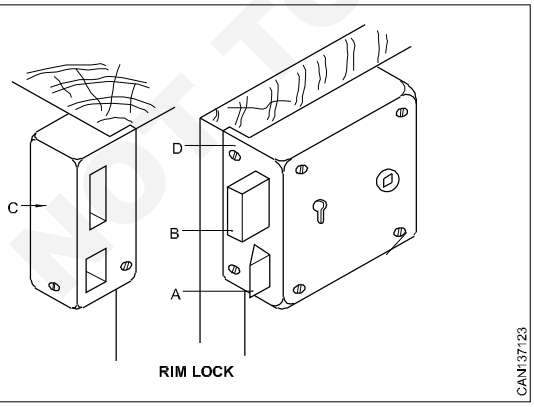
The leaf plates are attached to both sides of the door with screws or specially made.

Bolts which cannot be turn out easily. The leaf plates hold the handle in place and prevent damage to the key hole.

The leaf plate for a mortise lock with a cylinder (e) has an opening into which the locking cylinder fits instead of a key hole.

Rim locks (Fig 3)

Fig 3



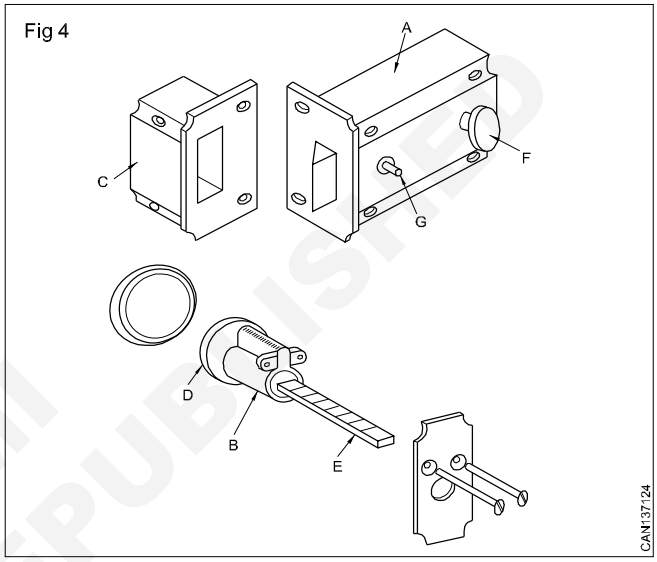
Rim locks have a latch bolt (a) operated by a handle and a lock bolt (b) operated by a key from the outside or inside of the door.

This kind of lock is attached with screws to the inside face of the door and the bolts shoot into a staple (c) there is a face plate (d) which is attached with screws to the door edge.

On the out side of the door two round plates are with screws one to hold to handle and other to cover the key hole. The handles have a square spindle which fits into the bush of the lock.

Cylinder rim night latch (Fig 4)

Fig 4



This is a special kind of rim lock. It consist of a latch (a) a locking cylinder (b) and a staple (c) there is a face plate (d) which is part of the shell of the cylinder the spindle (e) is fixed in the cylinder.

The latch bolt is operated from the outside by a key which rotates the spindle.

The spindle moved the bolt mechanism inside latch.

The bolt may also be shot back from the staple by turning the knob (f) of the latch from the inside.

The locking arm (g) is used to fix the bolt in place so that it cannot be operated from either side by key or the knob.

Pad locks

Pad locks have a ring which locks into a body. The locking mechanism can be either a lever mechanism or a locking cylinder as with the mortise lock.

Nails and screws, types and uses

Objectives: At the end of this lesson you shall be able to
- **list the different types of nails and screws**
- **state the uses of nails and screws**
- **state the sizes of nails and screws.**

Nails

Nails posses a head, shank and point.

They are usually made of wire or plate metal and mild steel.

For special purposes such as boat building, where nails may be in contact with water, copper and brass nails are used.

Mild steel wire nails are galvanized (coated with zinc) to prevent them from rusting.

For securing pieces of timber together or materials to wood.

Varieties or types

Nails generally obtain their names according to

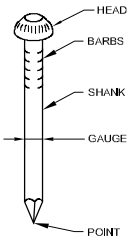
Shape of head

Shape of cross section

Their uses.

Diamond head nail (Fig 1)

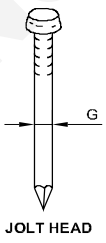
Fig 1



A round wire nail with a diamond shaped head used for general constructional work, securing flooring boards, living boards and packing case construction etc.

Jolt head or bullet head (Fig 2)

Fig 2

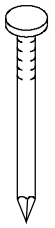


A round wire nail with a round head, which enters the timber cleanly leaving a smaller hole than the diamond head.

Used for same as diamond head.

Flat head round (Fig 3)

Fig 3

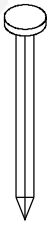


A round wire nail with a large round flat heads used for packing case construction (fruit cases) etc.,

Size : Range from 25mm to 150mm.

Flat head square (Fig 4)

Fig 4



Similar to the flat head round except that it has a square shank which is sometimes twisted to give greater holding power.

Used for packing cases and boxes etc.,

Size : Range from 20mm to 150mm.

Roofing nail /spring head (Fig 5)

Fig 5

Made of iron and galvanized to prevent rusting.

It has a large - dome - shaped head.

Sometimes it has square twisted shanks.

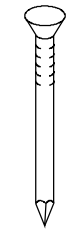
Size 45mm to 65mm.

Used for fixing corrugated galvanized roofing iron.

Sometimes called a spring head.

Panel pin (Fig 6)

Fig 6



PANEL PIN

CAN1372/6

A thin wire nail with an inverted cone shaped head.

For securing mouldings, fixing plywood to frames not likely to split the wood.

Generally used for work which is also glued.

Size: 12mm to 50mm.

Veneer pin (Fig 7)

Fig 7

VENEER PIN

CAN1372/7

A very thin wire nail similar to the panel pin, but sometimes headless.

To hold veneer in position while setting out and cutting or gluing and for fixing very small moulding.

Finishing or cut nail (Fig 8)

Fig 8

FINISHING NAIL

CAN1372/8

A small nail, rectangular in cross section.

Made from sheet metal with little or no head and no point.

Used for securing mouldings to frame such as the mouldings surrounding door panels.

Size from 12mm to 40mm.

Clout head (Fig 9)

Fig 9

CLOUT HEAD

CAN1372/9

Similar to the flat head round nail, usually shorter in length

It is having large flat head

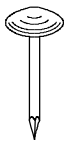
it is galvanized to prevent rusting.

Used for securing thin sheet metal and other materials such as roofing felt and leather to wood.

Size: 9mm to 40mm.

Upholstery nail (Fig 10)

Fig 10



UPHOLSTERY NAIL

CAN1372/A

A thin nail with a dome-shaped head.

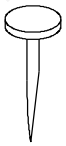
This nail usually made of brass or iron nickel plated or oxidized to suit the work.

For fixing materials such as rexin, leather etc to wood as in chair, theatre seats and up holstery in trains and cars etc.,

Size 12mm to 40mm.

Cut tack nail (Fig 11)

Fig 11



CUT TACK

CAN1372/B

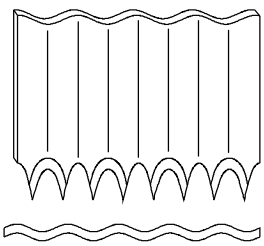
A short flat head nail with a tapering point.

To secure thin materials and fabrics to wood as used by motor car trimmers and up holsters etc.

Size 6mm to 25mm.

Corrugated fastener (Fig 12)

Fig 12



139 CORRUGATED BOX FASTENER OR WIGGLE NAIL

CAN1372/C

Made of corrugated plate iron with parallel or divergent corrugations with plain or saw teeth edges.

It is used for strengthening edge to edge joints as in sides of packing a case etc.

For holding the framed cores of cheap flush panel doors.

For holding together the parts of split patterns while turning.

Size 6mm to 25mm long with the to server corrugations.

Ordering nails

Nails usually sold by weight. When ordering state length, type and gauge.

Length is governed by the amount of nail inserted into the timber, which includes the head. The length is give in mm.

Types of name

It is determined by the shape of head, or use and the kind of metal used.

Gauge

Is the thickness of the nail and is indicted by a number based on a standard wire gauge number.

The higher the number the thinner the nail.

Common size wire nails range from 12mm to 150mm.

Holding power of the nail

Nails hold better when driven across the grain than along the grain.

Square nails with twisted shanks have greater holding power.

Greater holding power when driven obliquely or dovetailed.

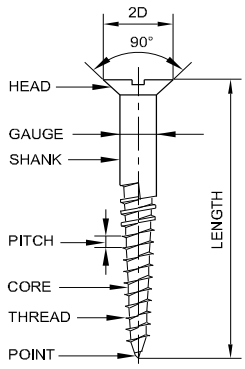
Nails with large flat heads have greater holding power.

Experiments have shown that if the shanks are cement

Screws

Wood screws are mostly made of mild steel, copper, brass and aluminum. (Fig 13)

Fig 13



They consist of head, shank and thread.

Available in various sizes.

HEAD the shape of which gives the screws its name.

The head of most screws are slotted to take the blade of screw driver.

Shank

Beneath the head about 2/3rds of which is threaded to a point.

Thread

Draws the screws into the timber and gives the screw greater holding power than nails.

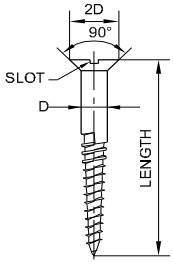
Mild steel screws are often galvanized (use in damp condition) nickel plated, blued, japanned oxidized to match the fittings they secure.

Phillips or recessed head screw have a crossed slot requiring a special screw driver.

Types of screws

Counter sunk or flat head (Fig 14)

Fig 14



The common counter sunk screw is made of mild steel.

It is used in damp conditions it is advisable to use the screws that have been galvanized or screws made of copper or brass.

Copper and brass screws must be driven carefully as they are easily broken.

Uses

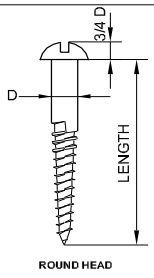
For general screwing purpose where it is necessary for the head to be flush with the surrounding surface.

Table top, chair seats, boxes and metal fitting to wood such as hinges.

Size: 12mm to 150mm length.

Round head (Fig 15)

Fig 15



Has a rounded head which is flat underneath.

Made of steel, copper or brass.

Brass and steel screws may be either nickel plated blued, black jappaned or oxidized to match the fittings being secured.

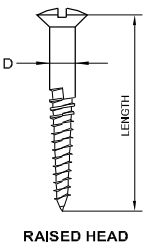
Uses

Where the head of the screw is visible as on ornament, or where the metal is too thin to allow counter sinking.

Galvanized steel round head screws with lead washer are sometimes used for fixing roofing iron.

Raised head or Oval head (Fig 16)

Fig 16



A combination of the counter sunk and round head screw.

it is made of the same metal and similar finishes as the round head screw.

Being contershunk it is much stronger than round head.

Uses

For securing thick sheet metal and metal fitting to wood, where strength as well as ornamentation is required.

It is often used by motor body builders with a small counter sunk cup or washer under the head for fixing metal panels and moulding.

Coach screw or square head (Fig 17)

Fig 17

CAN13721H

It is much stronger form of screw.

Made of mild steel (sometimes galvanised).

Being larger has to be driven with a spanner.

Made from 6mm dia to 20mm dia and from 40mm long.

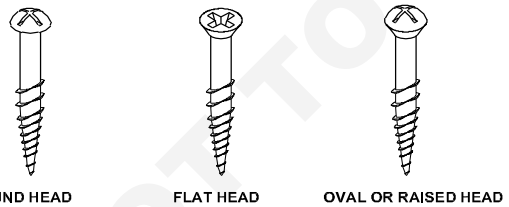
Uses

For rough work, bridge construction, fixing gate hinges, coach and carriage construction and for fixing machinery to bases etc.

Size 50mm to 150mm length.

Phillips or cross point head (Fig 18)

Fig 18



CAN13721I

These screws have a flat, oval or round head with two slots at right angles each other.

It provides more screw head surface against the screw driver tip than an ordinary screw does.

A special screw driver is needed.

Nail screw (Fig 19)

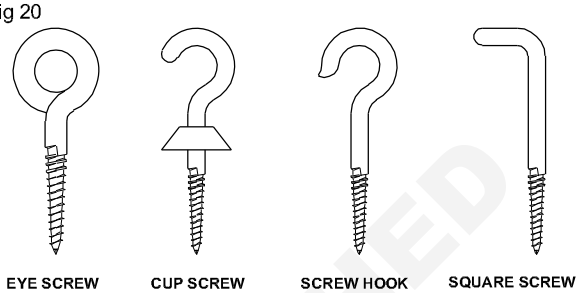
Nail screws have a very steep thread and can, therefore be driven with a hammer instead of a screw driver. They are commonly used for flooring, roofing and framing of rough work.

Fig 19

CAN13721J

Screw eyes, screw hooks, square screw, hooks and cup hooks are made in many sizes. (Fig 20)

Fig 20



CAN13721K

They are made from steel, brass or of galvanized iron and are used from special purposes, such as for hanging pictures, curtains, kitchen utensils keys etc.,

Large screws or wrench bolts (Fig 21)

Fig 21

CAN13721L

Large screws or wrench bolts are used for heavy joinery work and where greater holding power is needed. A wrench is used to drive these into a pilot hole that has been drilled into the wood

Ordering screws

Screws are usually sold in packets containing 100 Nos. and 200 Nos.

They can be brought by number.

When ordering state

– length
– kind, shape of head
– metal and finish.

Length

The length of screw is determined by the amount of the screw inserted into the timber.

The length of the counter sunk screw includes the head.

In case of round head the head is not included.

Gauge

The gauge thickness or diameter of the shank) is indicated by the number (not based on a standard wire gauge).

– Higher numbers indicate larger diameters.

– Lower number for smaller diameters.

Kind

It is determined by the shape of the head.

Metal

Steel (whether oxide japanned and nickels, brass, copper and aluminum).

Screws should be used in preference (heading) to nail when,

- Greater holding power is required.

– The appearance of the work may be spoiled by nails.

– The stock of driving a nail may damage the work.

– Vibration may weaken the holding power of nails.

Bolts, nut and washer

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of bolts,nuts and washer**
- **state the types and uses of bolts, Nuts and washer.**

Bolts

A bolt comprises of two parts a shank and a head.

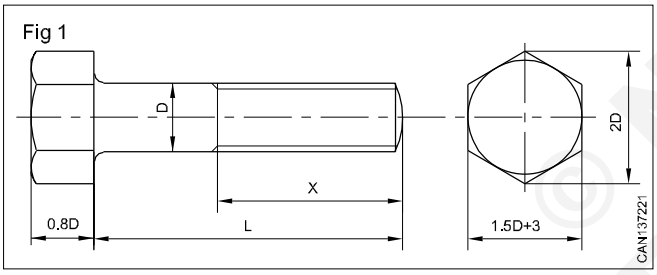
The shank is cylindrical and is threaded at the tail end for a sufficient length to engage with a nut.

The shape of the head depends upon the purpose for which the bolt is required.

While considering the length of the bolt the thickness of the head is not taken into account.

Hexagonal headed bolt (Fig 1)

Fig 1



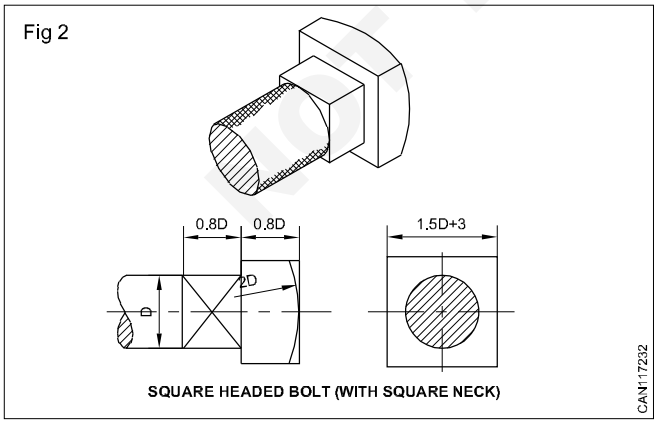
This is the most common form of a bolt.

The hexagonal head is chamfered at its upper end.

To prevent rotation of the bolt while screwing the nut on or off, the bolt head is held by another spanner.

Square headed bolt (Fig 2)

Fig 2



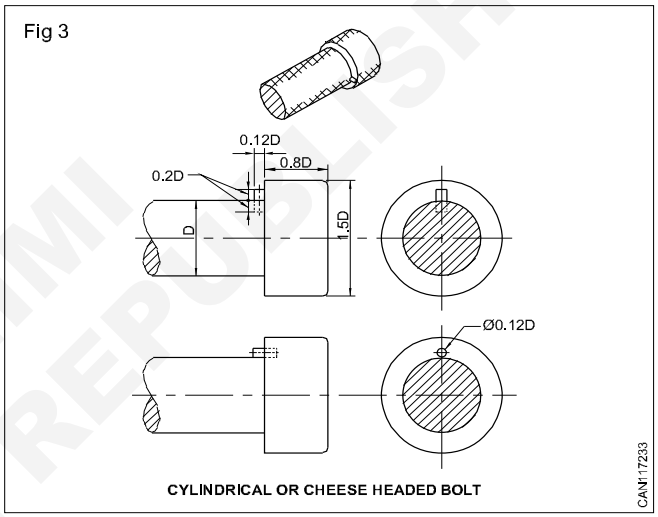
This bolt is generally used when the head is to be accommodated in a recess. This recess also is made of square shape. So that the bolt is prevented from turning when the nut is screwed on or off it.

This bolt is commonly used in bearing for shafts.

The bolt head is chamfered at its upper end.

Cylindrical or cheese headed bolt (Fig 3)

Fig 3



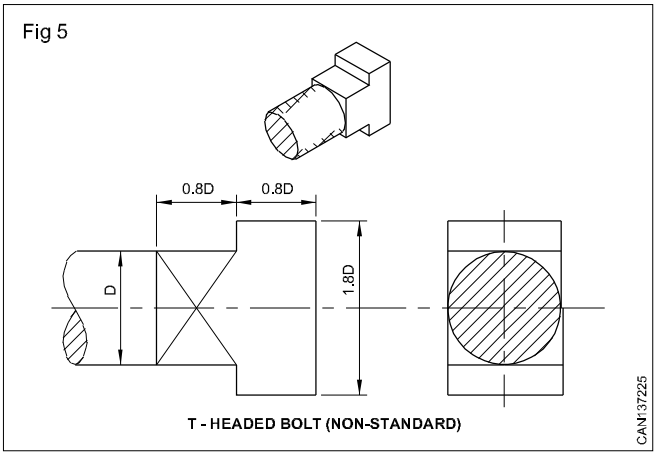
This bolt is used when the space for accommodating the bolt head is comparatively limited.

Where the use of a spanner for holding it is to be avoided.

It is commonly used in big ends of connecting rods, eccentrics etc.

T. Headed bolt (Fig 4)

Fig 5



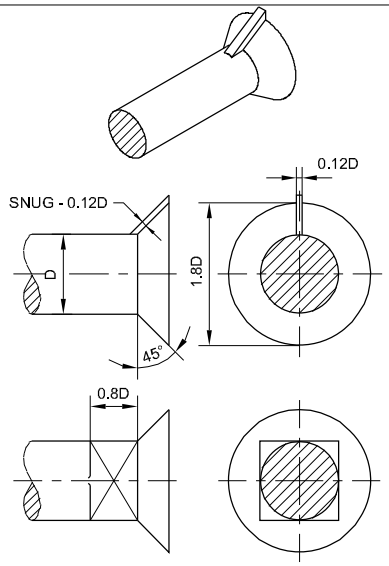
It is used in machine tool table in which T-slots are cut to accommodate the T-heads.

The neck of this bolt also usually square in section.

The T-head bolt is made use of in gland and stuffing box an arrangement in boiler mounting such as top valve, feed check valve etc.,

Counter sunk headed bolt (Fig 5)

Fig 5



COUNTER SUNK - HEAD BOLT

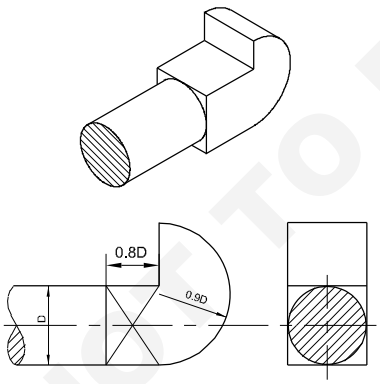
CAN\37226

Where the head of the bolt must not project above the surface of the connected piece, this form of bolt is used.

It may be provided with a snug or a neck for square cross section.

Hook bolt (Fig 6)

Fig 6



HOOK BOLT

CAN\37227

This bolt passes through a hole in one piece only, while the other piece is gripped by the hook shaped bolt head.

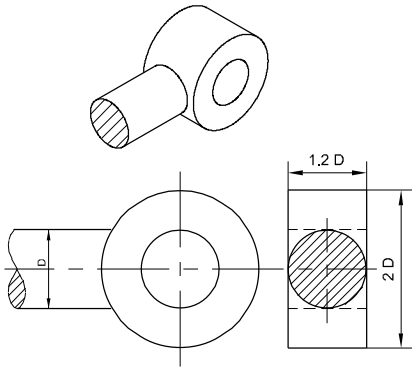
It is used when it is not possible to drill a hole in the piece adjoining the bolt head.

The square neck prevents rotation of the bolt.

Eye bolt (Fig 7)

This bolt has a circular ring of rectangular cross sections as its head.

Fig 7



EYE BOLT

CAN\37228

Head can be conveniently held to prevents its rotation.

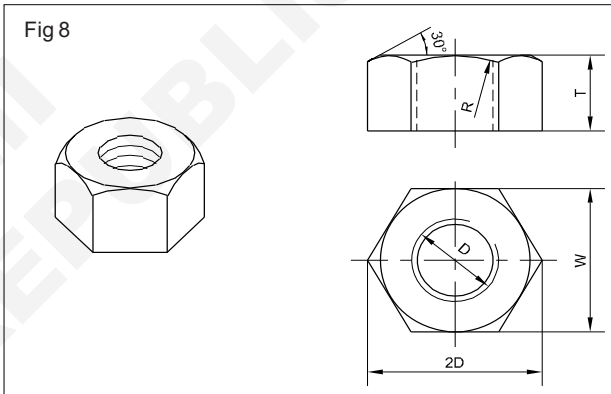
Nuts

Nuts are provided with an axial internal threaded hole and chamfered on it both side or one side.

Generally in the form of hexagonal cylindrical or square prisms.

Hexagonal nut (Fig 8)

Fig 8



HEXAGONAL NUT

CAN\37219

The upper corners of this nut are rounded off or chamfered.

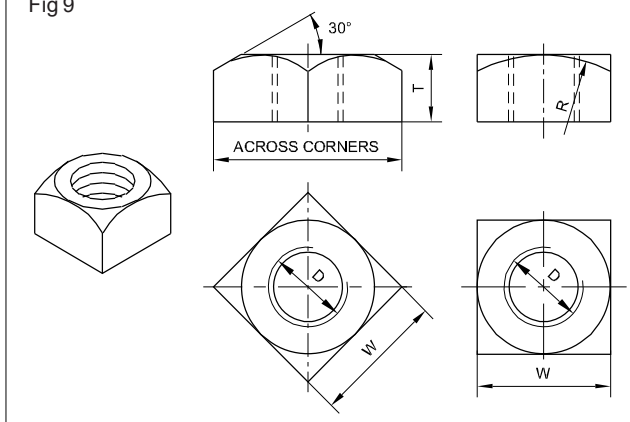
The chamfering is generally in conical.

The angle of chamfer is 30° to 45° with the base of the nut.

Due to chamfering an arc is formed on each vertical face and a circle is formed on the top surface of the nut.

Square nut (Fig 9)

Fig 9



SQUARE NUT

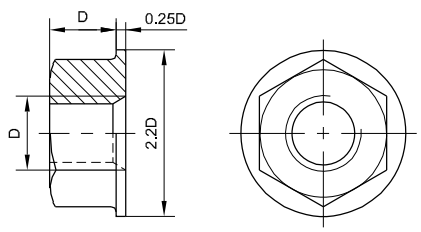
CAN\37222A

The upper corners of the square nut are also chamfered in the same manner of the hexagonal nut.

The width across flats of a square nut and a hexagonal nut for the same size of the bolt are also equal.

Flanged nut (Fig 10)

Fig 10



FLANGED NUT

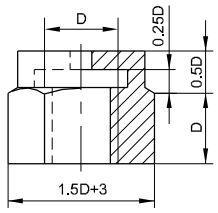
This is an hexagonal nut with a washer, i.e, a flat circular disc is attached to it.

It is thus provided with a larger bearing surface.

A bolt can be used in a comparatively large size hole with the help of this nut.

Cap nut (Fig 11)

Fig 11



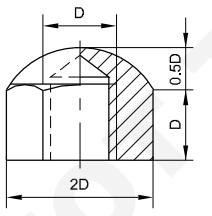
CAP NUT

It is also a hexagonal nut provided with a cylindrical cap at the tops to protect the end of the bolt from corrosion.

It also prevents leakage through the threads.

Dome unit (Fig 12)

Fig 12

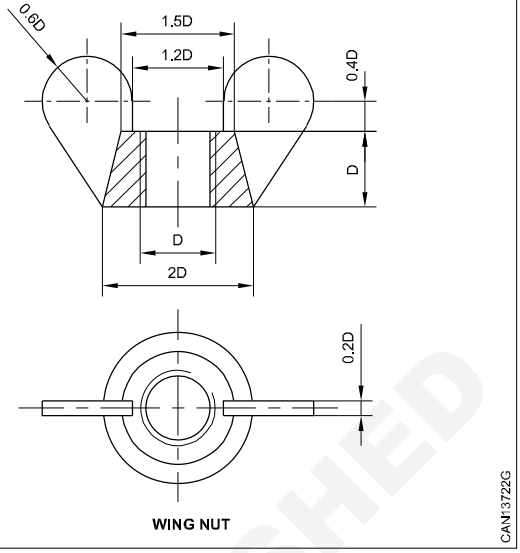


DOME NUT

It is a form of a cap nut having a spherical dome at the top.

Wing nut (Fig 13)

Fig 13



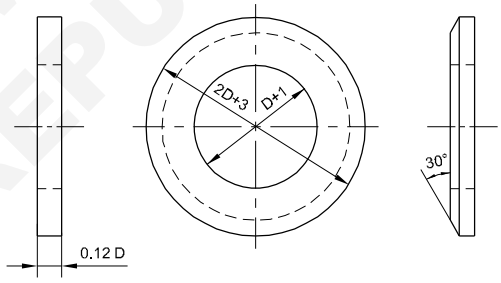
WING NUT

This nut can be easily operated by the thumb and a finger.

It is used where it is required to be adjusted frequently.

Washers (Fig 14)

Fig 14



PLAIN WASHER CHAMFERED WASHER

A washer is in cylindrical hollow piece of metal placed below the nut to provide smooth bearing surface for the nut to turn on.

It spreads the pressure of the nut over a greater area.

It also prevents the nut from cutting into the metal.

It allows the nut to be screwed on more tightly.

It is sometimes chamfered on the top flat surface, available in various sizes.

Driving tools

Objectives : At the end of this lesson you shall be able to
- **state the different types of screwdrivers and spanners and their uses**
- **specify a screwdriver and spanner**
- **list the precautions to be observed while using screwdrivers.**

Screwdrivers

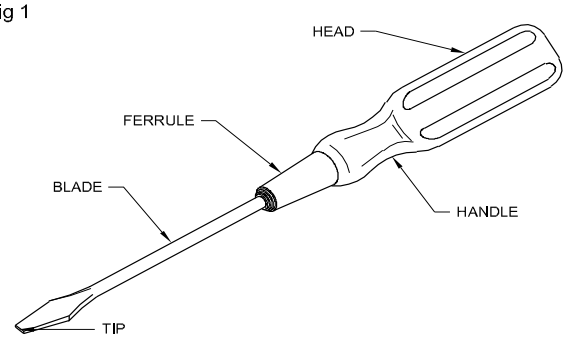
Screwdrivers are used to tighten or loosen screws and are available in various lengths.

Hand-held screwdrivers are of the following types.

Standard screwdrivers (light duty) (Fig1)

t is of round shank. blade with metal, wood or moulded, insulated material handle.

Fig 1



Standard screwdrivers (Heavy duty) (Fig 2)

It has a square blade. The shank is also of square section for applying extra twisting force with the end of a spanner. (Fig 3)

Fig 2

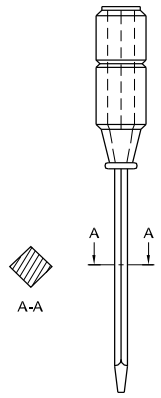
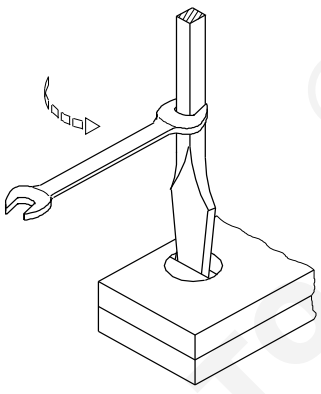


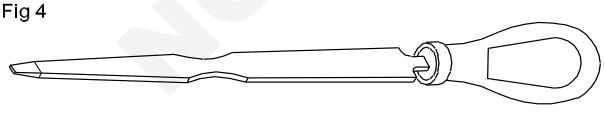
Fig 3



Heavy duty screwdrivers (London pattern) (Fig 4)

It has a flat blade and is mostly used by carpenters for fixing and removing wood screws.

Fig 4



Philips screwdrivers (Fig 5)

These are made with cruciform tips that are unlikely to slip from the matching slots.Philips recess head screws.

The sizes of Philips screwdrives are specified by point size 1,2,3 and 4.

Offset screwdrivers (Fig 6)

These are useful in some situations where the normal screwdriver cannot be used because of the length of the handle. They are also useful for applying greater turning force.

Fig 5

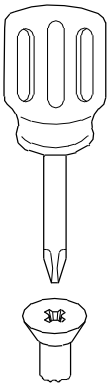
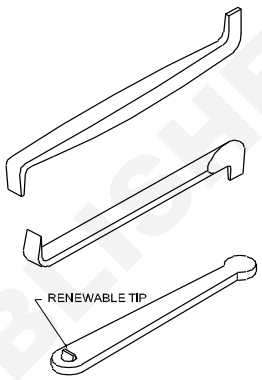


Fig 10



For quicker application ratchet offset screwdrivers are also available with renewable tips.

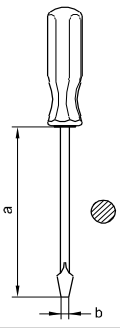
Specification

Screwdrivers (Fig 7) are specified according to the

- Length of the blade
- width of the tip.

Normal blade length 45 to 300mm. Width of blade: 3 to 10mm

Fig 11



The blades of screwdrivers are made of carbon steel or alloy steel, hardened and tempered.

Screwdrivers for special uses

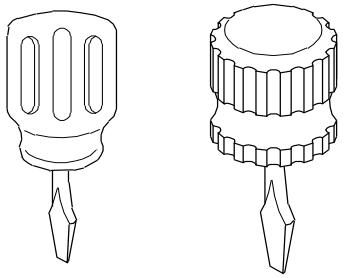
Small sturdy screwdrivers are available for use where there is limited space. (Fig 8)

Screwdrivers with blades sheathed in insulation are available for the use of electricians. (Fig 9)

Precautions

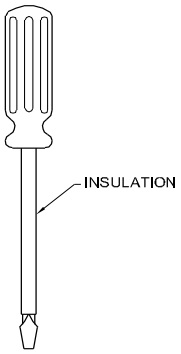
Use screwdrivers with tips correctly fitting into the screw slot. (Fig 10)

Fig 8



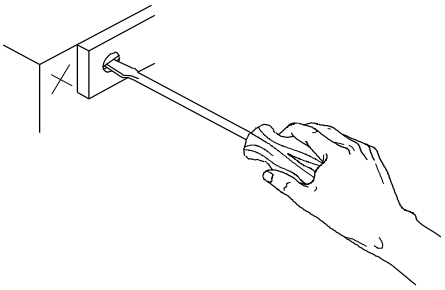
CAN13723B

Fig 9



CAN13723C

Fig 12



CAN13723A

Make sure your hand and the handle are dry.

Hold the screwdriver with its axis in line with the axis of the screw.

While using a Philips screwdriver apply more downward pressure.

Keep your hand away to avoid injury due to slipping of screwdriver.

Do not use screwdrivers with split or defective handles.

In the case of damaged screwdrivers, the blades can be ground (the faces will be parallel with the sides of the screw slot) and used. While grinding ensure the end of the tip is as thick as the slot of the screw.

While using screwdrivers on small jobs, brace the jobs on the bench or hold them in a vice.

Spanners (Fig 11)

A spanners is a hand tool with jaws or a ring at one end or at both ends of tightening or slackening nuts and bolts and screw heads. It is made drop forged, high utensil or alloy steel and heat treated for strength.

Types of spanners

- Open end spanners - Ring spanners

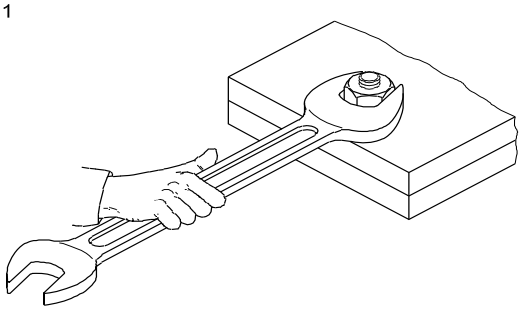
Open end spanners

They can be single ended or double ended.

Single-ended spanners (Fig 12)

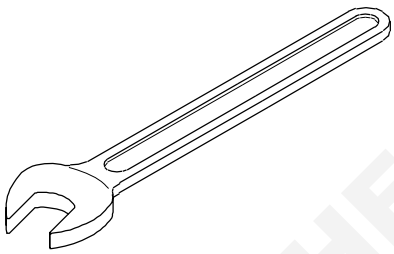
These are general purpose spanners. Single-ended spanners are mostly supplied with machine tools for a specific purpose.

Fig 11



CAN13723B

Fig 7

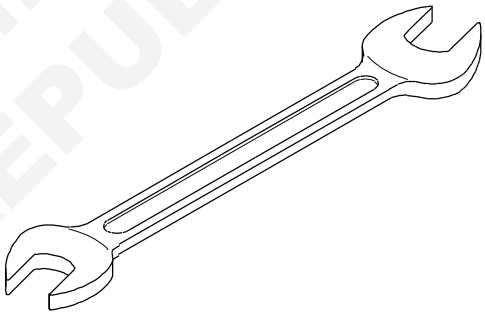


CAN13723C

Double-ended spanners (Fig 13)

Double-ended spanners are standard spanners having two different size openings. Some spanners are made of chrome vanadium steel.

Fig 8



CAN13723D

They are available in a set of 8, Nos 8 to 27mm.

8 × 10, 9 × 11, 12 × 13, 14 × 15, 16 × 17, 18 × 19, 20 × 22 and 24 × 27mm.

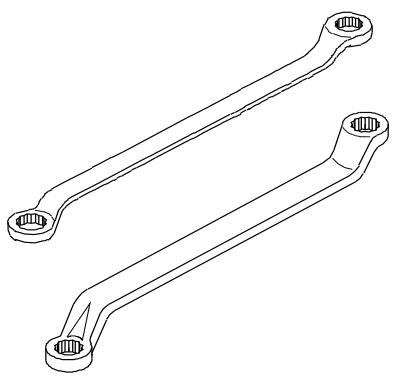
Ring spanners (Fig 14)

These types of spanners are used where obstruction close to the side of a nut prevails and application of open-ended spanners is not possible.

These are available in a set of 8 Nos.

(8 to 27 mm) 8 × 9, 10 × 11, 12 × 13, 14 × 15, 16 × 17, 18 × 19, 20 × 22 and 24 × 27mm.

Fig 9



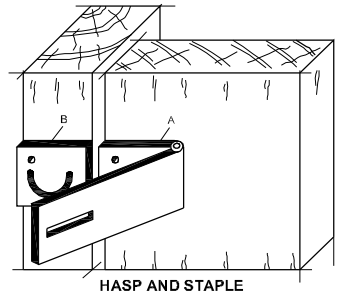
CAN13723E

Lock hinges hasp and staple

Objectives: At the end of this lesson you shall be able to
- **state the different types of hasp and staples**
- **state the constructional details of hasp and staples.**

Hasp and staple (Fig 1)

Fig 1



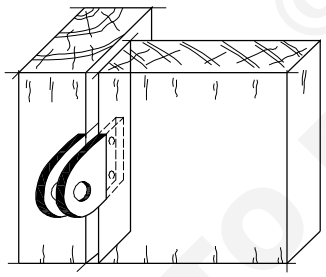
The hasp and staples is usually used in combination with a pad lock. It is installed on doors which do not have to be opened very often as it takes time to open.

The hasp (a) is screwed to the door a casement and the staple (b) to the frame.

For security reasons these types should be attached with bolt and nuts rather than with screws.

The device shown in Fig 2 is an alternative to the hasp and staples.

Fig 2

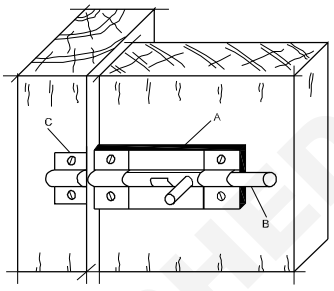


This is an efficient way of locking doors with a pad lock and the parts can be made by hand.

Two small plates have holes drilled in then for the pad lock and screwed to parts through. These plates are attached with screws to the edge of the door and the post.

Barrel bolt (Fig 3)

Fig 3

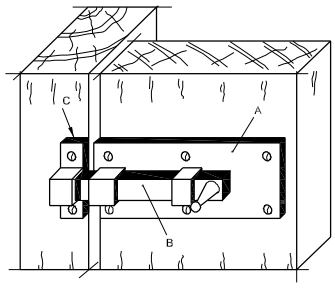


The barrel bolt consist of a plate (a) with a round bolt (b). The bolt engages in a staples (c)

The plate is attached with screws to the inside of the door of window and the staples is attached to the frame. Barrel bolts are often used to lock casements.

Tower bolt (Fig 4)

Fig 4



A tower bolt consist of a plate (a) with a flat bolt (b) fitted in the bolt engages in a staple (c) or in a striking plate in the frame.

The plate and the bolt usually fixed on the door or casement.

Other types of fitting

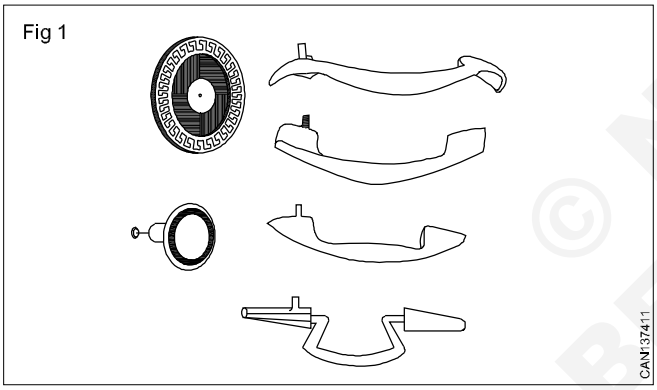
Objectives: At the end of this lesson you shall be able to
- **state the different types of handles and catches and uses**
- **explain the different types of mirror corners and uses**
- **state the different types of furniture castors and uses**
- **list the different types of ball catch and lense and uses.**

The selection of suitable fittings depends on

- Material
- Method of construction
- Type of finish
- Right or left hand fitting.

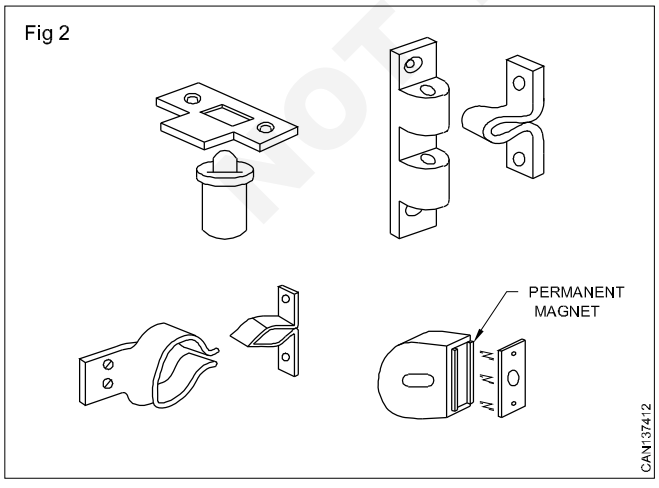
Handles and drawer pulls (Fig 1) : They are made from die-cast metal or plastic or a combination of both. Finished with satin nickel, brass, copper, aluminium, chrome plate and various colours of plastic. Their sizes vary according to requirements, generally-small, medium and large small drawer pulls to match larger door handles. They are secured by screw through the door or drawer front.

Fig 1



Catches (Fig 2) : They are fitted to the inside of the door or into the edges. Automatic closing and opening, having a spring type action, the door requiring a handle or knob for opening.

Fig 2

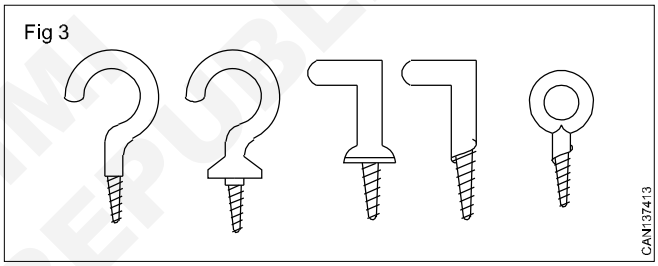


Ball catch (Fig 2) : is the simplest type to catch the door and cupboard, against wind or air. This consist of a ball and catch in the form of recessed hole which fits against each other.

Magnetic catch (Fig 2) : is automatic closing and opening. It consists of a strong permanent magnet in a case attached to the cabinet wall and a steel plate fixed to the door.

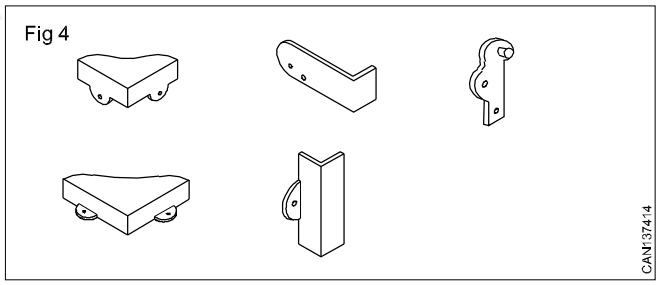
Screw Hooks and Eyes (Fig 3) : They are made of steel, brass or copper and may be straight or shouldered, with square or round hooks. Screw eyes are sized according to length, diameter of eye and gauge and are used in the doors walls of wood cup boards and screens open.

Fig 3



Mirror clips (Fig 4) - They are used for fixing polished edge mirrors to plywood backings.

Fig 4



Mirror Movements (Fig 4) - They are used for supporting mirrors between uprights to swivel.

Mirror Stays (Fig 4) - Are used to keep swivel mirrors at required angle.

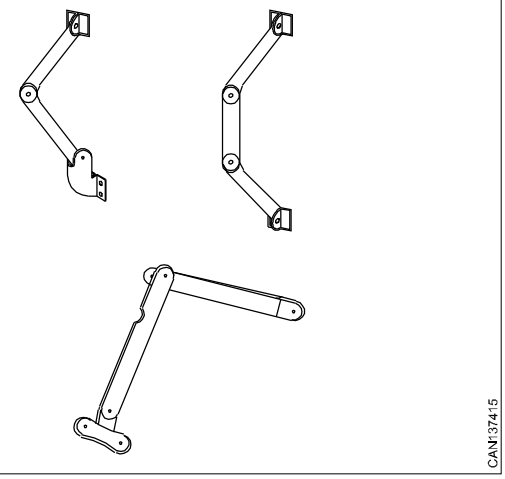
Stays (Fig 5) - They fold or slide so that the lids of boxes and table tops and can be supported in a open position to required size and can be left or right hand material and finish.

Cabin hooks (Fig 6) - They are of brass or steel and used to hold doors and screens opening.

Castors (Fig 7) - They are fitted to legs and bases of furniture to provide easy movement and available in a wide range of designs and sizes (diameter of wheel, any of the methods for fitting illustrated-grip-neck screw, socket,

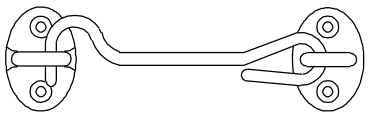
horizontal, vertical plate is selected and fixed according to the furniture movement.

Fig 5



CAN137415

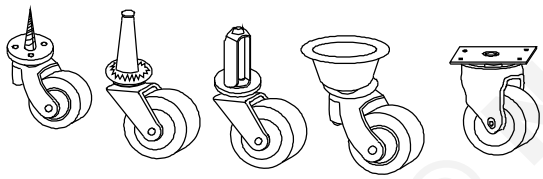
Fig 6



CABIN HOOK

CAN1374116

Fig 7

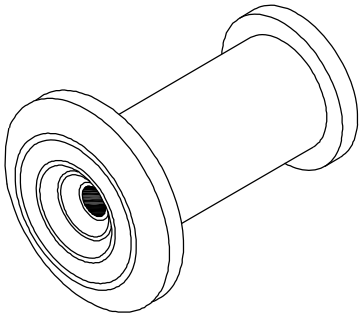


CAN137417

Lens (Fig 8)

The lens is mounted such that it gathers light ray from all angles on the outside of the door, and focuses them on a small pupil-sized region on the inside of the door, so that you (being on the inside) can see whatever is on the outside, through a wide range of angles. It is also known as 'PEEPHOLES'.

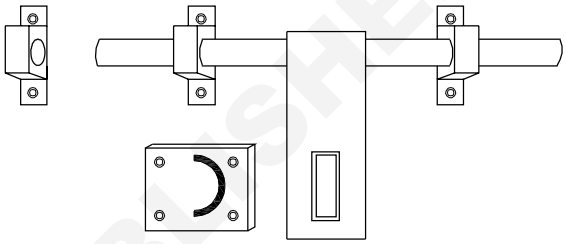
Fig 8



CAN137418

Altrap (Fig 9)

Fig 9



ALTRAP

CAN137419

It is mostly made of mild steel, brass and stainless steel.

It is commonly used for door front side middle (Lock rail) horizontal of the shutter edge. For security reasons these types should be attached with bolt and nuts rather than with screws.

Uses

The altrap is used to shutting the door and make it for safety with lock with is more strengthened it is mostly used for main door.

Miscellaneous hand tools

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

- **state the use of the crow bar**
- **explain the function and use of awls**
- **explain the function and use of butt gauge**
- **explain the specific use of pincers**
- **state the necessity and use of tool box**
- **list the different punches and their uses.**

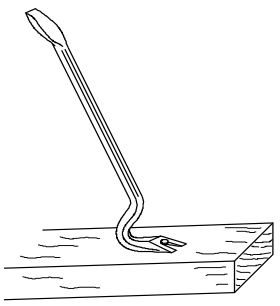
The crow bar (Fig 1)

This is an iron bar with a forged end used for pulling big nails out of timber and as a tool to move heavy objects. Other uses are to open crates or to loosen boards of concrete forms.

When a lot of force is needed to get out of a nail use a crow bar so as not to break the handle of your hammer.

For lifting very heavy jobs and iron bar should be used in place of smaller crow bar.

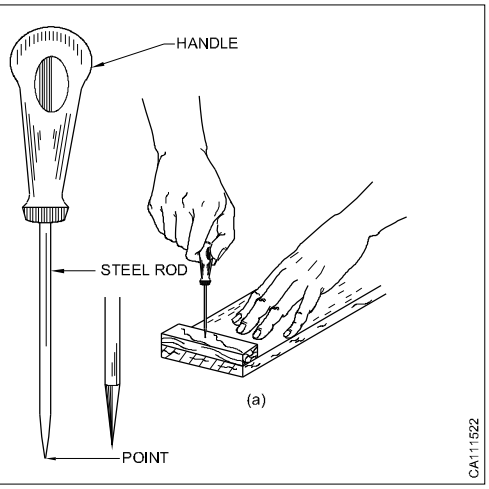
Fig 1



CAN137421

Awl (Fig 2)

Fig 2



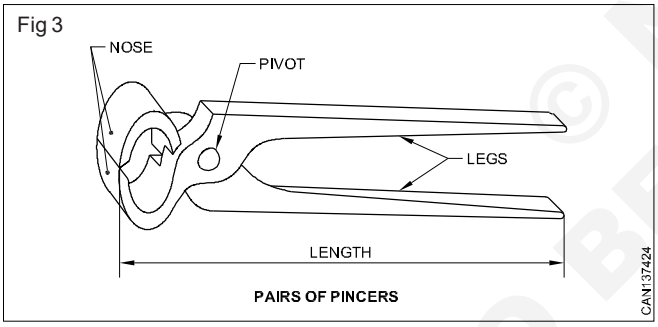
An awl is a thin pointed steel rod which is fitted with wooden or plastic handle. Awls are used for marking or piercing holes in wood. The tip can be either square or rounded. Awls with square shaped tips are preferred for piercing holes for small screws or nails.

Force the awl into the wood with a turning motion left and right so that it cuts its way through the wood.

An awl can easily be made from a thin steel rod, by hammering on end to a square shape and sharpening it, then fitting handle to the other end.

Pincers (Fig 3)

Fig 3



Pincer is used for pulling out and removing nails. It is also used for cutting wire.

A pair of pincers consists of two parts which can pivot. The ends of pivot axle is upset. Each part is a forged steel. The nose tips are hardened. Its jaws are bevelled inside and their outer surfaces are plain.

Thus the contact surfaces of the two jaws have a sharp edge.

Punches

Punches are used in order to make certain dimensional features of the layout permanent. There are two types of punches. They are centre punch and prick punch.

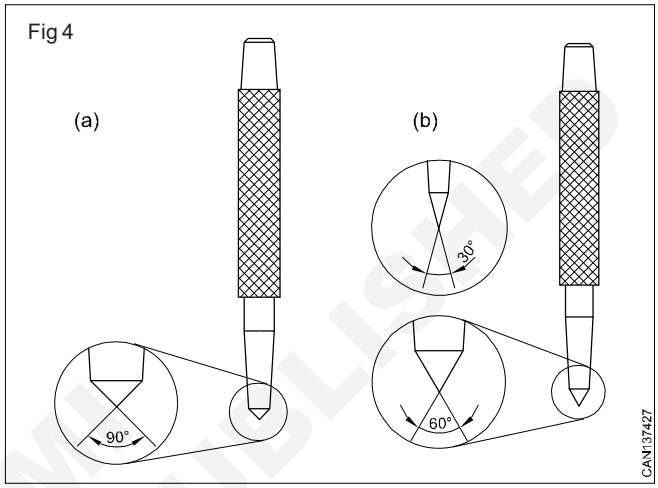
Centre Punch (Fig 4a)

The angle of the point is 90° in a centre punch. The punch mark made by this is wide and not very deep. This punch is used for locating holes. The wide punch mark gives a good seating for starting the drill.

Prick punch (Fig 4b)

The angle of the pick punch is 30° or 60°. The 30° point punch is used for making light punch marks needed to position dividers. The dividers leg will get a proper seating in the punch mark. The 60° prick punch is used for marking witness marks.

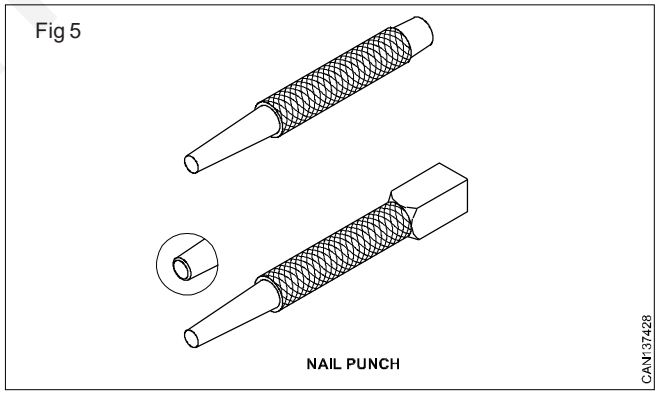
Fig 4



The witness marks should not be too close to one another.

Nail punch (Fig 5)

Fig 5



The nail punch is used along with the hammer to drive the head of nails below the surface of wood and to clench nails that go through to the other side of the board and stick out.

Nail punches are generally cylindrical in shape with concave points to keep the punch from slipping off the nail head.

Description of different carving tools

Objective : At the end of this lesson you shall be able to
- **state the description of carving tools.**

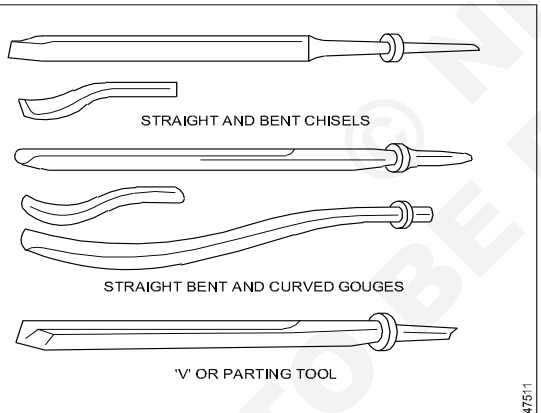
Attractive items used in the door frame, door shutters, tables, chairs and jewel boxes are made by the special carving tool by the carpenters. The carving surfaces are finished using french polish or varnish. The carving work is to beautify the work for good appearance.

Wood carving is a form of working wood by means of a cutting tool (knife) in one hand or a chisel by two hands or with one hand on a chisel and one hand on mallet, resulting in a wooden figure or figurine, or in the sculptural ornamentation of a wooden object. The phrase may also refer to the finished product, from individual sculptures to hand-worked moulding composing part of a tracery.

The making of sculpture in wood has been extremely widely practiced but survives much less well than the other main materials such as stone and bronze, as it is vulnerable to decay, insect damage, and fire. It therefore forms an important hidden element in the art history of many cultures.

Tools required for carving work Fig 1

Fig 1



CARVING TOOLS

Basic tools set

- The carving knife : a specialized knife used to pare, cut, and smooth wood.
- The gouge : a tool with a curved cutting edge used in a variety of forms and sizes for carving hollows, rounds and sweeping curves.
- The coping saw : a small saw that is used to cut off chunks of wood at once.
- The chisel : large and small, whose straight cutting edge is used for lines and cleaning up flat surfaces.
- The V-tool : used for parting and in certain classes of flat work for emphasizing lines.
- The vainer : a specialized deep gouge with a U-shaped cutting edge.
- Sharpening equipment, such as various stones and a strop : necessary for maintaining edges.

A special screw for fixing work to the workbench, and a mallet, complete the carvers kit though other tools, both specialized and adapted, are often used, such as a router for bringing grounds to a uniform level, bent gouges and bent chisels for cutting hollows too deep for the ordinary tool.

Note

- **Always keep your hand behind the carving tool**
- **When carving keep your figures in such a position they will not cut if the knife slips.**
- **Always keep the knife sharp.**

Portable electric router machine

Objective: At the end of this lesson you shall be able to
- **state the uses of portable electric router machine.**

Portable electric router (Fig 1): It is a most versatile machine and is used for ornamental work-edge mouldings and chamfers, surface. fluking “V” grooving, veining low relief carving, inlay recesses.

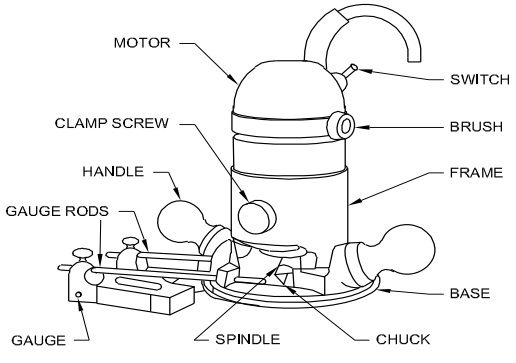
Adjustable fence is provided and the machine itself in adjustable for depth of cut.

It operates at very high speed from 16,000 to 27,000 rpm

While cutting it is help firmly on the handles with both hands and moved.

Attachments : jigs and templates and a wide range of cutters are available for use, with the router for shaped work.

Fig 1



PARTS OF PORTABLE ELECTRIC ROUTER

Ornamentation of timber

Objectives: At the end of this lesson you shall be able to
- **state different ornamentation works of timber**
- **state method of wood carving**
- **explain the method of matting or punching of timber**
- **state the tools required for ornamental carving.**

Ornamentation or decoration of wood article should emphasis the general outline of the work and enrich and beautify without interfering with its usefulness.

Craftsmen from the earliest times have endeavored to beautify their work by some form of decorative process.

Some types of ornamentation or decoration

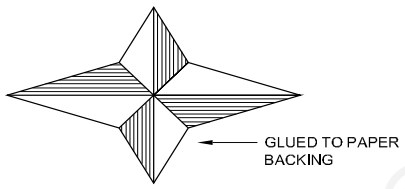
1 Figured timber

The natural grain of figured timber, if carefully selected, matched stained and finished, is sufficient itself to beautify the work. A good designer relies chiefly on figure, grain and colour of the timber.

2 Inlaying

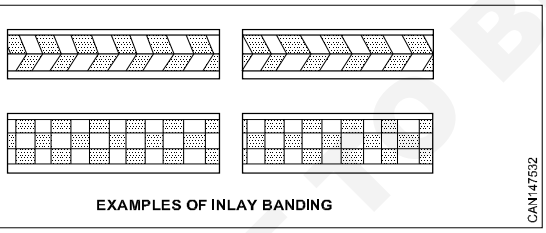
This is one of the oldest methods of ornamentation. In laying consists chiefly of cutting designs in thin wood and gluing them into carefully cut shallow recesses in the solid wood of the work. (Fig 1)

Fig 1



Inlay bandings are strips of inlay of built up patterns and are let into specially prepared grooves cut in the surface of the work. (Fig 2)

Fig 2

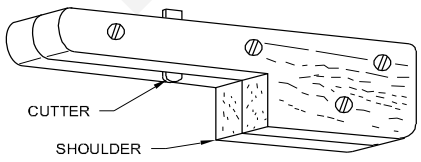


EXAMPLES OF INLAY BANDING

For inlaying banding a special tool, called a **`scratch'** is helpful.

The `scratch' is made of two pieces of wood with a cutter clamped between them. (Fig 3)

Fig 3



EXAMPLES OF INLAY BANDING

The cutter can be made from part of an old saw blade, its width depending on the width of the banding. The cutting edge is filed perfectly square.

3 Wood carving

Wood carving is also an ancient art, being a form of decoration applied to solid wood by cutting or carving designs by means of chisels, gouges or knives.

Chip carving

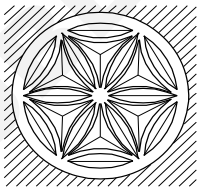
Chip carving is a simple method of carving requiring few tools.

A carving knife or one or two carving gouges and a carving chisel is all that is wanted.

The process consists of cutting a series of recesses or pockets with sides which slope into the wood at angle to the surface.

Chip carving designs are essentially geometrical patterns which are made up of straight lines and area of circles. (Fig 4)

Fig 4



CHIP CARVING DESIGN

Relief carving

Relief carving is a much more complicated method of carving.

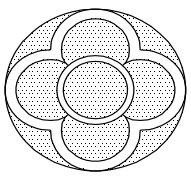
Briefly, it consists of drawing a design (which may be floral, pictorial etc) cutting away the back ground, then moulding and shaping the various forms.

In this way the design is made to standout in relief from the back ground. Special carving tools are required for this type of work.

All carving tools are ground and sharpened on both sides, and should be particularly sharp if satisfactory work is to be done.

4 Matting or punching (Fig 5)

Fig 5



PUNCHED DESIGN

This is a form of surface decoration produced by punching a design in the surface of the work, using various shaped punches. Thus the design or its background is slightly brought into relief by roughening or matting the surface of the wood.

The matted areas may be stained or coloured.

Properties of carving wood

Objective: At the end of this lesson you shall be able to
- **state the properties of wood required in selection of carving work.**

Wood is nature depends on designing, texture, grain, harden on and toughness as these properties are inbuilt on different types of woods. While some are suitable for construction work in flooring ceiling, wall panels, cabinets and other utilities furniture and other fittings and load carrying packages/crates required selected type of wood accordingly. Also architectural design crafts and artefacts require special characteristics to curve out decoratively in suitable wood.

The points to be noted while selecting the wood for carving should be as follows:

- Twisted or tends should be avoided.
- Cracks and knots to be discarded
- Fine texture with lengthy natural grains
- Flexibility to handle different type of carving tools
- Preferably solid timber without bores or cavities.

The carved objects should necessary have the ability to with filler materials,polish, stains and paints for better outlook and attractive appearance.

Preparation of bill of materials (For main door panel)

Objective: At the end of this lesson you shall be able to
- **prepare the bill of materials for carving work.**

Article : Floral carving work

Kind of wood : Teak wood

Sl. No.	Utilization to the job	W	T	L	No. of pieces
1	Rose Floral	600	× 30	× 1500	1

Sl. No.	W	T	L	No. of pieces	Volume M^3
1	0.6	× 0.03	× 1.5	1No	0.27m^3

Sl. No	Name of the material	Quantity	Cost of materials
1	Sand paper No.80, 100,120	each 2 Nos.	Rs. 12.00
2	Putty	50 grams	Rs. 10.00
3	Stain	100 grams	Rs. 20.00
4	White cotton cloth	200 grams	Rs. 50.00
5	French polish	1 liter	Rs. 250.00
6	White cotton waste	250 grams	Rs. 50.00
		Total	**Rs. 392.00**

Estimation of materials for floral carving work for main door panel

Objective: At the end of this lesson you shall be able to
- **estimate the materials and its cost.**

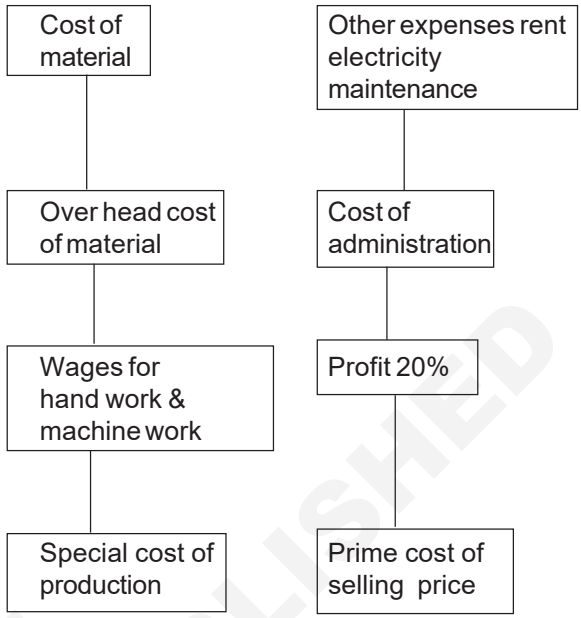
Cost of raw material

Volume of wood	= 0.27 cubic meter
Teak wood rate/ cubic meter	= Rs. 45000/-(approx)
Cost For 0.27m^3	= 12,150
Rounded to	= Rs.12,150/-

Detailed estimate

Cost of raw material (teak wood)	= Rs.12150.00
Over head cost @ 1%	= Rs121.00
Wages for carpenter for 3 day (8 hrs/day) @ Rs.100 per hrs (24 hrs x Rs.100)	= Rs. 2400.00
Cost of materials for Waxing and polishing	= Rs. 392.00
Special cost of waxing, polishing etc	= Rs. 1000.00
Adminstrative cost	= Rs.50.00
Electricity	= Rs. 200.00
Total	= Rs.16,313.00
Profit @ 20%	= Rs. 3262.60 or 3263
Total estimation cost	= Rs.19,576.00

Costing



Paints and its ingredients and agents

Objective : At the end of this lesson you shall be able to
- **state the ingredients of paints**
- **explain agents of paints.**

Paints

Introduction

One of the broad classification of building material is protection materials protection of a structure is a main factor necessarily with good appearance. Final finishing is required for all surface such as walls, ceilings wood works and metal works.

Paint is used to decorate, protect and prolong the life of natural and synthetic materials, and acts as a barrier against environmental conditions.

Decorative paints are applied on site to decorate and protect building and other objects, Industrial coatings are applied in factories to finish manufacured goods.

Ingredients of paints

A base

A vehicle or carrier

Drier

Colouring pigment

A solvent

Base

A base is a soild substance is a fine state of division and it forms the bulk of paint. It determine character of paint and it imparts durability to painted surface.

Commonly used bases are

White lead	Red lead	Zinc white
Oxide of iron	Titanium white	Aluminium white
Lithophone	Antimony white	

Vehicle or carrier

Vehicle is liquid substance that hold the ingredients of a paint in a liquid suspension. Vehicles employed are Linseed oil, Poppy oil, Tung oil and Nut oil.

Driers

These are substance to accelerate the process of drying. Drier absorb oxygen from air and transfer it to linseed oil which gets hardened. Some of the driers

a) Litharge b) Red lead c) Sulphate of Manganese

Colouring pigments

Colouring pigments gives desired colour besides the base

Pigments are Graphite lamp black

Indigo prussian blue

Umber

Chrome green

Copper sulphate

Solvent

The function of solvent is to make the paint thin that can easily applied on the surface. It helps the paint to penerate through the porous surface. The most commonly used solvents is spirit or turpentine.

Agents of paints

Thinner

The general term applied to a volatile liquid used to dilute or regulate the consistency (thickness) of a finishing material. Enabling it to be applied easily by brush or spray gun. The thinner must be comfortable with the finish use the thinner recommended to clean brushes and spray equipment.

Turpentine

Pure turpentine is an essential oil distilled from the sap (resins) or wood of certain pine trees.

It is used as a solvent and thinner in oil paint and wood fillers.

White spirit

It is used to replace pure turpentine as a thinner for paints and varnishes. Generally used for cleaning brushes and spray equipment after applying oil paints.

Benzine : is used as a solvent for removal of oil and grease.

Benzene (benzol) : is solvent naphtha used as thinners with other solvents in penetrating oil stains, priming paints.

Alcohols : are produced from fermentation of starches and sugary materials or distillation of wood.

Plasticizers : is substances added to enamels and cellulose lacquers to impart good flowing,levelling and adhesive characteristics to the mixture and to increase the elasticity flexibility of surface coating.

Flatting agents : is special additives such as waxes or fine silica, which reduce the gloss of the film to produce flat finishes, flat oil bound paints use a reduced amount of oil.

Catalysts and hardeners : is added to liqued plastic finishing materials to initiate and accelerate the curing or hardening of the resins.

Preparation of surface for staining

Objective : At the end of this lesson you shall be able to
• state the preparation of surface for staining.

It is wood surfaces by perfectly smooth before any form of finishing material is applied.

Scraping

- Punch nails and panel pins slightly below the surface.
- Remove setting -out marks and glue spots with smoothing plane.
- Remove plane marks and smooth cross grained areas with a scraper.

Sanding

- Sand with the grain using No 36 and No 50 sand paper on a cork sanding block.
- Rub with fine steel wool or sand with No 100 and 150 sand paper.
- Remove sanding dust. Avoid handling thus preventing finger marks.

Stopping

- This is the filling of holes, cracks and minor imperfections with a suitable compound coloured to match the wood.

Tools and equipment required for staining

Objective : At the end of this lesson you shall be able to
• state the staining tools

For good appearance of wooden articles and long life and to sell it at a reasonable price the articles are completed by staining, painting and polishing. To achieve smooth surface the staining tools are used as follows.

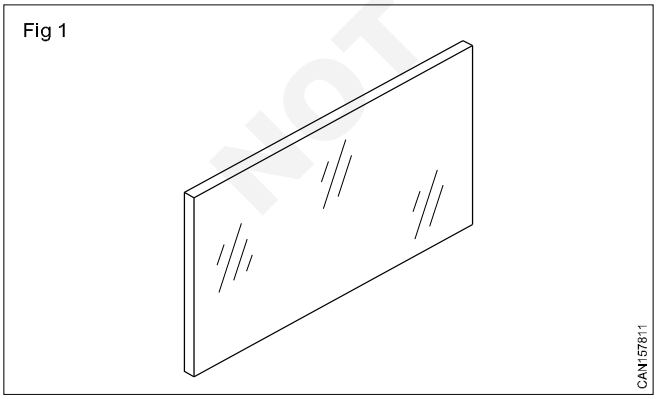
Required for staining tools and equipment

- Scrapers
- Power sander
- Sand paper
- Steel wool
- Paste wax.

Types of scraper

a) Hand scraper (Fig 1)

Fig 1



– The hand scraper is a flat piece of rectangular thin flexible blade of high-grade steel. (Fig 1)

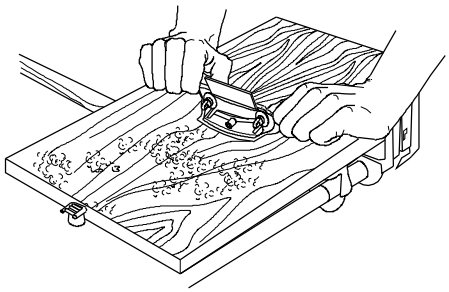
– The size of the scraper is (150 × 50 ×1mm)

– The cutting edges are formed by burnishing the long edges.

– When drawn over the timber very fine shavings are produced.

b) Shaving scraper (Fig 2)

Fig 2



USING A CABINET SCRAPER

Some scrapers are fitted with handles to make them easier to manipulate other are fitted in to a stock similar to a spoke shave to hold the scraper blade.

Power sander : The power sander is a power tool used to smooth surface by abrasion with sand paper.

Sand paper : The sand paper are used for preparing wood surface for finishing and levelling.

Steel wool : The steel wood is commonly used instead of coated abrasives for dry flatting or levelling between coats. Also used oil or wax for producing a satin finish.

Paste wax : Paste wax has been used for contours to seal protect and add shine to wood furniture.

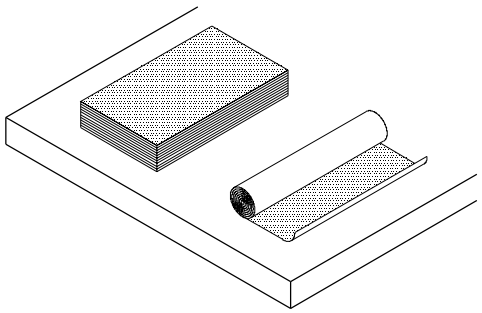
Uses of different grade sand paper

Objectives : At the end of this lesson you shall be able to
- **state uses of sandpaper**
- **state different grits and grades of sand paper**
- **state different types of sand paper.**

Sand paper is used for the final smoothing of a surface before a finish paint, varnish, polish or stain is applied.

It is also used in case where no further finish is applied sand paper is available in the market as sheets and as rolls. (Fig1)

Fig 1



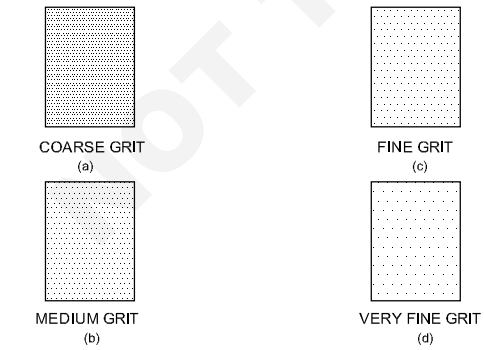
It consist of a lining of paper or lines, one side of which is coated with sharp coated flint or quartz crystals.

Different grades

Fig No.	Class	Grade (in Nos.)		
2a	Coarse grit	36	40	60
2b	Medium grit	80	100	120
2c	Fine grit	150	200	220
2d	Very fine grit	240	280	320

The Grit is classified in the following grades. (Fig 2)

Fig 2



It is in this order that the sand paper is used on a particular job.

Only a good surface preparation can give an excellent polish and finish.

Different types

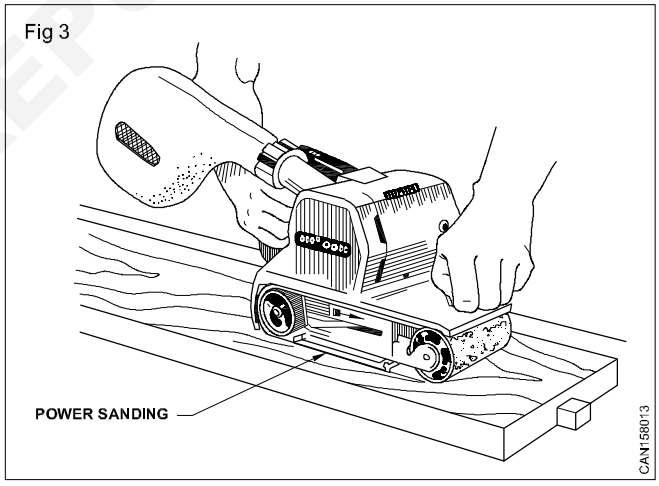
Apart from the grit classification, the abrasive materials is used and differentiated as follows.

a) Sand paper : Made of crushed flint or quartz. It has a yellowish sandy colour.

b) Garner paper : Is more durable than sand paper and has a reddish colour.

c) Emery cloth : Is of a black colour. It is not much used in the wood working trade. However, it is used with the powered sanding machine for sanding, wooden floor etc. (Fig 3)

Fig 3



Portable sander machine and uses

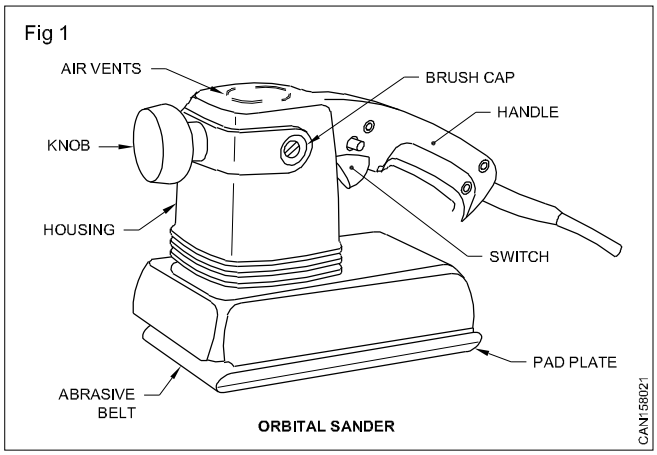
Objective : At the end of this lesson you shall be able to
- **state the different types of portable sander machine**
- **state the uses of portable sander machine.**

Description

A range of table power sanders are available to shape and finish materials or to prepare surface for painting and polishing.

Orbital sander (Fig 1)

Fig 1



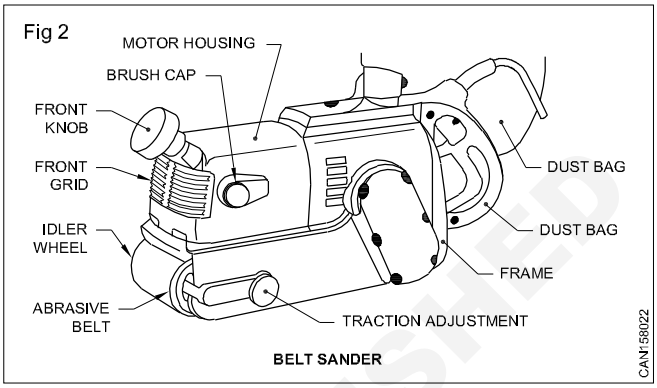
ORBITAL SANDER

This machine is suitable for sanding ,flat and curve surfaces. The sanding paper is fitted to a flexible base and is ideal for finishing work as it reproduces at high speed the action of sanding in either the horizontal or vertical positions.

Belt sander (Fig 2)

The belt sander is suitable for sanding flat surface and consists of a continuous abrasive bond fitted over rollers at each end of the machine.

Fig 2



BELT SANDER

Sanding of framed joinery works with grain can be actually carried out and scratching at joints avoided. A dust collecting bag is fitted to the back end of the machine.

Preparation of putty

Objectives : At the end of this lesson you shall be able to
- **explain the preparation of putty**
- **state the uses of putty.**

Preparation

The putty may be prepared by mixing resin, incense or shellac, common wax and whiting. All these ingredients melted together on the fire form a good filler.

It should be applied hot as it hardens very soon. It should then be cut down to the level for the surface first with sharpened chisel and then with the surface and sand paper.

In order to obtain coloured putty, while melting add to the ingredients the powder of the colour desired.

Putty or filler may also be prepared by mixing thin glue with chalk or whitening and coloured powder according to the colour with the wood must be stained.

Another method of preparation is scraping with a sharpened chisel the end of a planed piece of wood of the same kind as that form the work is made and adding to the shavings thus obtain a little thin melted glue.

A skillful joiner and cabinet maker does not make great use of fillers or putty, but takes good care to drive in nails and screws from sides hidden from views.

Staining

Objectives : At the end of this lesson you shall be able to
- **state the different types of stain**
- **state the process,methods and application of stain**
- **state the uses of stain.**

Staining

Staining is treating of surface on the job with a colouring solution or stain before applying clear finishing materials. Generally select grade figured cabinet timber or veneers are left their natural colour and rarely need staining prior to the application of finishing coats. Stains are usually transparent colours. Proprietary stains as generally named according to timber colours.

Types of staining (water stain)

Stain is prepared by dissolving coloured ingredients in hot water.

As far as possible avoid combination of colours. Purchase the colour required rather than mix two colours to obtain a third colour.

Oil stain

Oil stain are colours dissolved in mixture spirit, turpentine solvent, napthatolual or benzene. They are easy to apply and do not raise the grain.

Uses

To stain the wood to a uniform colur.

To stain cheap colourless wood an initiation of better wood.

To stain new furniture to match existing furniture in the home.

Process of staining

Preparation of surface sanding.

The surface is smoothened by throughly rubbing or sanding it by sand paper.

Puttying

The process of covering all gap in the wood.

Stopping

Stopping is done by means of hot weak glue.

Size so that the pores on the surface are filled up with boiled linseed oil.

Preparation of staining on different timber

Method of staining

- By brushes
- By spraying pistol

Application of staining on different timber

Depending upon the colour requirement of the timber the colour powder selected such as raw sienna, mahogany, umber and mixed with wood sealer and NC thinner required.

Application of staining

All stains can be brushed or sprayed or fairly, liberally and wiped or brushed along the grain.

Always test stain colour on scrap wood before use

It is better to use a stain, that is a shade lighter than required to use too dark as required.

Allow over night drying or more if possible.

The prevent and grain marking apply a coat of thin polish before staining.

French polish

Objectives : At the end of this lesson you shall be able to
- **describe about french polish**
- **state the application of french polish.**

Polish is a substance that of put on the surface of a piece of furniture in order to clean it and make it shine.

Although the polishing, varnishing staining and painting, of furnitures form a special branch and are separate works by themselves. yet the cabinet maker should have some knowledge of them especially, when he works in a small centre or village where there is no opportunity of finding a special man for works of this kind.

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

Shellac - 100 grams

Gum mastic - 10 grams

Gum Sandaraz - 10 grams

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 and texture.

- Polish has the excellent qualities of transparent depth, durability and hardness.
- It dries very quickly. It oil based it dries slowly.

Method of applying french polish

By cotton pad

By brushes

By spraying gun

Application of french polish on wooden surface

Process of polishing

Preparation 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 of polish.

Polishing

Applied first coat on the cleaned surface. Dry first coat second coat in circular motion

Apply finishing coat of polish glong the grain.

Note

It is process which takes a good deal of time and require great skill and practice.

More then a theoretical instruction for the preparation and application of this polish.It is much better to have a practical training,under an expert, who shows the way of applying it with success.

The filler should be of same colour of the wood which has to be polished removes finger marks and dirt from most surfaces.

Varnish

Objective : At the end of this lesson you shall be able to
- **state the type and uses of varnish.**

Varnish

Varnish is a clear transparent hard protective finish wooden surface like windows, door, floors and roof trusses from atmosphere. Different varnishes extist for specific needs oil varnish, consisting of a solvent and a drying oil is the preferred choice for wood work.

Spirit varnish dry evaporation. Spirit vanishes are resins dissolved in volatile solvent such as alcholies.

The film is formed by the resins after evaporation of the solvent.

Method of applying wax polish

Objective : At the end of this lesson you shall be able to
- **state the method of wax polish applying.**

Preparation of wood surface

– The surface is smoothened by thoroughly rubbing/ sanding it by sand paper.

Puttying

– The process of covering with putty on the gap and nail, screw head in the surface.

Prepare the wax polish

– Waxes are prepared into a paste by dissolving them in turpentine.

Waxing

– Apply wax with stiff brush or cloth pad in all directions of the wood.

– Allow 1/2 - 1 hour for the turpentine to evaporate.

– Wax polish by rubbing vigorously with a soft fluffless cloth (or) coconut fibre.

– Apply more thin coats with a soft cloth and allow 10-15 minutes for each coat to dry.

– Polish each coat by hard rubbing with soft cloth.

– Repeat until the desired gloss is obtained.

Note : For turned or cylindrical component, polishing is done by rotating the component.

Method of repolishing old furniture

Objective : At the end of this lesson you shall be able to
- **state the method of repolishing old furniture.**

Re polish on old furniture

Removed of old polish.

– With benzine and white spirits.

Surface preparation.

– Scrape with sharpened scraper.

– Smooth all the surface with sand paper No : 50

– Smooth all the surface with sand paper No : 100,120

– Remove sanding dust with brush.

Stopping/putting.

– Cover the holes and cracks with suitable compound (putty)

Staining

– Colour the surface with stain.

Sealar

– with diluted clear finishing material.

Application of polish

– First coat glide the rubber on to the surface use light pressure.

– Second coat re-charge rubber-change to circular movements.

– Finishing coat- Gradually change back to straight strokes along the grain.

Estimation process of wooden furniture

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

- **estimate the process of wooden furniture**

Article : Student chair
Description : With plank seat
Kind of wood : Teak wood.

Costing

Costing is the science of making the proper calculation of the price and or the technique and process of ascertaining costs. Cost can be defined as "the amount of expenditure incurred on a given thing". The price of a product is the sum of money the customer will ultimately have to pay for it. The price is different from the cost of a product. By ' the cost' it means the actual cost to the carpenter before he adds his risk and profit as well as Sales Tax in order to calculate " the price" only when he fully understands the the principles of costing will a carpenter be able to manage his business and control his workshop in a proper manner.

Estimate the materials required for a student chair (Fig 1)

Sl. No	Utilization to the job	W × T × L	No of pieces
1	Back leg	100 × 40 × 1050	2 Nos.
2	Front leg	50 × 50 × 450	2 Nos.
3	Back rest top rail	75 × 25 × 450	1 No.
4	Back rest middle rail	50 × 25 × 450	1 No.
5	Back rest vertical rail	30 × 20 × 450	2 Nos.
6	Back rest vertical	75 × 20 × 450	1 No.
7	Seat front rail	50 × 30 × 450	1 No.
8	Seat side rail	50 × 30 × 450	2 Nos.
9	Bottom rail	25 × 20 × 450	2 Nos.
10	Bottom cross rail	25 × 20 × 450	1 No.
11	Seat back rail	50 × 30 × 450	1 No.
12	Seat plank	250 × 20 × 450	2 Nos.

Example : Prime cost estimation for preparing student chair

Raw material for student chair (Dimensions in metres)

Sl. No	W × T × L	No of pieces	Volume m^3
1	0.1 × 0.04 × 1.05	2 Nos.	0.0084
2	0.05 × 0.05 × 0.45	2 Nos.	0.00225
3	0.075 × 0.025 × 0.45	1 No.	0.00084375
4	0.05 × 0.025 × 0.45	1 No.	0.005625
5	0.03 × 0.02 × 0.45	2 Nos.	0.00054
6	0.075 × 0.02 × 0.45	1 No.	0.000675
7	0.05 × 0.03 × 0.45	1 Nos.	0.000675
8	0.05 × 0.03 × 0.45	2 Nos.	0.00135
9	0.025 × 0.02 × 0.45	2 Nos.	0.00045
10	0.025 × 0.02 × 0.45	1 No.	0.000225
11	0.05 × 0.03 × 0.45	1 No.	0.000675
12	0.25 × 0.02 × 0.45	2 Nos.	0.0045
	Total volume		0.0214625m^3

Sl.No	Name of the material	Quantity	Rate (Rs)
1	Sand paper No. 50,80* 120	each 2 Nos.	12.00
2	Putty	100 grams	20.00
3	Wood filler	250 grams	30.00
4	Cotton waste white	250 grams	50.00
5	Small roll of cotton pad	250 grams	30.00
6	White cotton cloth	1/2metre	45.00
7	French polish	1 liter	250.00
8	Bowl	1 No.	30.00
9	Colour powder	200 grams	20.00
10	Coconut oil	100 grams	20.00
		Total	507.00

Cost of Raw material

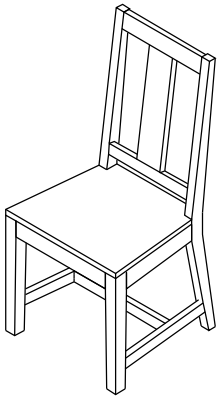
The total comes to	=	0.0211m^3
Teak wood rate/cubic meter	=	Rs.45000 (approx)
For 0.0211m^3	=	0.0211 x 45000
	=	949.50
Rounded to	=	950/-

Detail estimate

Cost of raw material	=	Rs.950.00
Over head cost @ Rs.1%	=	Rs. 95.00
Wages for carpenter for		
3 day 8 hrs/day@ Rs.100per hr	=	Rs.800.00
Cost of material for polishing	=	Rs.507.00
Special cost of waxing, Polishing etc	=	Rs. 500.00
Other cost rent & Electricity	=	Rs. 100.00
Administrative cost	=	Rs. 50.00
Total	=	**Rs.3002.00 (C.P)**
Profit @ 20%	=	Rs. 600.00
	=	Rs.3602.00
Prime cost of selling	=	**Rs.3602 (S.P)**

Estimation of the prime cost approximately.

Fig 1



CAN1586H1

Band saw machine

Objectives : At the end of this lesson you shall be able to
- **state the constructional features of band saw machine**
- **name the different types of band saw machine**
- **identify the parts and function of the band saw machine.**

CONSTRUCTION FEATURES OF BAND SAW MACHINE

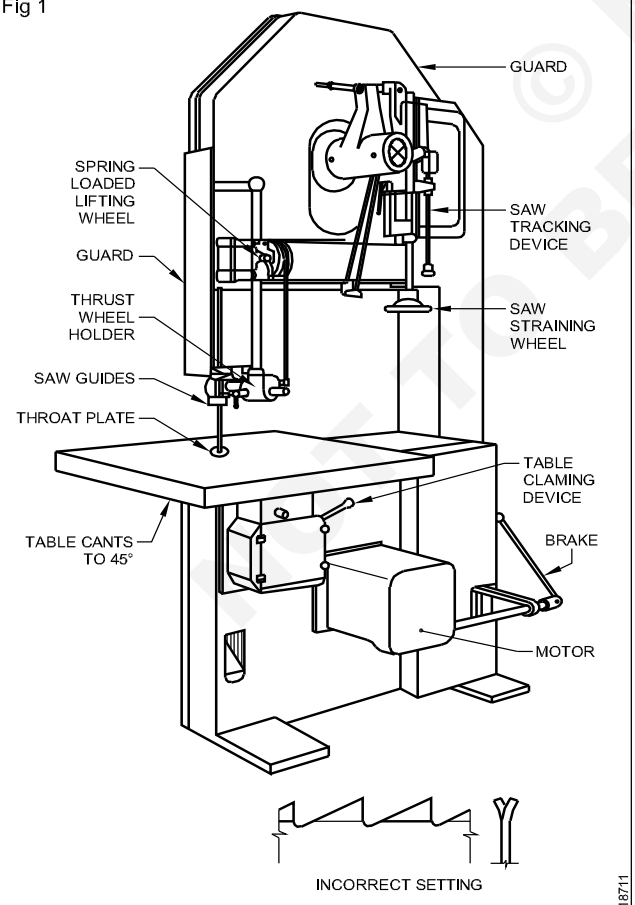
- Consists of an endless flexible saw blade.
- Saw blade running over two vertical wheels one above the other.
- A table is provided between the wheels to support the work while sawing.
- All the parts are mounted and supported on a cast iron frame.
- Power is usually supplied by an electric motor.
- Saw blade is used for sawing along the grain and across the grains, curves, circles and bevel cuttings.

Types of band saw machine

There are two types

- Vertical band saw machine (Fig 1)

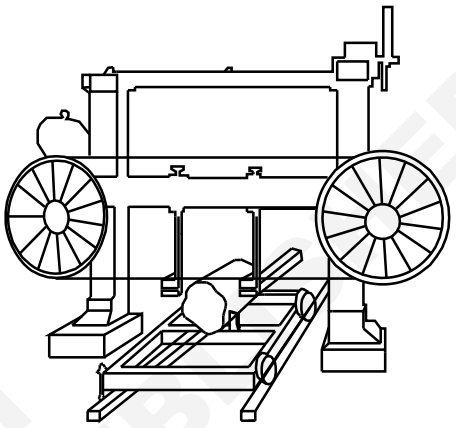
Fig 1



BANDSAWING MACHINE

- Horizontal band saw machine (Fig 2)

Fig 2



HORIZONTAL BANDSAW MACHINE

Horizontal band saw machine

- It is used for long cutting.
- Large diameter logs can be converted to give variations in timber size.

Vertical band saw machine

- It is used to size the timber after sawing done by horizontal band saw machine.

Size of band saw machine

- Size of band saw machine determined by the diameter of the wheels.

Blades	Cutting curves
1/4" = 6 mm	2" dia (ϕ 50 mm)
3/8" = 9 mm	3" dia (ϕ 75 mm)
1/2" = 12 mm	4" dia (ϕ 100 mm)
3/4" = 20 mm	6" dia (ϕ 150 mm)

- Size of the wheel ϕ762mm to ϕ915mm to use saw blade form 13mm to 38mm wide.

Parts and Function of band saw machine (Fig 1)

The frame

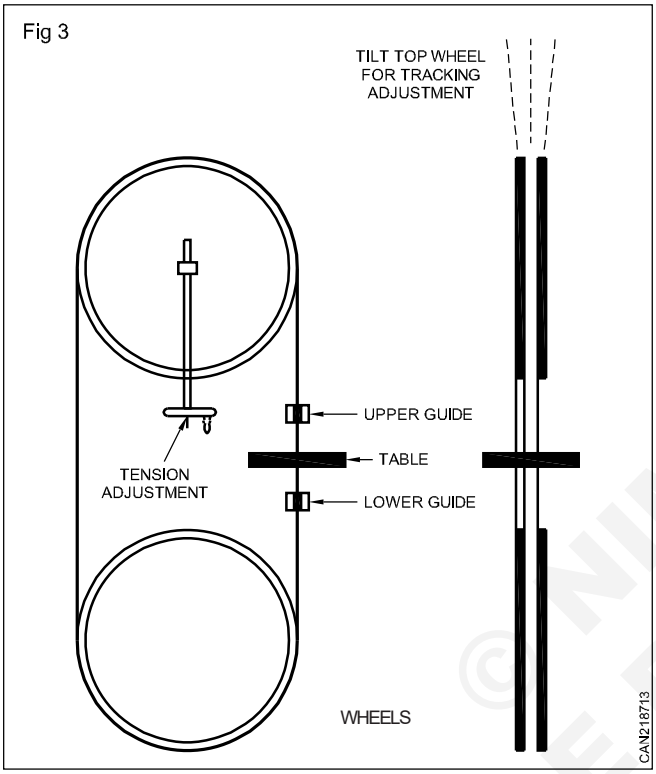
- All the parts are mounted and supported on a cast iron frame.
- Firmly fixed on a stand or floor to avoid vibration.

Wheels

- Runs on ball bearing.
- Suitably covered with strong guards.
- Each wheel is fitted with rubber tyres or band to preserve the set of the saw teeth and prevent the blade from stripping.
- One wheel fitted above the table and another below the table.

Lower wheel (Fig 3)

Fig 3



- It is the driven wheel.
- Not adjustable.
- Driven by an individual electric motor.
- Motor may be connected directly to wheel shaft or pulleys.

Upper wheel (Fig 3)

- It is an adjustable wheel.
- Raised or lowered by tensioning hand wheel.
- Permits difference in blade length and to provide tension.
- Can tilt backward and forward so that the tracking of the saw blade can be adjusted.

Table (Fig 3)

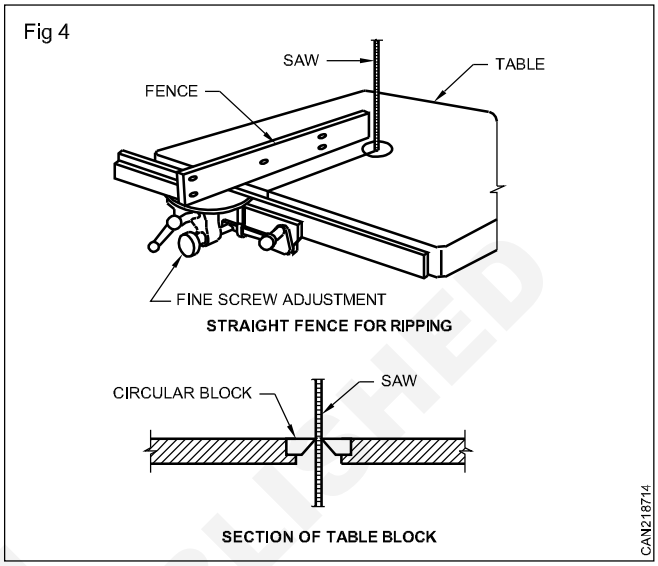
- Heavily ribbed for strength and carefully machined.
- It can be tilted and lowered at an angle to $45^{0.}$
- A scale and pointer beneath the table shows the exact degree of the tilt.

Height of the table is 975 mm (39") to 1050 mm (42") above the floor.

- Fasten to the casting directly above the lower wheel.
- It is slotted for the saw blade from the centre to one edge.

Throat Plate (Fig 4)

Fig 4



- An aluminium or wooden throat fitted where the saw blade passes through the table.

Throat plate prevents damage to the teeth of saw while breaking.

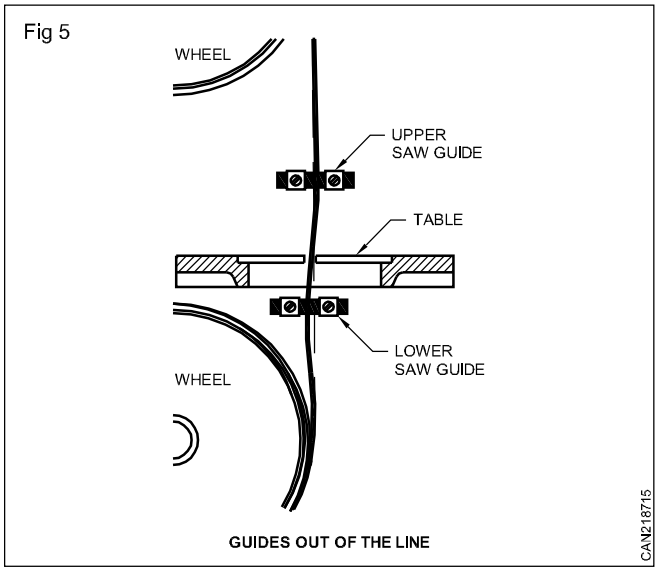
Ripping Fence/Mitre gauge (Fig 4)

- Set on the table.
- Assist accurate ripping and cross cutting.
- Mitre gauge sliding in a groove machined on the table.

Saw guides (Fig 5)

- Two guides (Jaws) are provided to keep the saw running true.

Fig 5



- One guide fitted above the table and the others below the table.
- Hold the blade in position and prevents blade from stripping.

Upper guide (Fig 5)

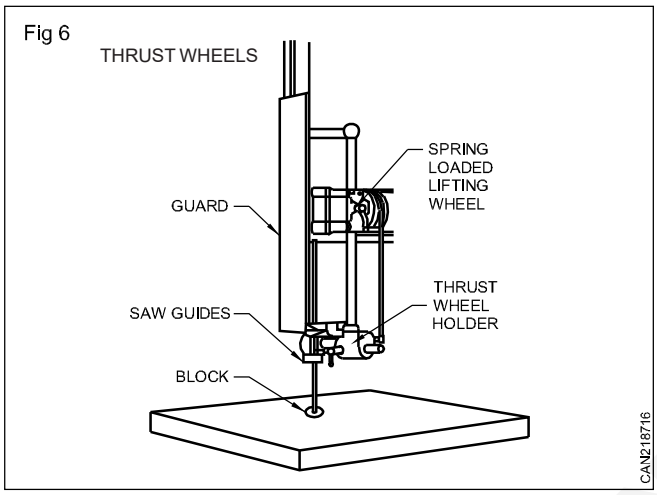
- Fitted to a sliding guide post.

Guide post can be adjusted according to the thickness of the stock being sawn.

- Each guides consists two steel Jaws.
- The jaws prevent wobbling or twisting in the cut.

Thrust wheels (Fig 6)

Fig 6

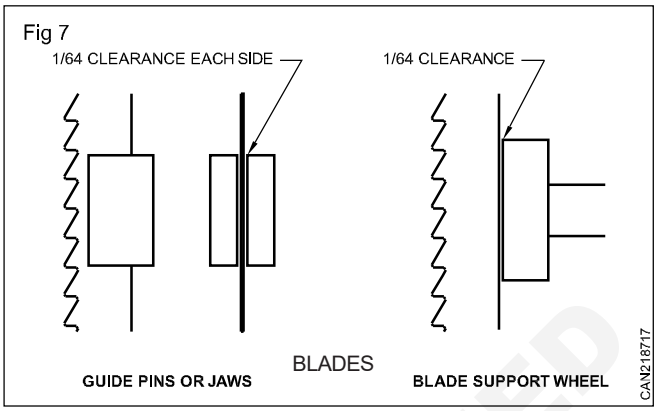


- Fixed behind the jaws.
- This wheel support the back of the blade while sawing.

Blades (Fig 7)

- Specify the width, length and gauge.

Fig 7

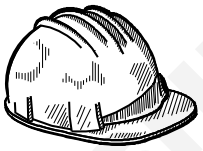
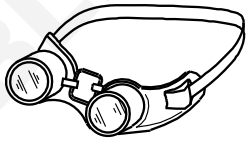
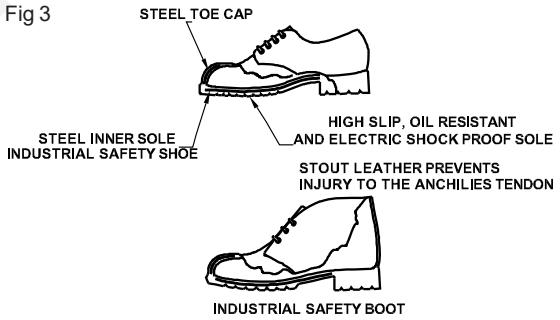
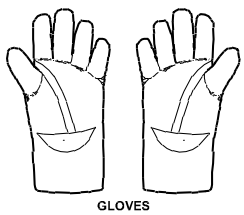
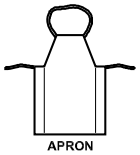


Personal protective equipment (PPE) for band saw machine

Objectives : At the end of this lesson you shall be able to
- **name the PPE used in band saw machine.**

Before you begin to do any wood working, the first thing to do is review your working area for any potential hazards that could contribute to an injury. When you take a few minutes to plan properly, then you can prevent many injuries or health concerns that are associated with wood working.

Personal protective equipments and their uses

Types of protection	PPE to be used
We have to wear helmet to protect the head from broken bandsaw blade	Fig 1  Helmet (Fig 1)
We have to wear goggles to safeguard the eyes from the saw dust during bandsawing	Fig 2  Goggles (Fig 2)
We have to wear safety shoe to protect from failing timber	Fig 3  Safety shoes (Fig 3)
We have to wear gloves to safeguard the fingers from saw blade and wood scales	Fig 4  Gloves (Fig 4)
We have to wear leather apron to safeguard the body from sawing wood	Fig 5  Leather apron (Fig 5)

Band saw machine - Operation

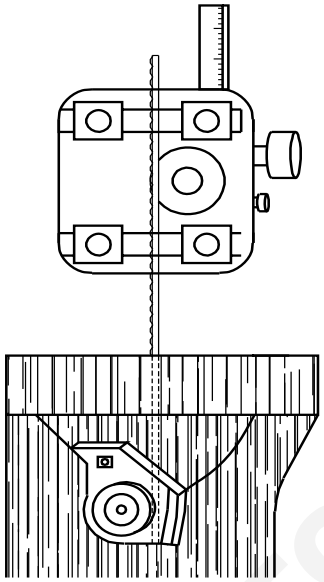
Objectives : At the end of this lesson you shall be able to
- **state the operation performed on band saw machine.**

Types of sawing operation

- Free hand sawing
- Ripping and re-sawing
- Cross cutting
- Curve cutting
- Cutting circles
- Bevel and chamber cutting

Free hand sawing - Most of band sawing work is done "freehand" i.e. the line on the work is guiding in to the saw by the sight without the use of any other attachments. Generally the right hand of the operator feeds the work while the left hand acts as a guide. (Fig 1)

Fig 1

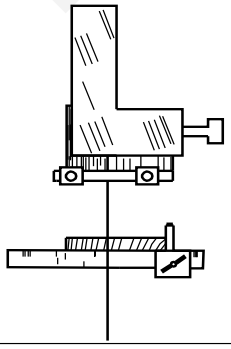


FREE HAND SAWING

CAN219111

Ripping and Re-sawing - Ripping and resawing is carried out using ripping fence as a guide. Make sure the table is set at right angle to the blade while ripping oblique cuts, such as bevels and large chamfers, using the fence on the tilted table, place the fence on the lower side of the saw. (Fig 2)

Fig 2

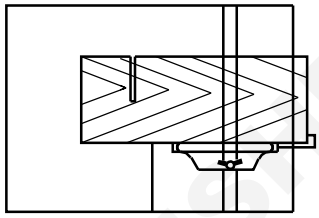


CAN219112

Cross cutting - Accurate cross cutting is carried out by using the mitre gauge. A number of short lengths can be cut using the mitre gauge in conjunction with the fence. Some mitre gauges are provided with stop rods which may be adjusted so that a number of pieces can be cut to the same length. (Fig 3)

Fig 3

CROSS CUTTING



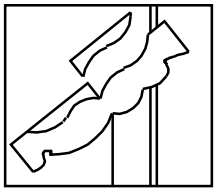
CAN219113

Curve cutting - For curve cutting, always feed the work slowly and evenly, keeping the line advancing straight towards the edge of the blade. Do not back out a curved cut while the saw is running. Where two curves meet to form a corner, a straight cut from the edge of the work should be made into the corner, prior to cutting the curve. (Fig 4)

Cutting circles - A circular disc may be cut free hand by feeding the work slowly and evenly, if a number of similar sized discs are required a jig may be used. (Fig 4)

Fig 4

CUTTING CIRCLES

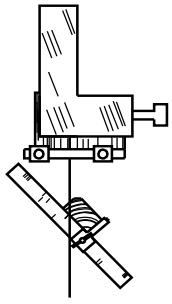


CAN219114

Bevel and chamfer cutting - When ripping oblique cuts, such as bevels and large chamfers, using the fence on the tilted, place the fence on the lower side of the saw. This method can be used for removing the corners of square stock in preparation for spindle turning. (Fig 5)

Fig 5

BEVEL AND CHAMFER CUTTING



CAN219115

Safety precaution, care & maintenance of band saw machine

Objectives : At the end of this lesson you shall be able to
- **state the safety precaution to be observed on band saw machine**
- **explain the care and maintenance of band saw machine with oiling and greasing.**

Safety precaution on band saw machine

Check clothing, sleeves rolled up from in sector wear eye shield.

Ensure the saw is switched off- remove scrape from table and floor.

Check the machine guards are in position and secure.

Check that the saw blade is positioned between the jaws and tracking correctly to just clear the thrust wheels.

Adjust the saw guide and sliding gaurd until it is about 5mm above the thickness of the wood.

Stand in front of the machine when switching on.

Switch-on and hear the sound of the machine. A clicking noise indicates the blade is about to break, or not tracking properly. Report abnormal noises to instructor.

Observers should be at least 1 metre away and not on side of saw.

Allow the saw to attain full speed before commencing to saw. Hold the work flat on the table never on a corner.

Keep fingers atleast 75 mm away from the blade and not in front of the saw teeth.

Use a push stick or a piece of scrap to push and guide small work.

Don't reach past the blade on either side.

Avoid backing out the curved cuts.

Do not saw cylindrical may work unless it has been clamped to a suitable jig cylindrical work spin and draw into the saw quickly as it cannot be held firmly in the hands.

Switch off to make any adjustments, remove the work or remove scraps.

Have attention to the job of sawing do not talk.

When finished, switch off and stay with the saw until it stops.

Care & maintenance of band saw machine with oiling & greasing

After the work, clean and lubricate the machine.

Remove the band saw blade by releasing tension and keep it a safe place.

Keep the blade free of gum and pitch.

Band saw wheel tyres may gather saw dust and gum it should be cleaned.

While working on the band saw machine if you hear a click noise, switch off the machine at once.

This indicates a crack in the saw blade.

Avoid using blades that are improperly filed or blazed.

Apply proper tension to the blade.

Apply oil to the sliding parts.

Apply grease to the bearing collars.

Follow the operating and maintenance instruction of manufacture of band saw machine for Manuel lubrication of points in the machine.

Circular saw machine

Objectives : At the end of this lesson you shall be able to
- **describe a circular saw machine**
- **name the different types of circular saw**
- **state the size of the circular saw**
- **identify the parts of circular saw.**

The circular saw is possibly the most useful of all the woodworking machines. It can be used for cross cutting, ripping, mitring, bevelling chamfering grooving, trenching and cutting tenons. Some saws may have moulding heads and special cutters fitted for producing small shaped mouldings.

Types of circular saw machine

There are many type and sizes for circular saws, ranging from small bench circular saws and large heavy circular saw machines(e.g)

Portable type circular saw

Stationary type circular saw.

Sizes of circular saw machine

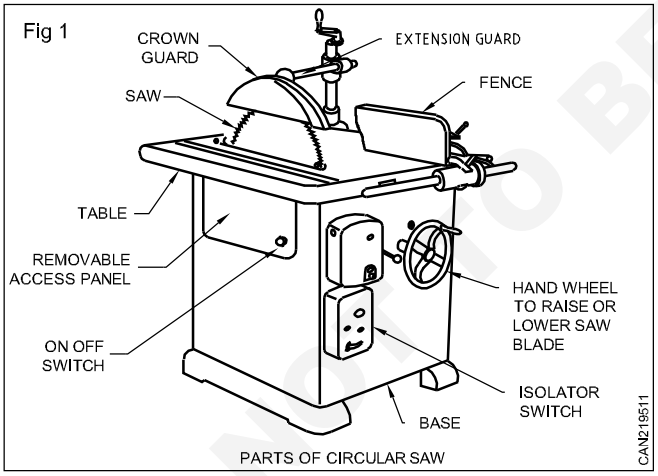
The size of the circular saw machine, determined by the maximum diameter of the circular blade used.

The thickness of the blade used is 2mm to 5mm

The diameter of the blade used is 200 to 400mm

Identification of parts of circular saw machine. (Fig 1)

Fig 1



PARTS OF CIRCULAR SAW

Base

Circular saw machine consists of a heavy cast iron frame or base.

Mounted with saw arbor or spindle and table with an electric motor.

Table

Circular saw machine consists of a fabricated steel sheet iron table.

The circular saw mounted above base and carried on trunnions which enable it to be tilled, at an angle to 45 for bevel sawing.

The saw arbor or spindle

The saw mounted spindle is drive by an electric motor housed under to table.

Arbor runs on ball baring attached to the base.

It may be coupled directly to an electric motor or indirectly by a belt and pulley.

A 2 HP to 3 HP motor should be used.

Hand wheel

The whole saw assemble may be raised or lowered by means of a hand wheel, when required.

Mitre gauge

The mitre gauge is used to guide and hold work piece, when cross cutting.

Ripping fence

The ripping fence can be clamped on either side of the saw.

The ripping fence is used for guiding the stock, when ripping boards lengthwise to required width, and when grooving rebating, bevelling and chamfering.

The fence should be checked occasionally to see, that it is exactly parallel with saw blade.

Saw safety guard

The guard provided with saws and should be adjusted and used whenever possible to prevent accidental contact with the saw blade.

The guard should revere be set higher than level with the top of teeth.

Saw blade

- The blade is made from chrome molybdenum steel.
- The number of teeth (Pitch) depends on the type or shape and the diameter of the blade.
- The saw blade of 200 to 400mm dia may be used.

Function of circular saw machine and different types of blades and its uses

Objectives : At the end of this lesson you shall be able to
- **state the function of circular saw in different operation.**

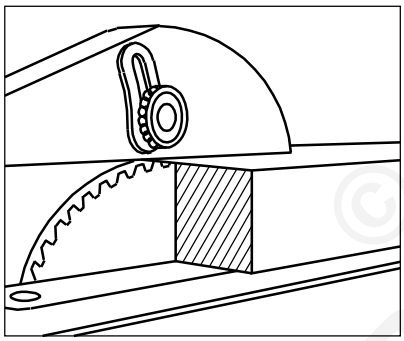
Function of circular saw machine

1 The rip cutting or ripping to cut along the grain
2 Cross cutting to cut across the grain
3 Mitre cutting
4 Cutting bevels
5 Cutting rebates
6 Cutting grooves
7 Trenching
8 Cutting Tenons

Ripping

Ripping is the operation of cutting the timber, lengthwise along the grain, using the ripping fence as guide. (Fig 1)

Fig 1



STRAIGHT RIPPING

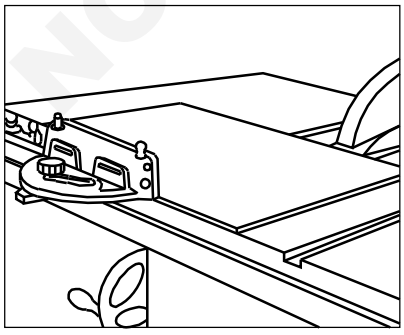
CAN219811

Cross cutting

Cross-cutting. Set the blade so that it projects about 6 mm above the stock.

Use the mitre gauge to support and push the work through the saw. (Fig 2)

Fig 2



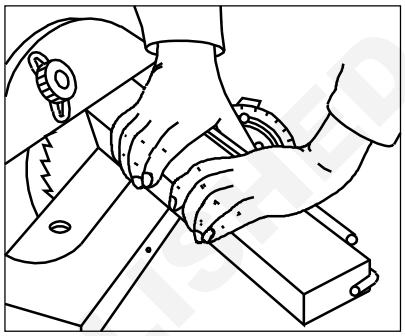
CROSS CUTTING

CAN219812

Mitre cutting

Mitre cutting is carried out with the table horizontal and using the mitre gauge set at the required angle. i.e. 45° (Fig 3)

Fig 3



STRAIGHT OR COMPOUND MITRING

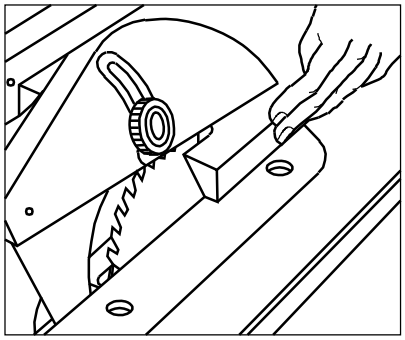
CAN219813

The work must be held very firmly to prevent the saw creeping away from the line and spoiling the desired angle.

Cutting bevels

Cutting bevels, Tilt the saw at the desired angle and use the fence on the lower side of the saw when ripping. (Fig 4)

Fig 4



BEVEL RIPPING

CAN219814

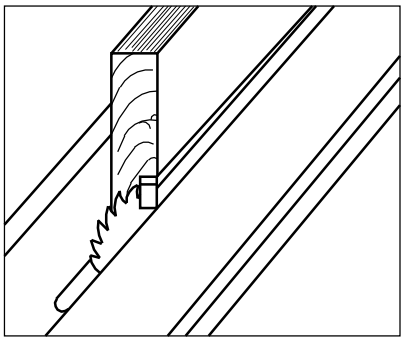
Rebating

Rebating is carried out using the ripping fence and with the saw adjusted to the required depth of cut.

Two cuts and two settings are required to remove the waste from the rebate. (Fig 5)

The guard has to be removed for this operation.

Fig 5



REBATING

CAN219815

Grooving

Grooving is done using ripping blade and making several cuts until the required width of groove produced. Or a dado head". (Fig 6) When cutting trenches or dadoes across the grain the stock is held against the metre gauge.

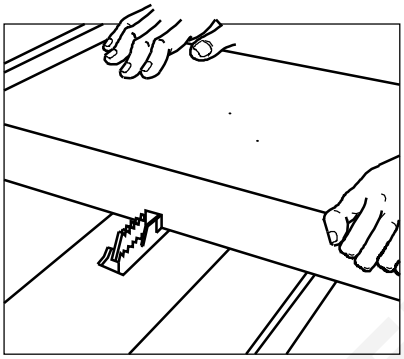
Several cuts may be made with a cross-cut blade or one cut using the dado head.

Grooves and trenches are some times cut using on ordinary saw blade, which is mounted on the saw arbor so that it will "Wobble" and make a cut wider than its own thickness.

Cutting tenons

Cutting tenons, cut the shoulders first, having the fence set the length of tenon and using a pair of blades of the same diameter, separated by a wooden or metal spacing collar or two separate cuts may be made with a single saw blade.

Fig 6



GROOVING

CAN219816

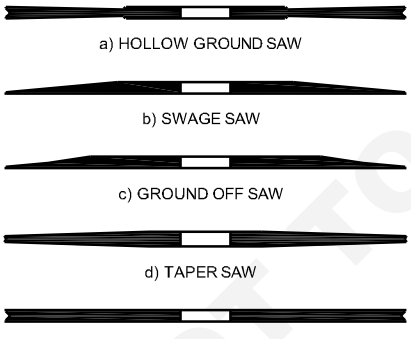
Different types of circular saw blades and uses

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

- **state the different types of saw blades used in circular saw machine.**

TYPES OF SAW BLADES (Fig 1)

Fig 1



TYPES OF SAW BLADES

CAN219911

1 Hollow ground saw Fig 1a

2 Swage saw Fig 1b

3 Ground off saw Fig 1c

4 Taper saw Fig 1d

5 Plate saw Fig 1e

1 Hollow ground saw

These saws are hollow ground from the collar area to the teeth, giving clearance in working without the need for setting the teeth.

At the collar area in the centre of the plate, it is parallel and ground with hollow taper from this point to the rim of the saw as shown.

They are used mainly for accurate dimensioning and often termed "dimension saws".

2 Swage saw

This type of saw is ground off from the collar area in a straight taper to the rim. it is used for cutting thin board.

As the saw is finer at the rim. It has more teeth with shallower gullets than the plate saw.

3 Ground off saw

This type has a thin edge and is ground as shown on one side only. As the saw is small, it is used for cutting thin boards and veneers.

4 Taper saw

This form of saw tapered, as the name suggests on both side from the collar area to the rim. They are used for splitting boards with very little waste in the cut.

5 Plate saw

This is the normal parallel saw used for all kind of sawing both ripping and cross cutting. They may be spring or swage set.

Safety precaution, care & maintenance of circular saw machine

Objectives : At the end of this lesson you shall be able to
- **state the safety precaution to observed on circular saw machine**
- **explain the care and maintenance of circular saw machine with oiling and greasing.**

Safety precaution to be observed in circular saw machine

- See that the blade is properly fitted and tightened to the arbour.
- Make sure the guard and splitter are firmly secured in the correct position.
- Use saws which are properly sharpened and set.
- Always use flat stock for sawing.
- Do not use the fence as a stop when cross cutting.
- Use a forked push stick when ripping narrow pieces.
- While using the saw keep fingers at least 100mm away from blade
- Do not reach past the blade.
- Never saw free hand on circular saw machine.
- Switch off the machine to make any adjustment to the fence, table, guard or to change blade.
- Use correct saw for the job it should be sharped and properly set.
- Do not allow others to stand in line with the blade.
- Do not stand directly in line with the blade
- Materials should be free from splits, loose knots, warps and nails.

Care and maintenance

- After the work, clean and lubricate the machine
- Switch off the machine to remove small sawn pieces and waste scraps Frome saw table and floor.
- Hold the material against the fence or mitre gauge
- Check the blade use correct sawing for the job
- Setting the blade teeth should project 8 – 10 mm above the to top of work
- Before switching check blade runs free
- Allow the motor to reach full speed be for sawing
- Switch off the machine to change the blades.

Oiling and greasing

Circular saw machine bearings provided with oil caps or grease nipples require regular oiling and greasing

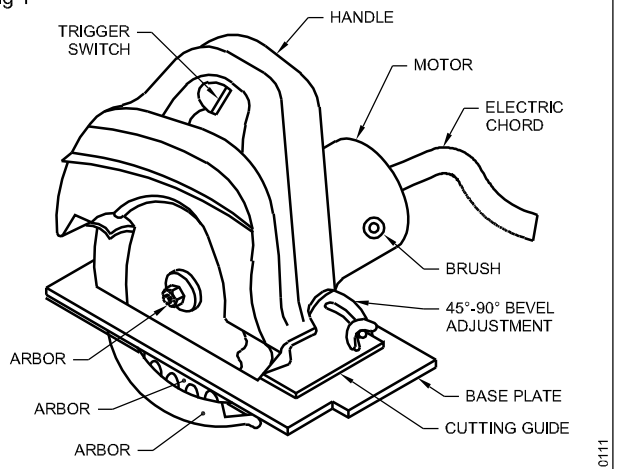
After the work clean and oiling the machine work table**.**

Portable power circular saw machine - operation

Objectives : At the end of this lesson you shall be able to
- **state the operations of portable circular saw machine.**

The portable power saws, like hand saws are taken to the job to operate. They can be used quite easily and accurately for sawing pieces of timber.

Fig 1



PARTS OF THE PORTABLE ELECTRIC CIRCULAR SAW

Uses of portable type circular saw in different operations portable circular saw is used for

1 Ripping to cut along the grain

2 Cross cutting across the grain

3 Bevelling

4 Grooving

5 Trenching

6 Rebating

7 Mitring

To carry out the above operations the saws are fitted with a base plate; the cutting guide can be adjusted for depth of cut, and tilted uo to 45° - 90° bevel adjustment. For normal sawing, and especally for sawing plywood and veneered panels, the depth of cut should be adjusted so that the teeth of the saw just project through the thickness of the board; this helps to prevent splintering. Remember the teeth of the saw cut upwards towards the sole plate, if possible set out for cutting on the back of plywood sheets.

Circular Saw Blades: Many types of blades are available, each being designed for a specific use in the home workshop a combination rip and cross-cut blade is the most popular, although a cross-cut blade is to be recommended for smooth cross-cutting, especially in soft timber. Use bladeswith fine teeth for plywood, blockboard, hardboard and laminates set sole for minimum projection of teeth.

Tungsten carbide tipped blades are expensive, but they can be used for a wider variety of materials and will cut 40-50 times longer between sharpenings than standard high speed steel blades. They can be used for sawing hard abrasive materials such as some hardwoods, resin bonded plywood, particle boards, hardboards and laminated plastics.

Safety precautions

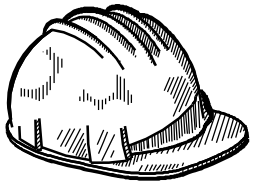
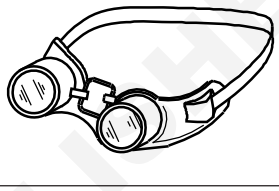
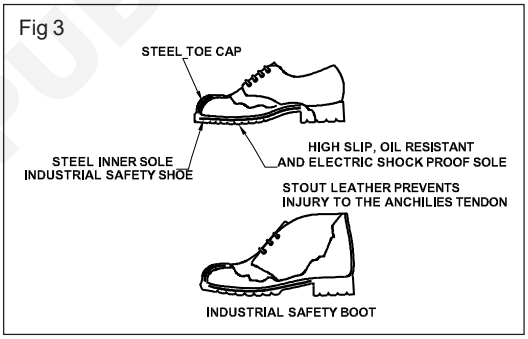
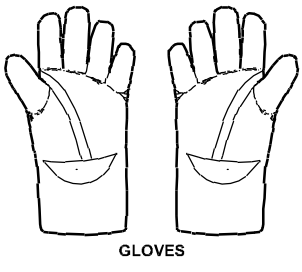
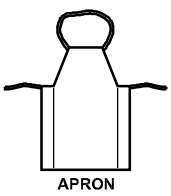
Objective: At the end of this lesson you shall be able to
- **state the precautions to be followed while using a portable type circular saw machine.**

- See that the blade is sharp and sound it should ring if tapped.
- Check for loose clothing wear eye shield.
- Check that slack of lead is away from saw, and that guard is operating properly.
- Switch off and remove plug to make any adjustments blade should just project through material.
- Use trigger switch only allow saw to reach full speed before use.
- Keep behind the saw and keep hands above the sole plate.
- Do not force the saw.
- Make sure the saw has stopped running before putting it down.
- Do not exceed the maximum operating speed marked on the saw.
- Use only specified flanges.
- The life of a wood cutter saw will differ according to the material being cut. The harder the material, the shorter the life of the saw.

Personal protective equipments for the circular saw machine

Objectives : At the end of this lesson you shall be able to
- **name the PPE used in circular saw machine.**

Personal protective equipments and their uses

Types of protection	PPE to be used
We have to wear helmet to protect the head from broken timber	Fig 1  Helmet (Fig 1)
We have to wear goggles to safegaurd the eyes from the sawing dust during circular saw machine	Fig 2  Goggles (Fig 2)
We have to wear safety shoe to protect from failing timber	Fig 3  Safety shoes (Fig 3)
We have to wear gloves to safeguard the fingers from circular saw blade and wood scales	Fig 4  Gloves (Fig 4)
We have to wear leather apron to safeguard the body from sawing wood	Fig 5  Leather apron (Fig 5)

Planing machine and P.P.E

Objectives : At the end of this lesson you shall be able to
- **describe a planing machine**
- **name the different types of planing machine**
- **specify the size of planing machine**
- **identify the parts and function of surface/thickness planer**
- **name the PPE used for surface, thickness planer.**

Planing is the most important basic operation connected with carpenter work. Constructions such as carcases, frames, doors, drawers, etc., produced from accurately prepared timber are more likely to finish square and true than from badly prepared stock.

Types of planing machine

There are two types

- Jointer / surface planer
- Thickness planer

Size of planing machine

Specification jointer/surface planer: Speed for the cutter head range from 3600 RPM to 6000 RPM.

Size of the machine is determined by maximum width of cut and is equal to the length of the knives.

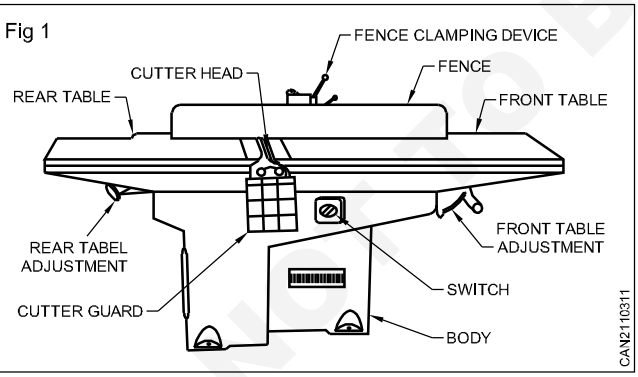
Common size range from 10 cm to 90 cm.

Specification of thickness planer: The size of thickness planer is determined by maximum thickness and maximum width of stock it can plane

Width range from 200mm to 600mm maximum thickness is 250mm.

Parts and function of surface planer (Fig 1)

Fig 1

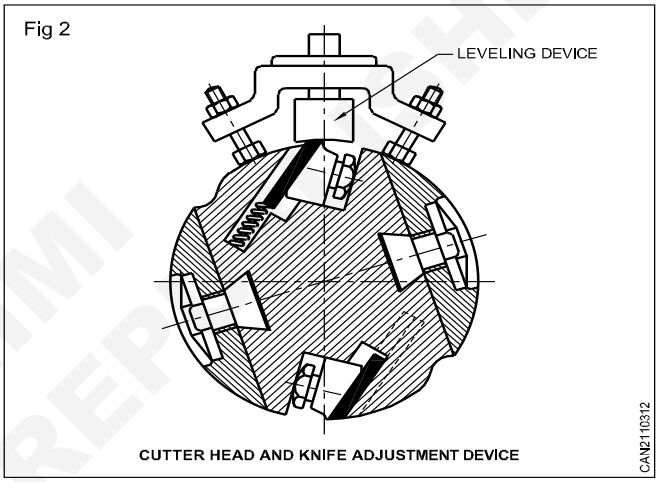


Table

- Comprises of two independent adjustable tables.
- Tables are mounted on ridged cost iron frame.
- Table are adjustable for levelness and cutting height.
- Table of the jointer consist of two parts.
- The front or infeed table and
- The rear or out feed table.
- The surface of the rear table must be level (even with the cutting edge of the knives).
- If the rear table is higher or lower, the planed edge or surface will not be straight and accurate.
- The front table is easily adjusted by means of hand wheel.

Cutter head (Fig 2)

Fig 2



CUTTER HEAD AND KNIFE ADJUSTMENT DEVICE

- The cutter head has two to four knives.
- A levelling device is used to set the knives on cutter head.

Front table

- This is the infeed table.
- This table can easily adjusted to the depth of the cut.
- It supports board which is fed in the knives.

Rear table

- The rear table is also adjustable.
- For most cuts, it should be even with the cutting edges of the knives.
- This table supports the board after it is planed.

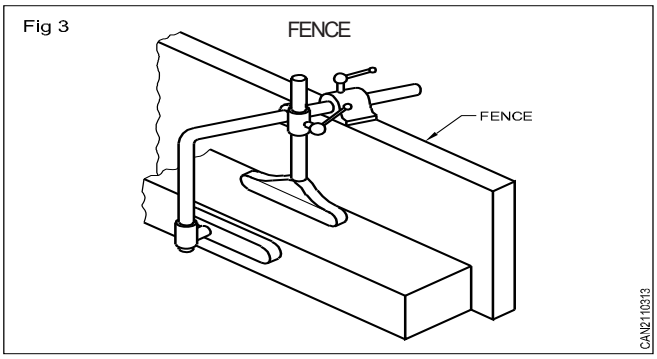
Fence (Fig 3)

- The fence is used as a guide.
- It is usually set at an angle of 90° to the table to get the edges planed at right angles to the face.
- It can be set at an angle to produce a chamfer or bevel.

Guard

- The guard covers the cutting knives.
- It swings out as the board is planed, thereby protecting the operator.

Fig 3



- On some jointer there is a back guard which adjusts behind the fence. This is particularly useful when the fence is adjusted to cut rebates.

Table adjuster

- Some times called as table adjustment hand wheel.
- These are conveniently located under the front and the rear table.

They raise or lower the table according to the types of cut desired.

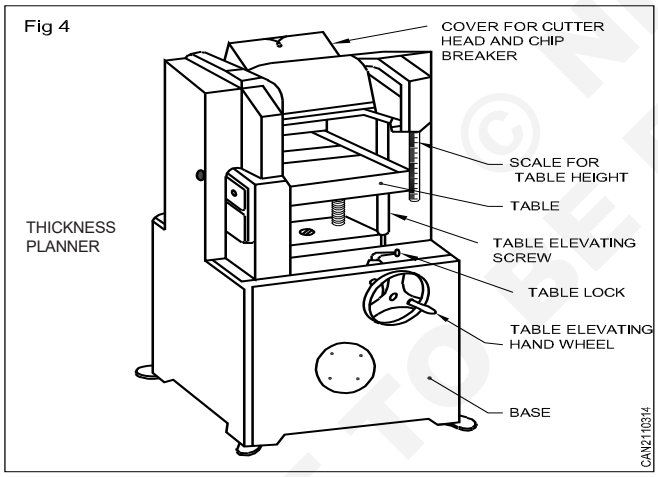
Base

- The base is the stand or support which holds the jointer
- Made of cast iron.

Thickness planner

Parts and function of thickness planing machine (Fig 4)

Fig 4



Base: Made of cast iron frame. It supports the table cutter head and rollers.

Table: Tables are mounted on a cast iron frame.

Machined and ground to a perfect flat surface

The table and lower roll assembly is adjustable up and down for various thickness of stock.

Infeed roll: It is called as corrugated infeed roll. (Fig 5)

As the stock enters the machine the top surface is gripped by corrugated feed roll. It is powered and moves the stock forward for planing.

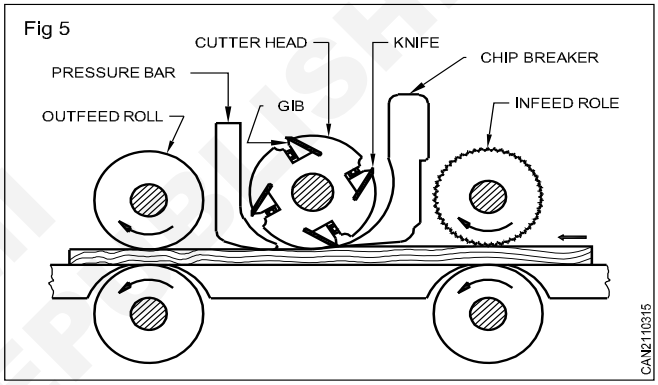
Out feed roll: Out feed roll is in behind the press bar. It is powered and move the stock out of the machine. (Fig 5)

Chip breaker

The chip breaker press down on stock the infront of the cutter head and prevents excessive chipping by the knives. (Fig 5)

Pressure bar (Fig 5)

Fig 5



The pressure bar is located behind the cutter head and rides on the planed surface.

It holds the stock firmly down on the bed and prevent it vibrating and chattering.

Rolls (Fig 5)

These two rolls located directly under the infeed and outfeed rolls.

These rolls set slightly above the surface of the table

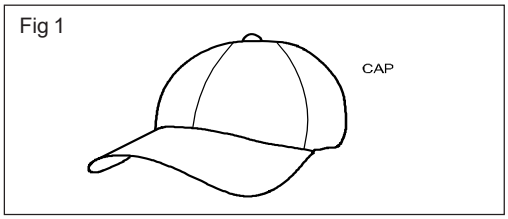
It helps to carry the stock while planing.

Personal protective equipments (PPE) used in surface, thickness planer for planing operations

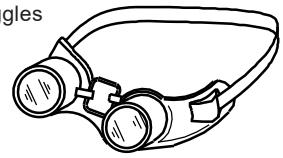
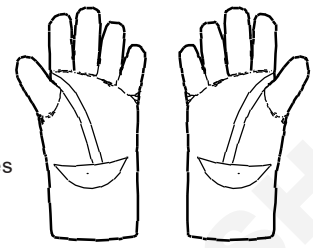
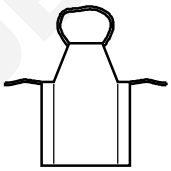
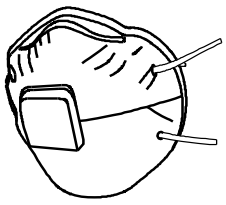
Objectives: At the end of this lesson you shall be able to

- **name the PPE used in plaining machine.**

Personal protective equipments and their uses

Types of protection	PPE to be used
We have to wear cap to protect from head the planing dust during planing machine (Fig 1)	Fig 1 

Personal protective equipments and their uses

Types of protection	PPE to be used
We have to wear goggles to safegaurd the eyes from the planing dust during planing (Fig 2)	Fig 2 Goggles 
We have to wear gloves to safeguard the hand during the wood slip and to avoid the knife of planing (Fig 3)	Fig 3 Gloves  GLOVES
We have to wear leather apron to safeguard the body from planing wood (Fig 4)	Fig 4 Leather apron  APRON
We have to wear nose mask to protect the lungs from the spray plaining dust during planing (Fig 5)	Fig 5 Nose mask 
We have to wear safety shoes to the foot to protect from the falling wood due to turn the wood during planing (Fig 6)	Fig 6 INDUSTRIAL SAFETY SHOE Safety shoes  INDUSTRIAL SAFETY BOOT

Surface/Thickness planer- Operation, safety, care and maintenance, and oiling

Objectives : At the end of this lesson you shall be able to
- **state the operations surface, thickness planer**
- **state the safety precautions to be observed on planing machine**
- **explain the care and maintenance, oiling and greasing of planing machine.**

Jointer / surface planer operations

- Straightening the board
- Shooting/ Jointing edges
- Forming bevel, taper and rebate (Fig 1 to 4)

Operations of thickness planer

The thickness planer is used to plane the flat surface and required thickness.

Safety precautions to be observed

- Do not plane warped or twisted board.
- Never bend down to look into a planer while it is running.
- Never plane stock of varying thickness at the same time.
- Make sure the guard is in place and tight.
- Adjust front table only for depth of cut. A 0.7 mm cut is sufficient for finishing.
- Do not allow fingers within 100mm of cutters.
- Feed the stock slowly and evenly.
- Do not allow plane stock less than 250mm long.
- Do not allow plane stock less than 9mm thick.
- Mark direction of grain onthe wood and plain with grain.
- Use both hands to press the stock, on the front table when starting a cut when the job moved 200mm.

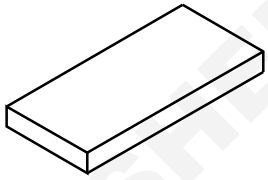
Care and maintenance

- Knife edges should be parallel with the out feed table
- Check in and out feed table for proper alignment.
- Keep knives sharp at all time.
- Switch off and allow the blades to stop rotating before any adjustment.
- When rebating wide stock the guard has to be removed.
- Check the floor is clear of scraps.

Oiling and greasing

Oiling and greasing of the machine should be done as per the manufacturers instruction given with the machine periodically.

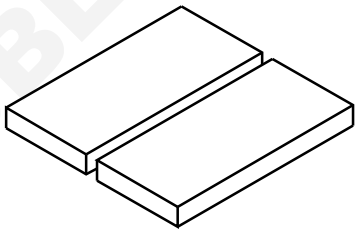
Fig 1



STRAIGHTENING THE BOARD

CAN2110611

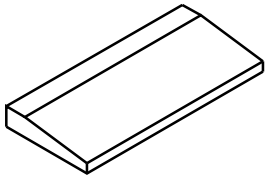
Fig 2



JOINING EDGES

CAN2110612

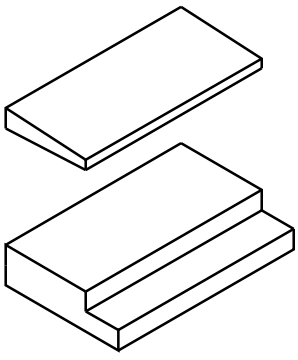
Fig 3



BEVEL EDGE

CAN2110613

Fig 4



TAPER AND REBATE

CAN2110614

Pedestal grinding machine safety precautions P.P.E and care and maintenance

Objectives : At the end of this lesson you shall be able to
- **name different types of pedestal grinding machine**
- **specify the sizes of pedestal grinding machine**
- **name the parts and function of pedestal grinding machine**
- **state the operations, care and maintenance of pedestal grinding machine**
- **state the safety precaution and PPE to be observed on pedestal grinding machine.**

Description

Pedestal grinding machine comes under the group off hand grinding. They are mounted on a base (pedestal) which is fastened to the floor. They are used for heavy duty work, grind various cutting tools and perform other rough grinding.

Types of pedestal grinding machine

Off-hand grinding is the operation of removing material which does not required great accuracy in size or shape. This is carried out by pressing the work piece by hand against a grinding wheel.

Off-hand grinding is performed for rough grinding of jobs and resharpening of

Scribers

Punches

Chisels

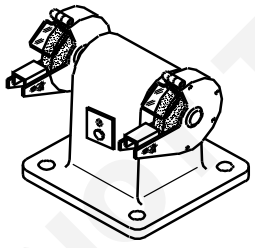
Twist drills

Single point cutting tools etc.

Off-hand grinding is performed with a bench or pedestal grinder

Bench grinder (Fig 1)

Fig 1



BENCH GRINDER

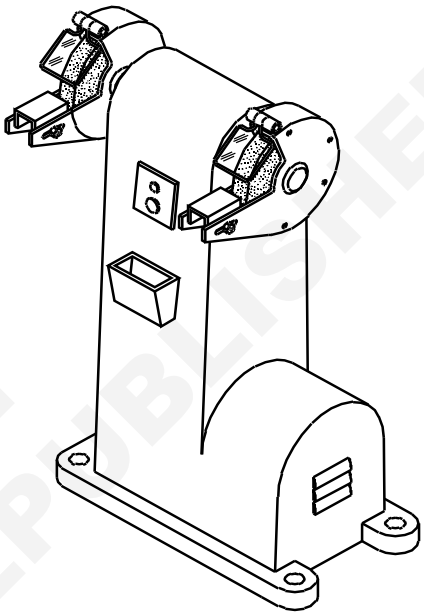
CAN2111011

Bench grinding are fitted to a bench or table, and are useful for light duty work.

Pedestal grinder (Fig 2)

Pedestal grinder are mounted on a base (pedestal), which is fastened to the floor. They are used for heavy duty work.

Fig 2



PEDESTAL GRINDER

CAN2111012

Sizes

The size depends up on the size of the grinding wheel and the power of the motor or drive

Parts

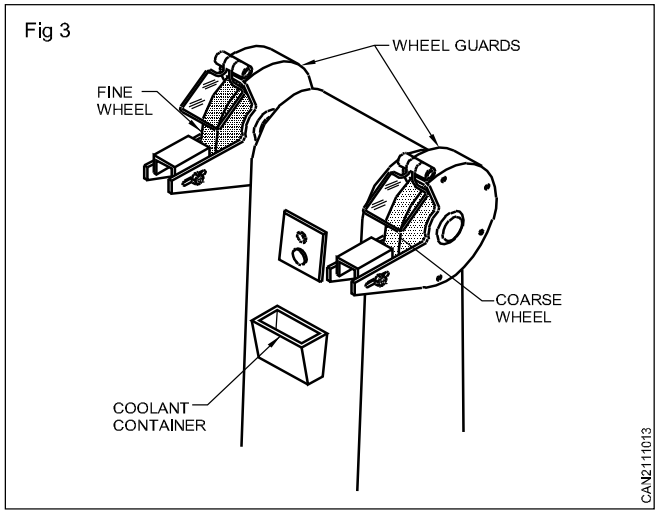
These grinders consist of an electric motor and the spindle for mounting the grinding wheels. On one end of the spindle a coarse-grained wheel is fitted, and on the other end, a fine-grained wheel. For safety while working wheel guards are provided.

A coolant container (Fig 3) is provided for frequent cooling of the work.

Adjustable work-rest are provided for both the wheels to support the work while grinding. These work-rest must be set very close to the wheels. Fig 4)

Extra eye shields are also provided for the protection of the eyes.(Fig 4)

Fig 3

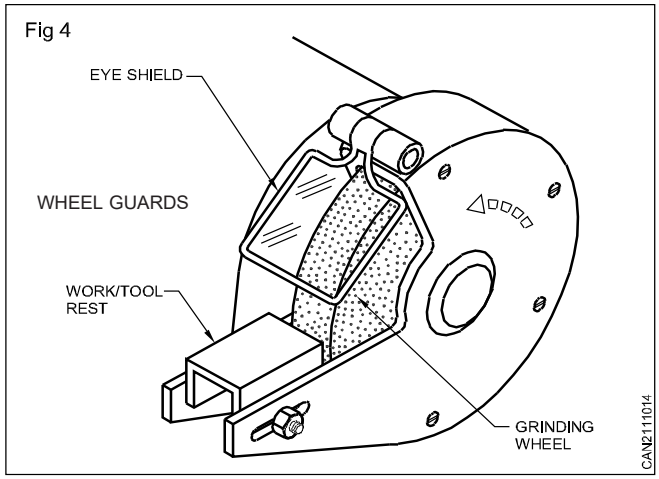


Function of Pedestal grinding machine

Grinding is the process of removing material by the cutting action of the countless hard and sharp abrasive particles of a revolving grinding wheel as they come in contact with the surface to be ground.

Pedestal grinders are used to sharpen high speed steel cutting tools and high carbon steel cutting tools

Fig 4



Operation

Pedestal grinding machine is performed for rough grinding of jobs and resharpening of scribers, punches, chisels,, twist drills, single point cutting tools etc. To desipitate the heat while grinding, periodic quenching of tool in coolant is necessary.

Safety precaution, PPE, care and maintenance in pedestal grinding machine

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

- **state the safety precaution to be observed on pedestal grinding machine**
- **name the PPE used in pedestal grinding machine**
- **explain the care and maintenance of pedestal grinding machine.**

Safety precaution for pedestal grinding machine

- Ensure the workshop floor neat & tidy
- Check the electrical connections are done properly
- Ensure the grinding wheels do not touch the work rest and that the gap between wheel and rest is not greater than 2 to 3mm
- Check the grinding wheels are running true, and are not glazed, damaged or loaded in any way
- Never leave the machine running
- When starting stay aside
- Start grinding only after the machine at maximum speed
- Do not grind on the side of the wheel
- Do not give heavy load to the grinding wheel
- Move the job across the face of the wheel slowly.

Personal protective equipment for the pedestal grinding machine

- Face shield must be worn at all times when grinding.
- Safety footwear must be worn when operating this equipment.
- Gloves must not be worn when machine is operating. Machine to be at stand still if gloves required for manual operations.
- Hearing protection must be worn where noise levels are in occupational exposure limit.

Care and maintenance of pedestal grinding machine with oiling and greasing

- Don't use a cracked wheel
- Don't force a wheel on to the arbour of machine
- Ensure the guards are in properly fitted before starting the machine
- Be careful while grinding the job against jamming
- While starting the machine do not stand directly in front of the machine
- Oiling and greasing should be done according to the manufacturer's instructions of the machine.

Pedestal drilling machine safety precautions P.P.E of care and maintenance

Objectives: At the end of this lesson you shall be able to
- **describe a pedestal drilling machine**
- **name the types and size of pedestal drilling machine**
- **name the parts of the pedestal drilling machine**
- **state the function and operation performed on pedestal drilling machine.**

Description

A drilling machine is one of the important machine tools in the workshop. The pedestal drill has a long column which stands on the floor. The means it is capable of being used, to drill large pieces of materials and produce large holes.

Drilling is the production of cylindrical holes of definite diameters in workpieces by using a multi-point cutting tool called a 'drill'. It is the first operation done internally for any further operation.

Types

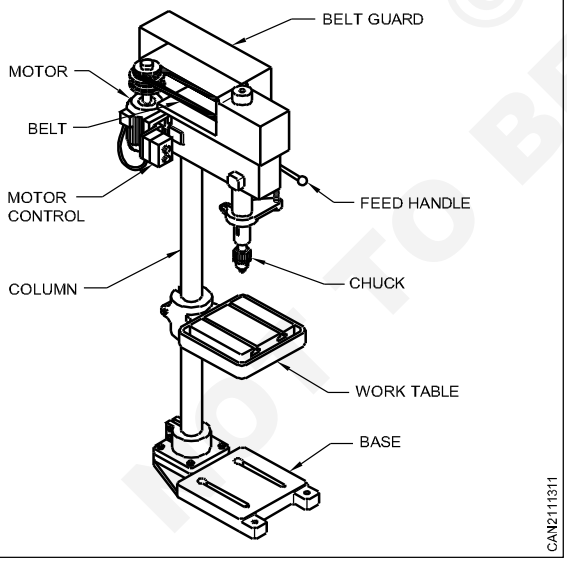
- Hand feed- depth of cut and feed by hand pressure.
- Power feed - feed the cutting tool into the work automatically.

size

Mainly depends up on the maximum diameter of the drill bit it can hold or the maximum diameter of the hole by which it can produce.

Parts of pedestal drilling machine (Fig 1)

Fig 1



Base: It is one of the main parts of a drilling machine is generallly made of cast iron or steel. The base is generally fitted to the floor and supports all other parts of the machine.

Worktable: The worktable is generally made of cast iron and it is mounted on the column.

T-slots are provided at the top surface and support the work piece. The table can move up and down. The shape of the table can be rectangular or circular.

Column: In while the work table, motor and other attachments mounted.

Chuck: The chuck is mounted on the lower end of the spindle, which holds the drill bits.

Spindle: It is a circular taper shoft which helps to hold the drill chuck. It is made of high carbon chromium steel. There is a key hole provided on the spindle to change the drill chuck.

Feed handle: Which controls the feeding of the drill bit into the work and move the spindle up and down.

Pulley: Pulley is used to transmit power and also for getting different speed in a drilling machine.

Motor: Which rotates the drill chuck which holds the drill bit with the help of belt and pulleys.

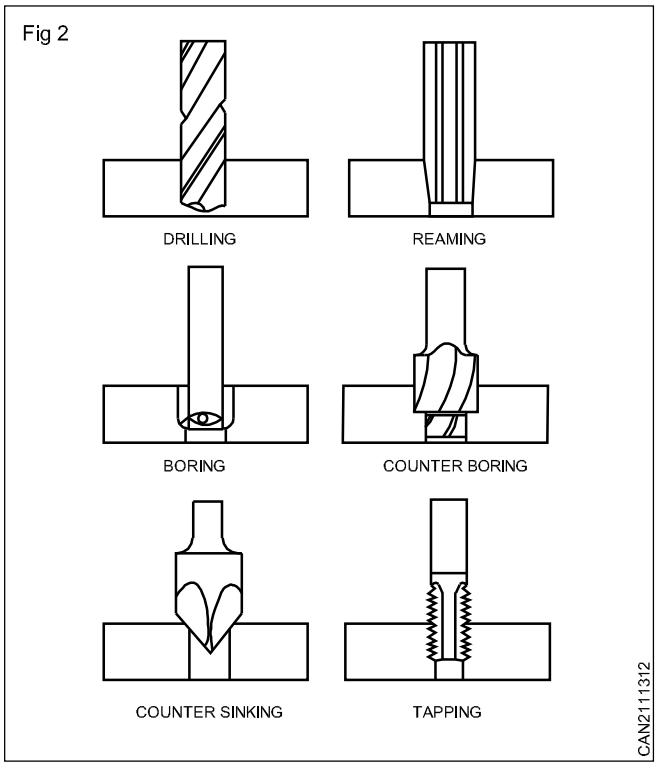
Motor control: Which helps to start and stop the motor and hence the machine.

Function

The drilling machine can perform operations other than drilling, such as counter sinking, counter boring reaming and tapping large and small holes.

Operations (Fig 2)

Fig 2



Drilling machine use a drilling tool that has cutting edges at its points. This cutting tool is held in the drill press by a chuck or mores taper and is rotated and fed into the work at variable speeds. Drilling machines may be used to other operations such as plane drilling, core drilling, step drilling, countersinking, boring, counter boring, spot facing, reaming and tapping.

Safety precaution and PPE in pedestal drilling machine

Objectives: At the end of this lesson you shall be able to
- **follow safety precautions while using a drilling machine**
- **name the PPE used in pedestal drilling machine.**

Safety precautions for pedestal drilling machine

- Keep the shop floor clean.
- Check the electrical connection.
- Check the rotation of the working tool.
- Never place any tool an the table of drilling machine.
- Remove all the tools and clean the machine after use.
- Do not support the job by hand use proper holding devices.
- Make adjustments after stopping the machine.

PPE used in pedestal drilling machine

- Wear goggles for eye protection.
- Wear safety shoes for leg protection.
- Wear hand gloves for hand protection.

Care and maintenance of pedestal drilling machine with oiling and greasing

Objective: At the end of this lesson you shall be able to
- **State the care and maintenance of drilling machine with oiling and greasing.**

- Operations under adverse conditions require special care. If it is under dusty conditions operate at the slowest speed to avoid excess tear and wear of the tool.
- Do not strike the machine with hard tools and metal pieces.
- Stop the machine and change the suitable spindle speed.
- Apply coolant while drilling.
- The work piece and the drill should be rigidly held.
- Switch off power when not in use.
- Use the drill drift for removing the drills, chucks or sockets.
- Clean and oil, grease the machine after use.
- Stop the machine to remove the swarf.
- Use a Brush to clean the chips and swarf.
- Oiling and greasing should be done according to the manufacturer's in instructions of the machine.

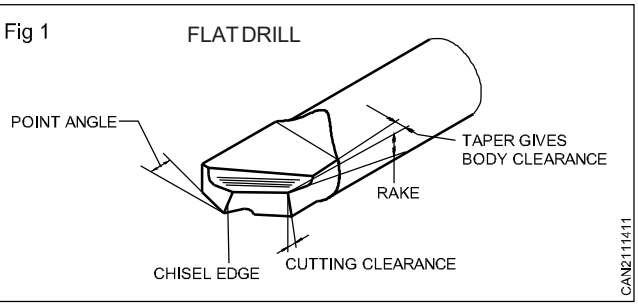
Types drill bits used in drill machine

Objectives: At the end of this lesson you shall be able to
- **name the types of drill bits**
- **state the uses of different types of drill bits.**

Types of drills and their specific uses

Flat drill (Fig 1)

Fig 1 FLAT DRILL



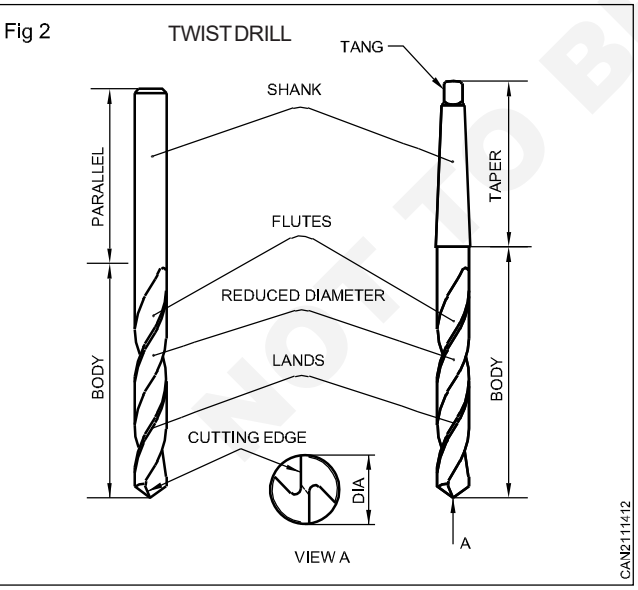
The earliest form of drill was the flat drill which is easy to operate besides being inexpensive to produce. But it is difficult to hold during operation, and the chip removal is poor. Its operating efficiency is very low.

Twist Drill

Almost all drilling operation is done using a twist drill. It is called a twist drill as it has two or more spiral or helical flutes formed along its length. The two basic types of twist drills are, parallel shank and taper shank twist drills are available below 13mm size (Fig 2).

Parts of a twist drill (Fig 2)

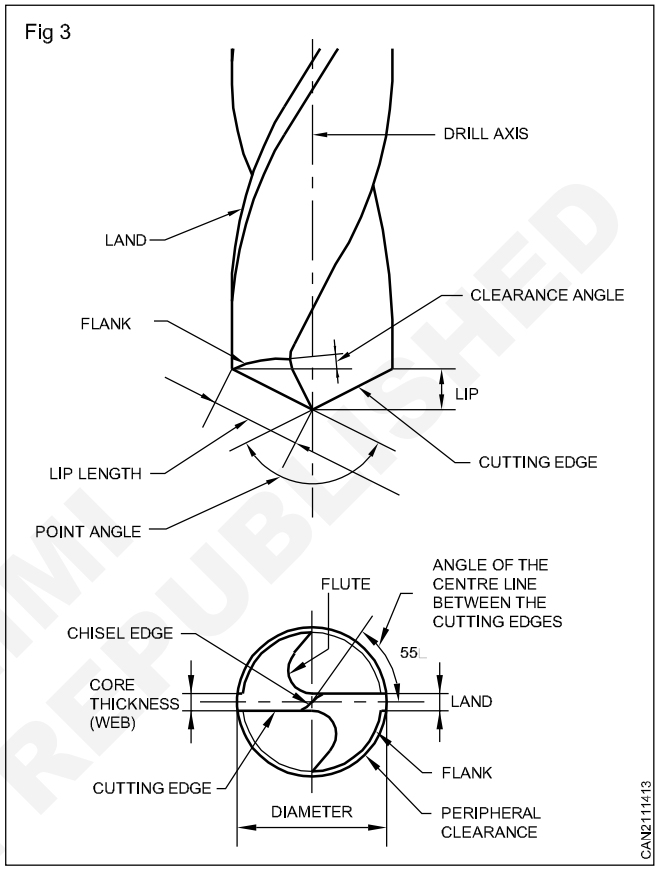
Fig 2 TWIST DRILL



Drills are made from high speed steel. The spiral flutes are machined at an angle of 27 ½ to its axis.

The flutes provide a correct cutting angle which provides an escape path for the chips. It carries the coolant to the cutting edge during drilling. (Fig 3)

Fig 3



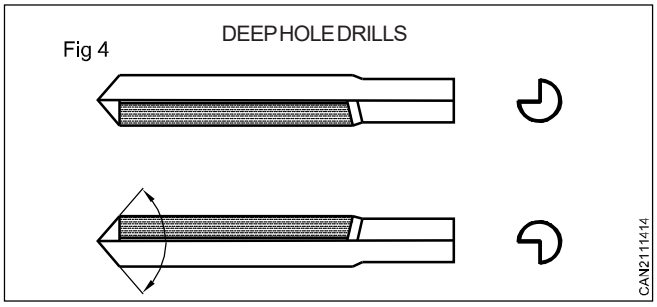
The portions left between the flutes are called 'lands'. The size of a drill is determined and governed by the diameter over the lands.

The point angle is the cutting angle, and for general purpose work, it is 118. The clearance angle serves the purpose of clearing the back of the lip from fouling with the work. It is mostly 8.

Deep Hole Drills

Deep hole drilling is done by using a type of drill known as 'D' bit (Fig 4)

Fig 4 DEEP HOLE DRILLS



Drills are manufactured with varying helix angles for drilling different materials. General purpose drills have a standard helix angle of 27 ½. They are used on mild steel and cast iron.(Fig 5a)

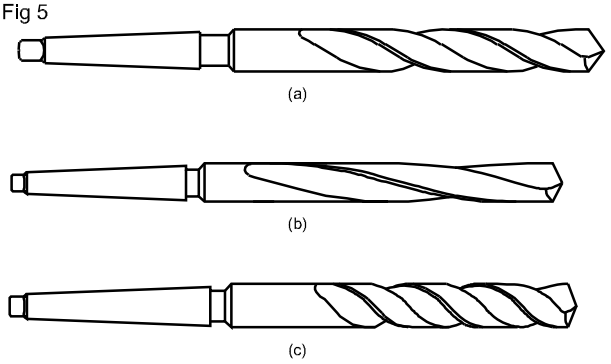
A slow helix drill is used on materials like brass, gun-metal, phosphor-bronze and plastics. (Fig 5b)

A quick helix drill is used for copper, aluminium and other soft metals. (Fig 5c)

A quick helix drill should never be used on brass as it will ' dig in' and the work piece may be thrown from the machine table.

Drills are made of high speed steel.

Fig 5



Wood turning lathe

Objectives: At the end of this lesson you shall be able to
- **describe the wood turning lathe**
- **name the types and size of wood turning lathe**
- **name the parts and function of the wood turning lathe**
- **state the operation performed on wood turning lathe.**

DESCRIPTION

The lathe is a machine which holds and rotates wood against hand held cutting tools to produce circular, cylindrical or moulded shapes.

- Wood turning lathe consists of horizontal cast iron bed
- The bed supports headstock, tailstock to hold the work piece.
- Circular or cylindrical shape of the job is obtained by rotary motion.

Types

The main types are (a) bench mounted (b) frame mounted And also it can be classified in two (a) spindle turning – the grain of the wooden work piece runs parallel the lathe bed.

(b) face plate turning – the grain of the wood to run perpendicular to the bed of the lathe.

Size of wood turning lathe

Determined by "Swing" the largest diameter of the work piece can be turned.

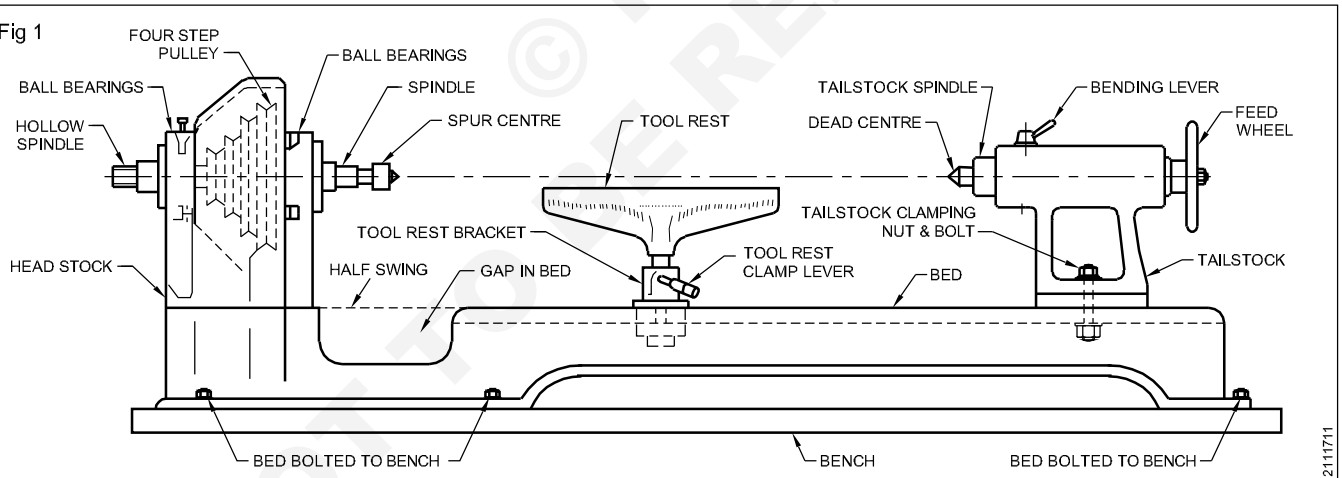
- Swing is twice the distance from the centre of the spindle to the bed.
- The maximum swing dia is 300 mm.
- Length of the bed.
- The maximum distance between centres.

Parts and function (Fig 1)

Head Stock

- Permanently fixed to the left hand end of the bed.
- Made with a set of cone pulleys running on a spindle.
- Right hand end of the spindle is threaded to fix chucks, hollow portions is to receive the spur centre, live centre for driving the work.

Fig 1



THE LATHE

Tail stock

- Movable and can be fixed in any position along the bed
- Spindle is hollow to hold the cup centre (dead centre)
- Spindle can be moved in and out of the tail stock by running hand wheel.
- The cup centre is moved by turning the hand wheel.

Tool Rest (Fig 2)

- Movable bracket
- Can be adjusted up and down at any position along the bed.
- Available in different lengths
- Top edge is straight smooth to move the tool easily
- Can clamp to the bed of the lathe as required.

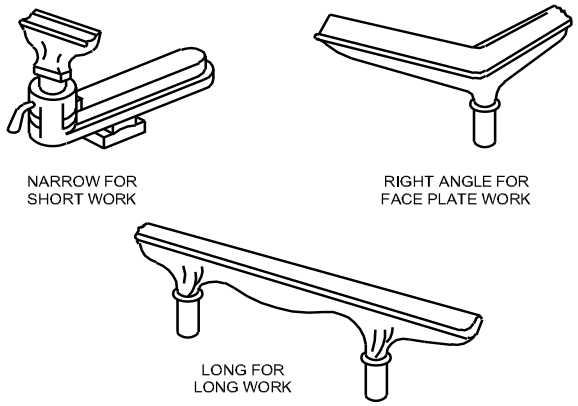
Spur centre/live centre (Fig 3)

- Fixed to the spindle nose
- Drives the work
- Tapered to fix into the hollow spindle nose.

Cup entre or dead centre (Fig 4)

Tapered shape to fit into the tail stock spindle to hold the job.

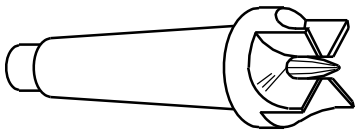
Fig 2



TOOL RESTS

CAN2111712

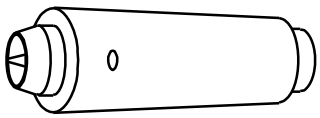
Fig 3



SPUR CENTER

CAN2111713

Fig 4



CUP CENTER

CAN2111714

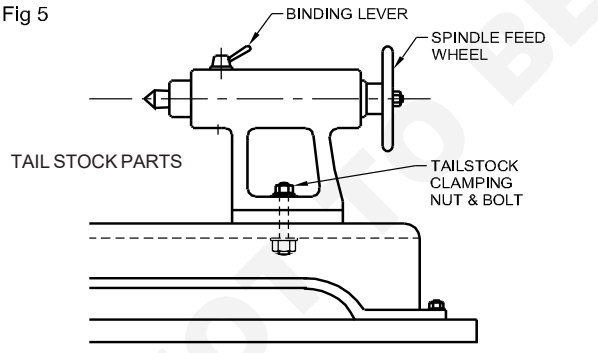
Binding lever (Fig 5)

Used to tighten the tail stock spindle to the tails stock.

Spindle feed wheel (Fig 5)

Adjust the tail stock on the bed to the required distance.

Fig 5

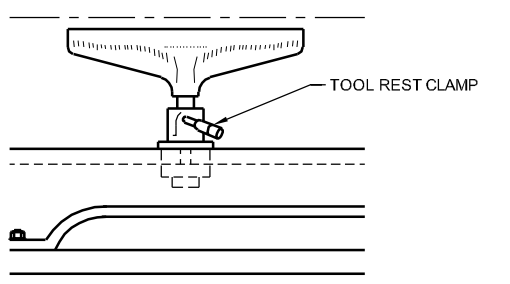


CAN2111715

Tool rest clamp (Fig 6)

Set the tail stock on the bed required distance firmly.

Fig 6



CAN2111716

Tail stock clamping nut and bolt (Fig 6)

Set the tail stock required distance firmly to the bed.

CHUCKS

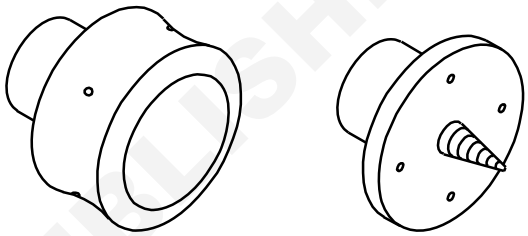
Cup chuck (Fig 7)

- Called hollow chuck
- Mouth is slightly tapered the end of the job can be drive in and held while turning
- Grain of the job usually parallel to the axis of the chuck
- Turns small cups and door knobs.

Screw chuck (Fig 7)

- Have a screw point into the centre portion
- Screw point is to hold the work piece
- Used for small turning works like knobs.

Fig 7



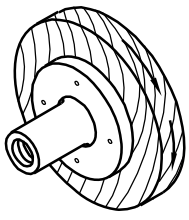
CUP CHUCK SCREW CHUCK

CAN2111717

Face plate (Fig 8)

- Flat circular plate
- Plate has screw holes
- Job can be screwed on the face plate for turning
- Face plate can be fixed to head stock spindle by screwing
- Grain of the work piece should be at right angles to the axis of the lathe.
- Used for turning jobs like stand, base, fruit bowls etc.

Fig 8



USE OF FACE PLATE

CAN2111718

Operations of wood turning lathe

- Cutting or rough turning, smooth cylindrical turning.
- Plain turning, taper turning.
- Internal turning, face plate turning.
- Concave and convex surface turning, forming beads.
- Making chamfer, parting the job.
- Drilling, boring, sanding, polishing.

Safety precaution and PPE for wood turning lathe

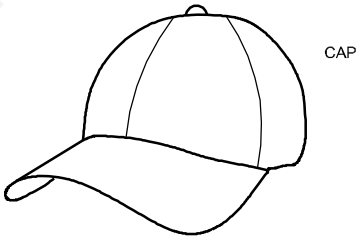
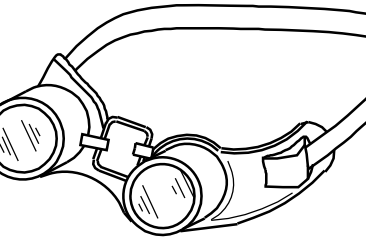
Objectives : At the end of this lesson you shall be able to
• **state the safety precaution to be followed while using a wood turning lathe.**

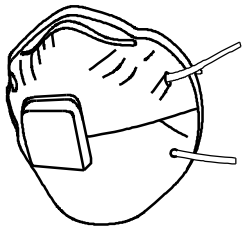
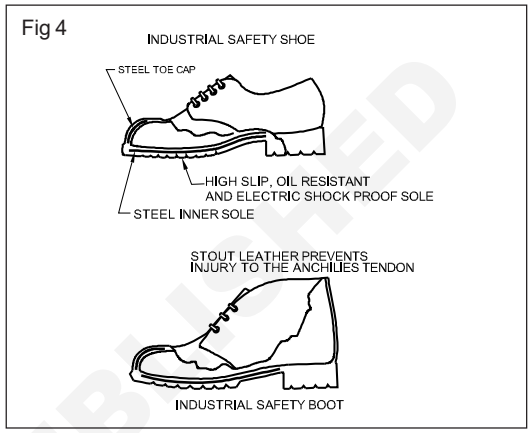
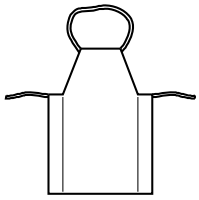
- Correct dress is necessary- remove rings and watches roll sleeves above elbows
- Switch off the lathe to check job size and adjustment
- Stand to one side when switching 'on'.
- Keep the work shop neat and tidy
- Work piece should be free from splits and knots
- Mount the job tightly with the lathe
- Apply grease or wax at the dead centre properly
- Properly adjust the tool rest
- Before starting check the free rotation of the work
- Tools must be sharpened and keep it in safe place
- Check the rotation of the work (It is always against to the worker)
- Adjust tool rest close the work with in 3mm and to the correct height.

Personal protective equipments (PPE)

Objectives : At the end of this lesson you shall be able to
• **name the PPE used in wood turning lathe.**

Personal protective equipments and their uses

Types of protection	PPE to be used
We have to wear cap to protect from the head wood dust during wood turning	Fig 1  Cap (Fig 1)
We have to wear goggles to safeguard the eyes from the saw wood dust during wood turning	Fig 2  Goggles (Fig 2)

Types of protection	PPE to be used
We have to wear nose mask to protect the lungs from the spray of the wood dust	Fig 3  Nose mask (Fig 3)
We have to wear safety shoes to the foot to protect from the falling chisels due to vibration during wood turning	Fig 4  Safety shoes (Fig 4)
We have to wear leather apron to safeguard the body from the sharp wood scraps during wood turning	Fig 5  Leather apron (Fig 5)

Care and maintenance with oiling and greasing in wood turning lathe

Objectives : At the end of this lesson you shall be able to
- **state the care and maintenance of wood turning lathe with oiling and greasing.**

Care and maintenance

- Lubricate tail stock
- Use always sharpened tools
- Begin cutting
- Turning with a slow speed
- Keep the tool rest close to the work
- Fix the work piece securely and check set up by hand rotate the job by hand and check the clearance between work piece and tool rest
- Select turning speed carefully
- Wood with knot and split should not be turned
- Keep your sleeves rolled up
- Remove both spur and cup centre when they are not in use.
- Check guards are in position and secure
- Screw face plate on tightly by hand
- Wax or grease dead centre end of wood
- Do not attempt to stop the lathe by grasping the job.

Oiling and greasing

Oiling tail stock, spindle bed and head stock ball bearing provided with oil caps (or) grease caps require regular oiling and greasing.

Types and applications of wood turning chisels

Objectives : At the end of this lesson you shall be able to
- **name the types of wood turning chisels**
- **state the application of wood turning chisels.**

Turning chisels are used on spindle turned work for smoothing surface after removing the bulk of the waste with a roughing gouge. They are used on straights tapered and slightly hollowed work for marking positions of details, squaring and rounding shoulders and forming beads and convex shapes.

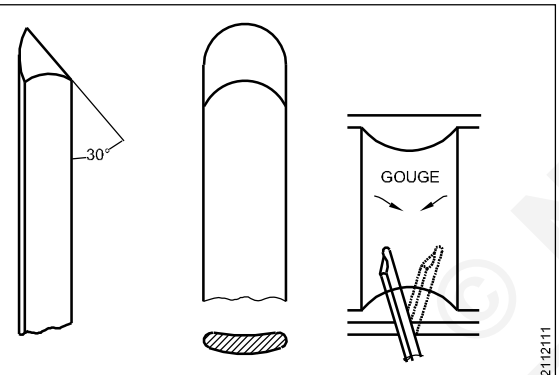
Chisels uses in wood working lathe

Gouge chisel (Fig1)

Sharpened on the convex or outside surface used for cutting rough surface quickly and turning the work from square to round.

Size 6 mm to 40mm.

Fig 1

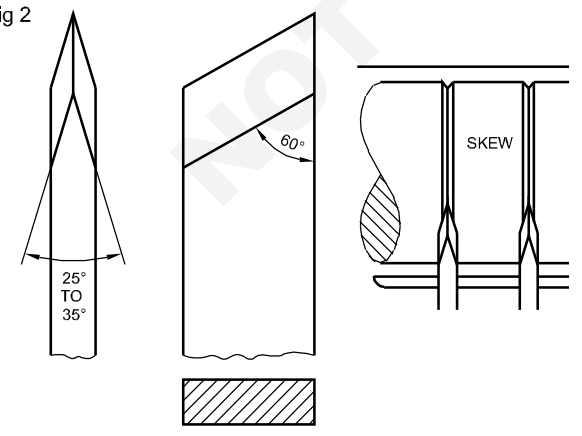


GROUND CHISEL

Skew chisel (Fig 2)

- Sharpened on both surfaces.
- Used for "V shaped grooves, tapper turning cutting beads and making smooth surface size 6 mm to 40mm.

Fig 2



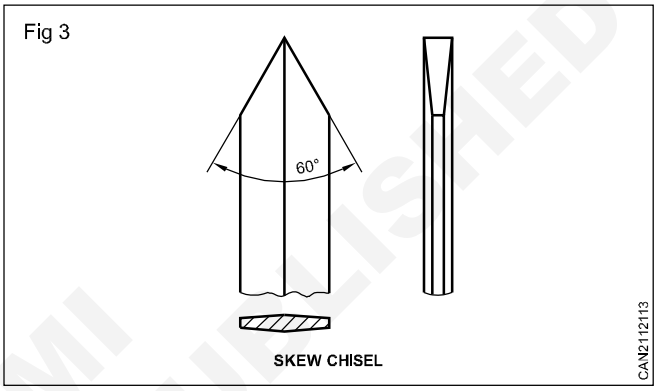
SKEW CHISEL

Parting tool (Fig 3)

Blade is narrow in width used for deep cut or separating the work piece and different shoulder cuts according to the dimensions.

Size 6 mm to 8mm.

Fig 3

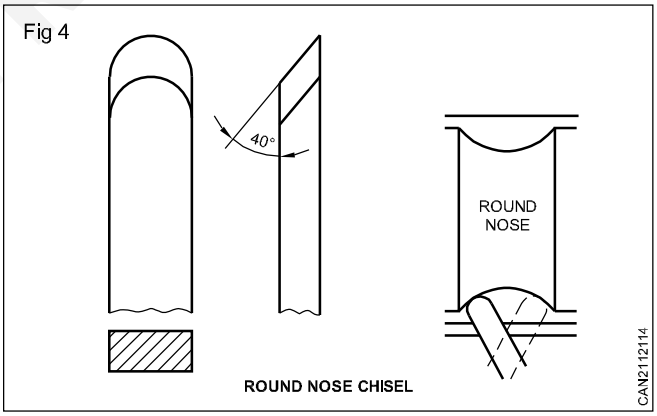


SKEW CHISEL

Round nose chisel (Fig 4)

- Sharpened on one side only.
- Used for forming the hollow or concave surface size 6 mm to 20mm.

Fig 4

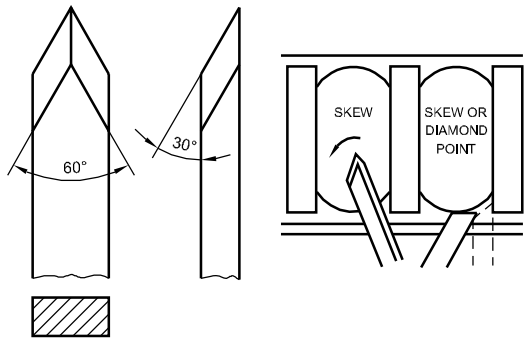


ROUND NOSE CHISEL

Spear point chisel (Fig 5)

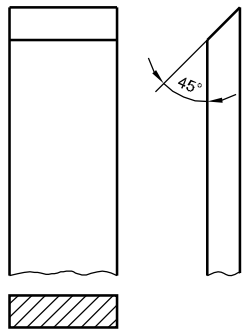
- Called as diamond point chisel.
- Sharpened on one side only.
- Used for scraping beads, squaring ends, producing flat surface size 6mm to 20mm.

Fig 5



SPEAR POINT CHISEL

Fig 6



FLAT NOSE CHISEL

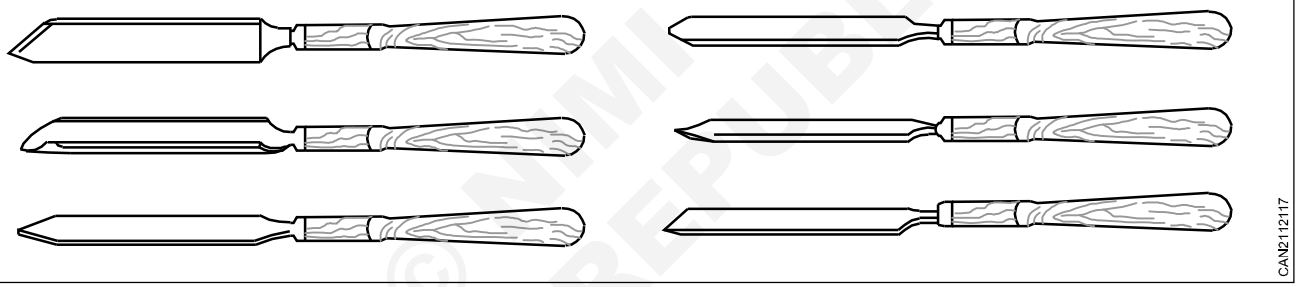
Flat or facing chisel (Fig 6)

- Sharpened on one side only.
- Similar to ordinary firmer chisel, thicker than other chisel.
- Used for scraping cylinders, beads and surface work.

Signature of cutting tools (Fig 7)

1 Skew chisel
2 Gouge chisel
3 Parting chisel
4 Round nose chisel
5 Spear paint chisel
6 Flat or facing chisel

Fig 7 SIGNATURE OF CUTTING TOOLS



Mortise machine

Objectives : At the end of this lesson you shall be able to
- **describe a mortise machine**
- **state the types of mortise machine**
- **specify the size of mortise machine**
- **name the parts and function of mortise machine**
- **state the operation of mortise machine.**

DESERIPTION

A mortise machine is a specialized wood working machine used to cut square or rectangular holes in a piece of timber such as a mortise in a mortise and tenon joint.

Mortise machine consists of a heavy cast iron frame with vertical slides.

Frame supports mortising head, table and operating handle.

Types

- There are two types
- Hollow chisel mortiser
- Chain mortiser

Sizes

The size of mortising machine depends up on the size of the mortise it cannot produced with the cutter head mounted on the mortising machine.

Selection of chain

- Pitch 13 mm for small holes 5mm to 8m wide and 19 mm to 35mm long.
- Pitch 16mm for medium holes 5mm to 8 mm wide and 22mm to 38 mm long.
- Pitch 22mm for large holes 6mm to 22mm wide and 38mm to 75mm long.

Parts of hollow chisel mortiser (Fig 1)

Parts

Frame/Pedestal

- Cast iron frame.
- Fixed vertically on the floor.

Table

- Sets horizontal position to the frame.
- Moves laterally to line up with chisel.
- Moves longitudinally to traverse the length of mortise.

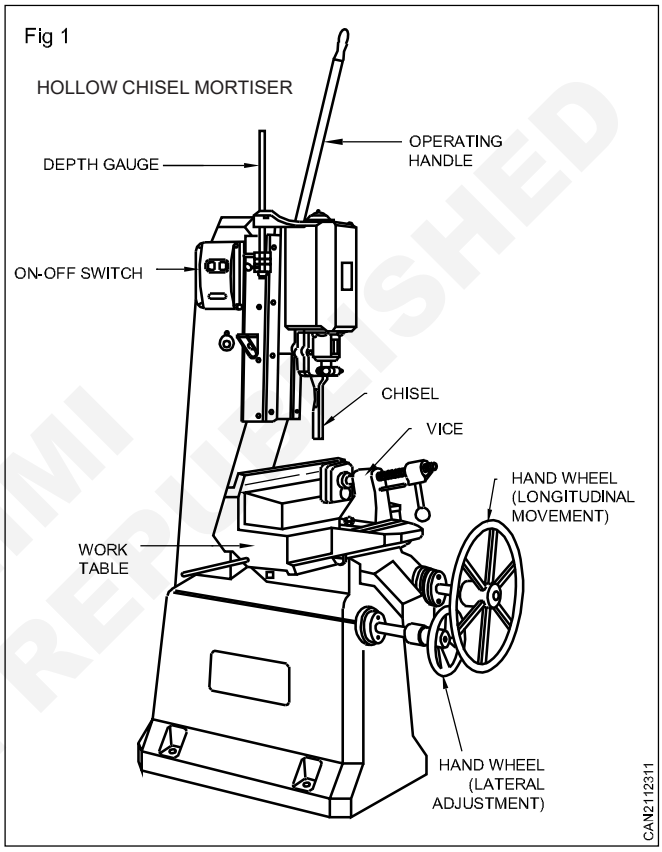
Fence

- To support the job.

Vice

- To tighten the job with fence.

Fig 1



Hand wheel

Set the table to move the job laterally and longitudinally.

Depth gauge

- Set the depth of mortise to the required size.

Chuck

Set the chisel and auger bit to make mortise.

Auger

Twisted in shape fixed into the hollow chisel to form mortise.

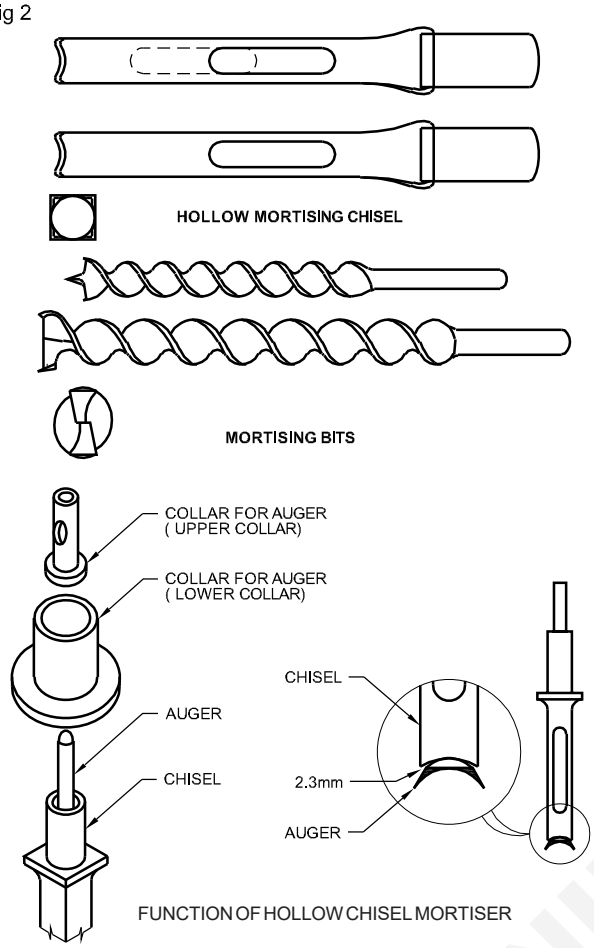
Chisel

- Square in shape.
- Receive the auger to form the mortise.
- Size: 6mm to 40mm.

Function of hollow chisel mortiser (Fig 2)

- Consist of upper collar and lower collar.

Fig 2



- Upper collar grips the auger bit.
- Lower collar holds the hollow chisel.
- Auger bit revolves inside a square hollow chisel (Fig 2A).
- Auger bores the holes.
- Chisel converts the round hole to the square mortise.
- Mortise head can be adjusted up and down, left and right.
- Cutter head mounted directly to the motor.
- Size 6mm to 15mm.

Chain mortise (Fig 3)

- Has an endless chain saw shaped.
- Chain moves around a steel guide bar with sprocket wheel. (Fig 4)

Fig 3

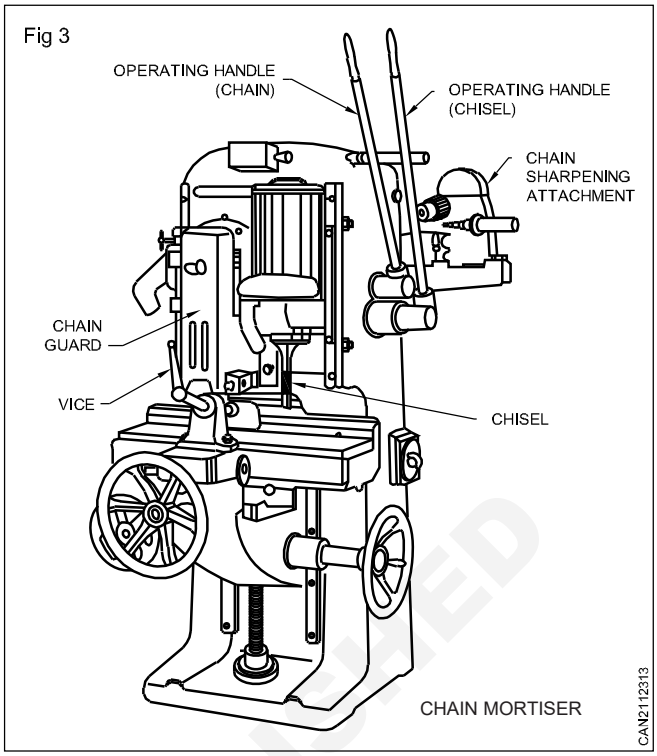
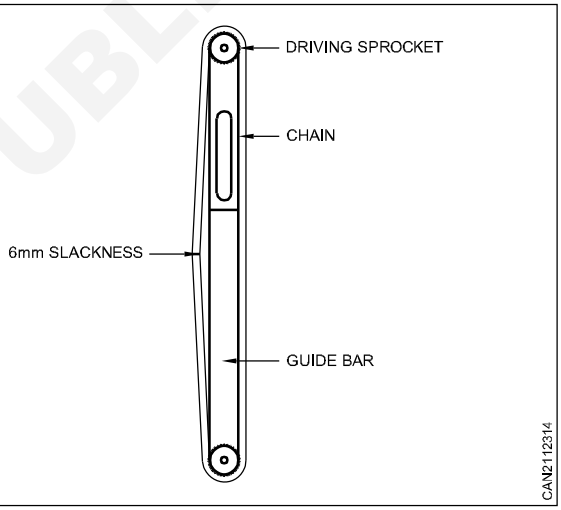
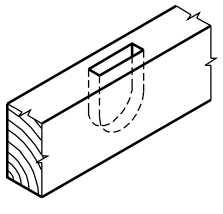


Fig 4



- Sprocket wheel runs on ball bearing.
- Makes a mortise with round buttons. (Fig 5)
- Size 6mm to 40mm.

Fig 5



Safety precaution, PPE, care and maintenance in mortising machine

Objectives : At the end of this lesson you shall be able to
- **state the safety precaution and PPE to be followed while mortising machine**
- **explain the care and maintenance of mortising machine.**

- The working area should be well lit, clean and free of debris.
- Inspect lumber for foreign materials (Nails, screws, etc.)
- Select the correct auger and chisels set for the mortise
- Use the correct key and tighten the chuck uniformly when the auger bit is inserted.
- Always remove the chuck key before starting the mortising machine.
- Place the stock on the table against the fence.
- When positioned correctly, lock the fence in place by tightening the levers.
- Set the work piece on the table so that the chip clearing slot of the chisel faces the direction you will move the work piece to make your next cut.
- Tighten the table clamp to hold the work piece securely against the fence.
- Lower the work piece hold-down until slightly above the work piece and tighten.
- Make sure the chisel and bit are properly installed.
- Turn the Power “On” check that the machine runs without vibration or shaking. Visually check that the bit does not wobble.
- Keep clear of moving machine parts.
- Proceed with cut. Lower the chisel into the work piece using a steady even pressure until it bottoms out on the depth stop.
- Rise the chisel. Re-position work piece to continue the cut.
- The work piece should be moved so that the chisel is releasing chips into the already cut part of the work piece.
- Allow the auger bit to cut at its own speed without applying excessive pressure.
- Keep hands clear of the auger and chisel when the machine is running.
- Do not remove waste material from the table while the machine is running.
- Switch OFF power when finished
- Never leave the machine running unattended.

Care and maintenance

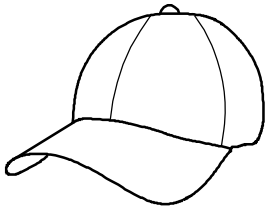
- Chain should be fed smoothly with uniform pressure.
- Chain moves deeper, speed should be reduced.
- Tension of the chain can be adjusted by guide bar.
- Lubricate sprocket wheel.
- Chain chisels and auger bit should be kept sharp and in good condition.

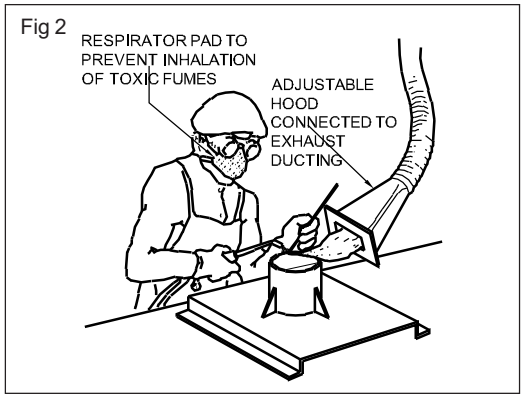
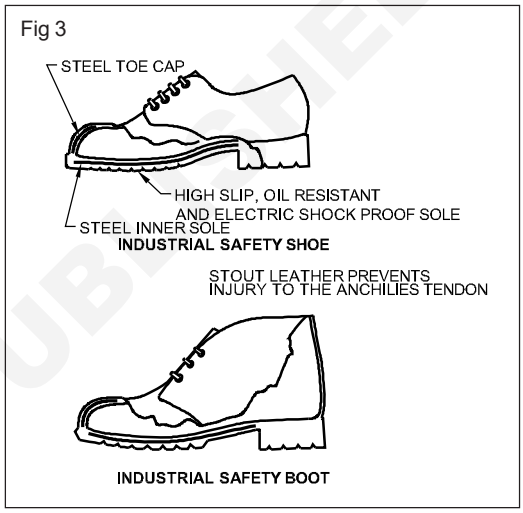
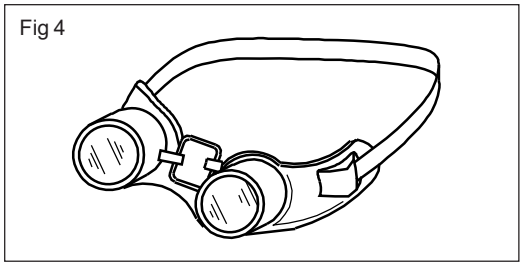
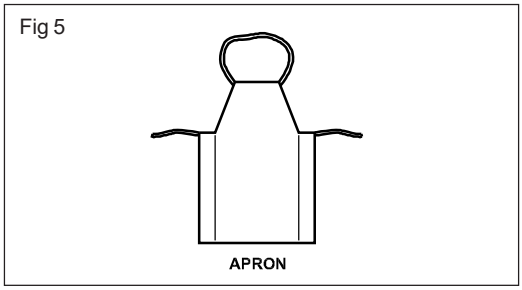
Oiling and greasing

Oiling and greasing of the mortising machine should be done as per manufactures. Instructions given with the machine periodically.

Personal protection equipment (PPE) for mortising machine

Objectives : At the end of this lesson you shall be able to
- **name the PPE used in mortising machine.**

Types of protection	PPE to be used
We have to wear cap to protect from the head wood dust during wood mortising.	Fig 1  Cap (Fig 1)

Types of protection	PPE to be used
We have to wear nose mask to protect the lungs from the spray of the wood dust.	 Nose mask (Fig 2)
We have to wear safety shoes to the foot to protect from the falling wood due to vibration during wood mortising.	 Safety shoes (Fig 3)
We have to wear goggles to safegaurd the eyes from the wood dust during wood working.	 Goggles (Fig 4)
We have to wear leather apron to protect from the sharp wood scraps during wood mortising.	 Leather apron (Fig 5)

Tenoning machine

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of tenoning machine**
- **state the uses of tenoning machine.**

CONSTRUCTION

- Design of this machine consists top and bottom tenoning head, cut off saw and a carriage.
- Tenon heads and cut off saw having individual motor.
- Used to produce plain shoulder tenon, shaped shoulder tenon and grooves.

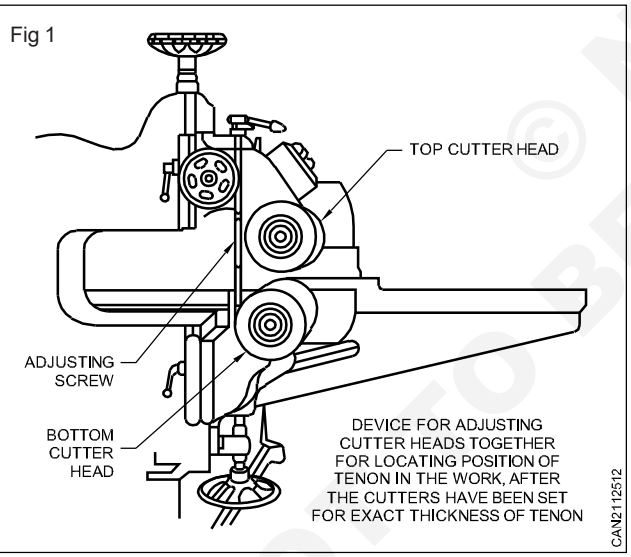
Frame

- Heavy cast iron frame
- Fixed vertically on the floor
- Attached with tenon head cutoff saw blade and a carriage.

Tenon heads (Fig 1)

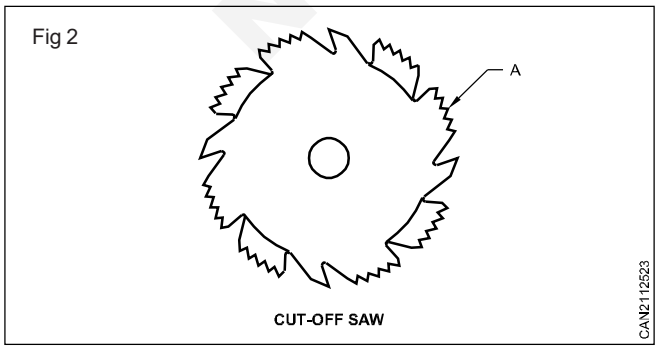
- Fixed on the motor
- One is above and another is below the table
- Moves up and down, front and back, powered with individual motor
- Fixed with cutter head and scriber.

Fig 1



Cut-off saw (Fig 2)

Fig 2



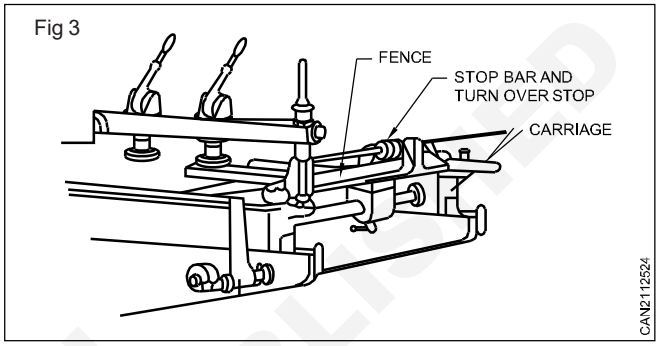
- Powered with individual motor
- Cutting the required length of the tenon.

Carriage

- Holds the table
- Moves forward through tenon head.

Table (Fig 3)

Fig 3



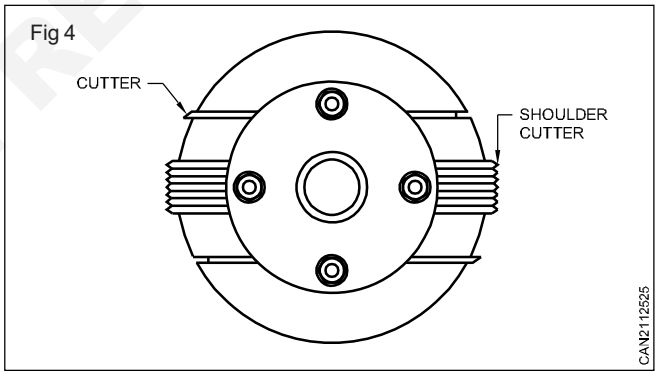
Supports the fence and the job.

Fence

- Hold the job and can be adjusted to an angle of 45°.

Cutter (Fig 4)

Fig 4



- Tool steel
- Fixed with tenon head
- cutting edges bevelled and sharpened
- Form the surface of the tenon.

Scriber

- Fixed with tenon head
- Marks and forms shoulder on tenon.

Adjustment hand wheel

- Adjusts the tenon head up and down to the required size.

Calculation of timber - weight, area and volume

Objectives : At the end of this lesson you shall be able to
- **state the method of calculation of timber**
  - **logs**
  - **planks**
  - **boards.**

Volume of logs

Take the measurement of girth diameter always in the middle of the log. (Fig 1)

Example (Fig 2)

Volume in M^3

$$V = \left(\frac{d_1 + d_2}{2}\right)^2 X \frac{ll}{4} X length$$

$$V = \left(\frac{0.45m + 0.53m}{2}\right)^2 X \frac{3.14}{4} X 4.50m$$

$V = (0.49m)^2 \times 0.785 \times 4.50m$

$V = 0.848m^3$

Note

V = Volume

1 Remove the bark in the middle of the log. (Fig 1)

2 Measure d_1 and d_2. (Fig 2)

Plank Volume and Area (Fig 3)

Measure at BB when the thickness is 40mm and more.

Measure at AA when the thickness is less than 40mm

Example Volume in M^3

V = Width x length x thickness

V = 0.43 m x 5.60m x 0.045m

$V = 0.108M^3$

Area of boards (Fig 4)

Example

Area in sq.metre

Area = length x width

Area = 2.44 m x 1.22 m = 2.97 sq metre

Plank weight

Weight **=** Volume x density gm/cm^3

Unit in kg

Fig 1

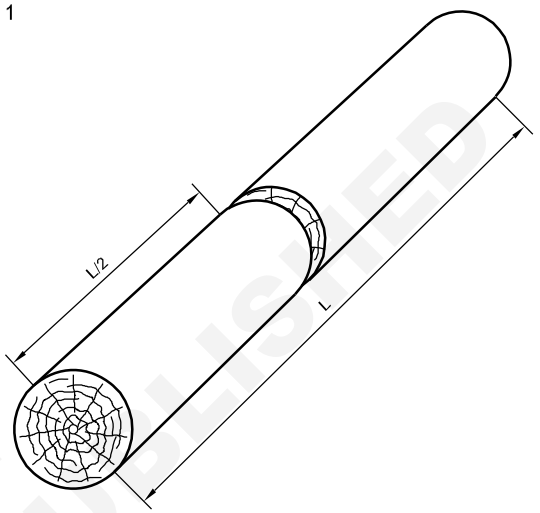


Fig 2

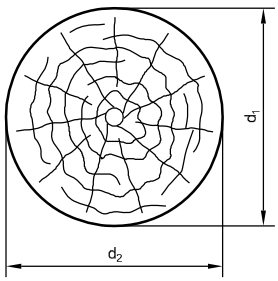


Fig 3

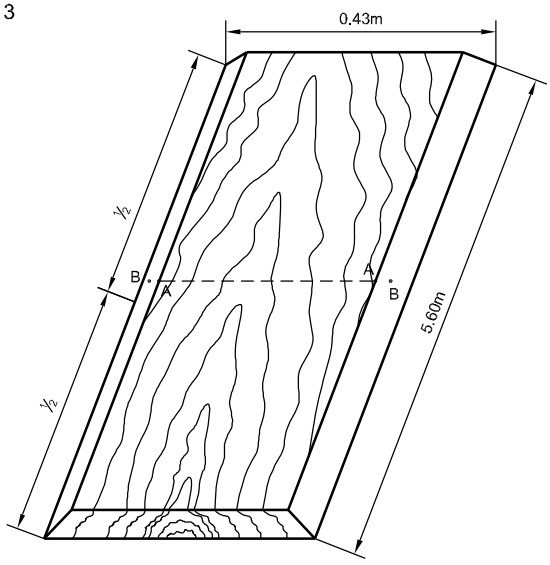
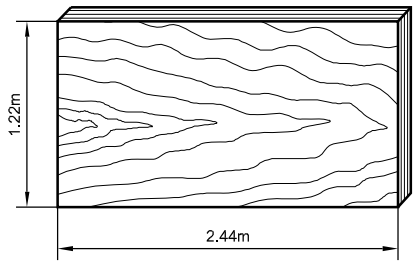


Fig 4



Plank weight (Fig 5)

Example = weight in Kg, density = 0.7 gm/cc

weight = volume x density

Volume of the plank = width x length x thickness

= 1.4m x 0.4m x 0.025m

∴ 1 meter = 100cm = 0.4m x 100 = 40 cm

= 1.4m x 100 = 140 cm

= 0.025m x 100 = 2.5 cm

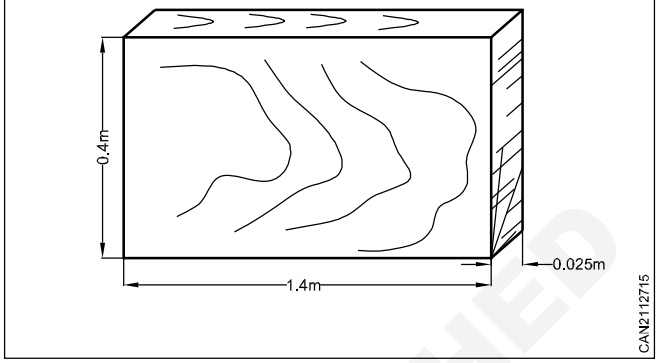
= 40 x 140 x 2.5 = 14000 cm^3

weight = 14000 x 0.7 = 9800 gm

∴ 1 kg = 1000 gm = (9800 ÷ 1000) = 9.8 kg

Plank weight = 9.8 k.g

Fig 5



Types of sanding machine, safety precaution & PPE

Objectives : At the end of this lesson you shall be able to
- **describe a sanding machine**
- **state the different types of sanding machine**
- **name the parts and uses of the sanding machine.**

Sanding machines are made in different shapes and sizes.

They differ from each other in appearance, construction and operation.

Various kind of abrasives are used for sanding purpose.

Abrasive

An abrasive is a material when rubbed against another material wears down and polish the work.

Emery wheel, grinding stone, rubbing stone, oil stone and sand paper are all abrasives.

Abrasives are made by gluing some gritty material to paper or cloth.

Types and uses

The most important sanding machines are

1 Disk sander

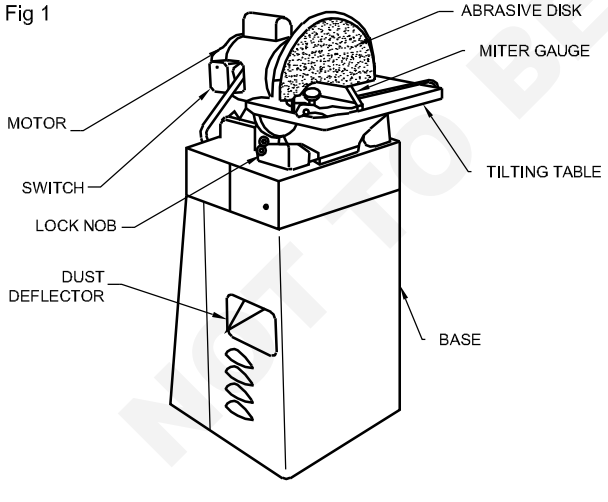
2 Belt sander

3 Drum sander

4 Spindle sander

Disk sander (Fig 1)

Fig 1



DISK SANDER

A disk sander is usually a small machine which cannot serve a large production operations because the surface of the disk is not very large and the sand paper wears out very fast. (Fig 1)

Lower half of the disk is covered by a dust hood and the upper edge and one side is covered by an iron guard.

An iron table is fastened to the column in front of the disk.

The table can be raised or lowered and can be tilted to 45°.

It is provided with a mitre gauge, which slides a slot milled in the table.

The disk is covered with either garnet or aluminium oxide paper.

The work done on disk sanders mostly is edge sanding (straight and convex surface).(Fig 2)

The disk (sander) diameter range from 200 mm to 600 mm.

Fig 2

LATHE DISK SANDER, WOODEN TABLE

Belt Sander (Fig 3)

The belt sander has an endless belt running over the pulleys mounted on a cast iron column.

One pulley is adjustable along the axis of the belt which makes portable a certain variations in the length the belt. Belt sanders are used in both horizontal and vertical positions.

The frame is cast in two pieces which stand separately.

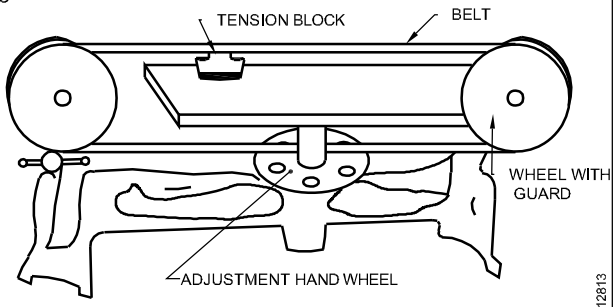
There is also a counter weight tension device which keeps the belt under the correct tension and also facilitates replacement of the belt.

The frame has a gap for the table and is possible to sand of the work upto the length of 2500 mm.

The table can be raised and lowered to the desired height.

In sanding the work is placed on the table and sanding is done by pressing the belt against the work with a self balancing sanding shoe.

Fig 3



BELT SANDER

The shoe can be moved along the axis of the belt and is balanced by a counter weight.

This causes the shoe to be lifted automatically when no sanding is being done.

The motor is connected directly to the pulley.

The dust either is collected in a bag or is exhausted.

The belt sander is useful for sanding flat work such as table top, flush doors, panels etc. (Fig 3)

Its size is indicated by the width of the sander belt.

The length of the belt varies with different types of sanders.

Drum sanders

Drum sanders generally are large, heavy production machines.

The sanding dust produced is exhausted directly into a blower system.

The drum sander is built on the principle of a planer machines.

The drum sander has a bed and feed rolls.

Instead of the cutter head, it has from one to four sanding drums.

Same sander finish both the surfaces at the same time and have four drums above and four drums below the bed.

Sanding drums are steel cylinders covered with a resilient material such as rubber or felt.

Each drum is driven by an individual motor.

The grit number of the abrasive used depends up on the type of work to be done.

For sanding the first drum which comes in contact with the work is covered with rough grit and the others which progressively finer grits.

The abrasive used either are aluminium oxide for high speed machines and hard wood finishing. (Fig 4)

The garnet for slower speeds and soft woods finishing.

Drum sanders are used to sand doors flat work, ply wood, composition wall board etc. (Fig 5)

The width of a drum sander is from 600 mm to 2400 mm.

Fig 4

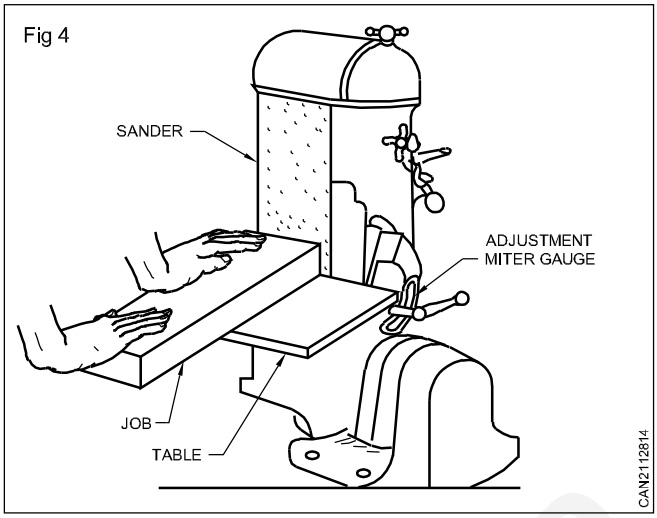
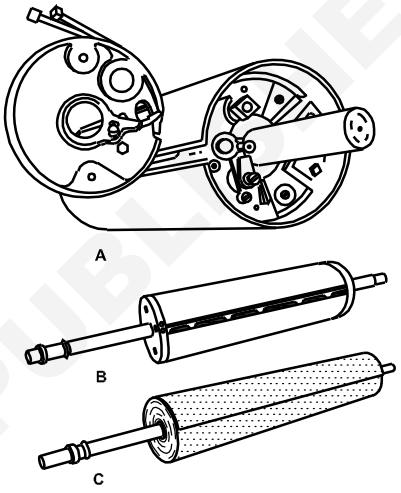


Fig 5

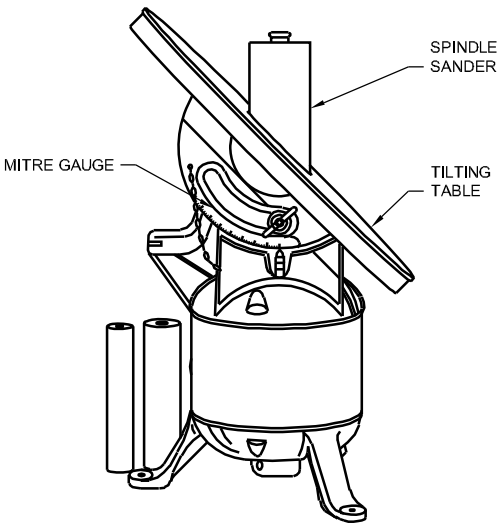


SANDING DRUM

Spindle sander

Spindle sanders are really small drum sanders. (Fig 6)

Fig 6

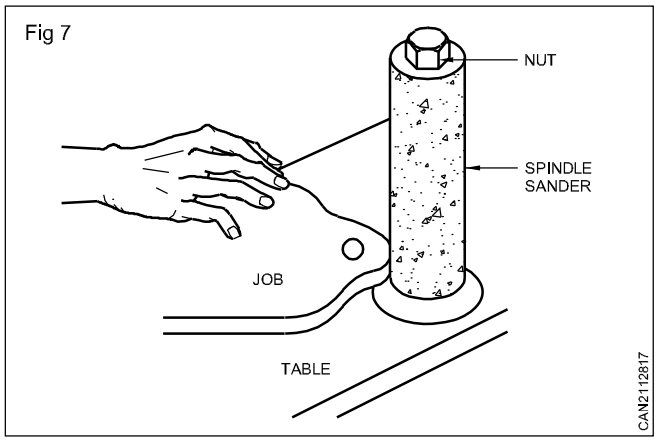


SPINDLE SANDER WITH A TILTING TABLE

The most common types of spindle sander resembles a shaper in appearance.

Spindle sander has a vertical shaft which projects through a horizontal table. (Fig 7)

Fig 7



Spindles are available different in diameter and are screwed to the end of the shaft.

The shaft in modern machines is the rotor of a motor.

The shaft moves up and down through the slotted table.

The table can tilted at and angle of 45°

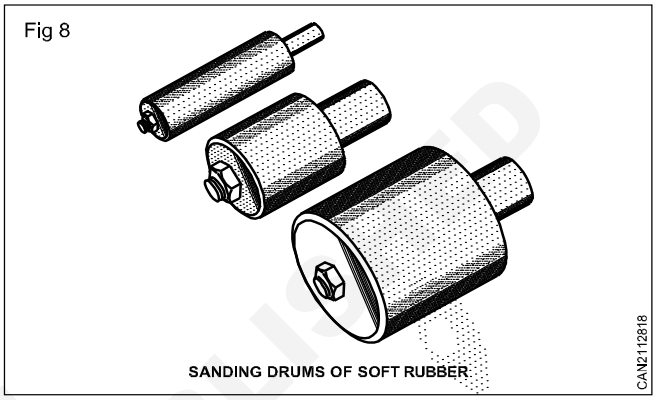
Table is provided with a ring which fills around the different diameter of spindle.

Spindle sander are made both bench and production types. (Fig 7)

The spindles are made of metal, wood, soft rubber or rubber tubing.

Spindle sander are used to sand hollows and irregular curves. (Fig 8)

Fig 8



Safety precaution and PPE for sanding machine

Objectives: At the end of this lesson you shall be able to
- **state the safety precautions to be observed on sanding machine.**

Safety precautions to be observed

Be sure that the belt or disk is correctly mounted .

The belt must be tracked in the centre of the drums and plates.

Do not operate the disk sander if the abrasive paper is in loose condition.

Check the guards and table adjustment are in the correct position and securely locked in place.

Use the table, fence and guides to control the position of the work when ever possible.

When sanding the end grain of narrow pieces on the belt sander always support the work against the table.

Sand only on the side of the disk sander that is moving down towards the table.

Move the work along the surface only.

Always use a pad or push block when sanding thin pieces on the belt sander.

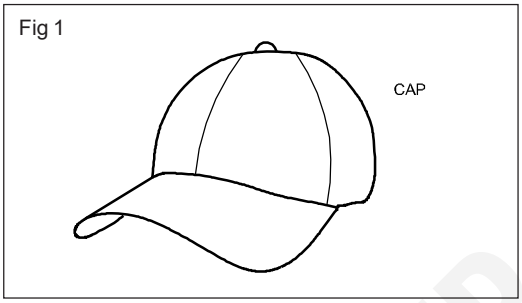
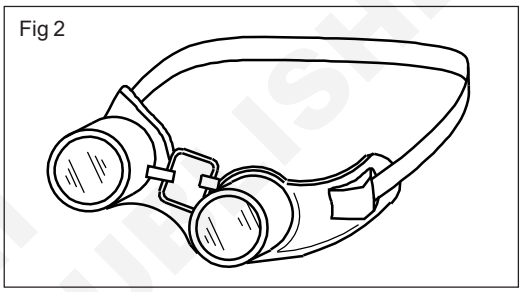
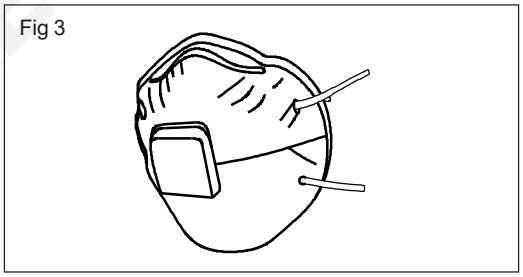
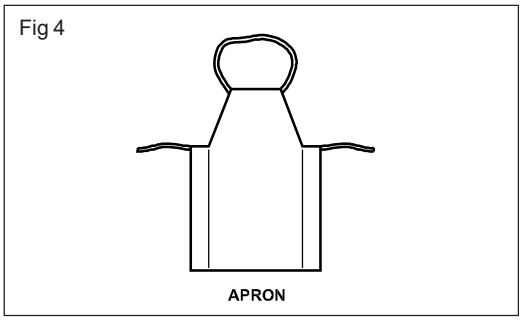
Sand only clean new wood.

Do not sand work that has excess glue or nailed surface.

Do not sand small piece, they may become trapped between the disc and table.

Personal protective equipments (PPE) for wood sanding machine

Objectives : At the end of this lesson you shall be able to
- **name the PPE used in wood sanding machine.**

Necessaries of protection	Name of the PPE & Figure
We have to wear cap to protect from the head sanding dust during wood sanding.	Fig 1  Cap (Fig 1)
We have to wear goggles to safeguard the eyes from the sanding dust during sanding.	Fig 2  Goggles (Fig 2)
We have to wear nose mask to protect the lungs from the spray sanding dust.	Fig 3  Nose Mask (Fig 3)
We have to wear leather apron to protect the body during sanding.	Fig 4  Leather apron (Fig 4)

Introduction of modular kitchen

Objectives : At the end of this lesson you shall be able to
- **state the introduction of modular kitchen**
- **state the advantage of modular kitchen.**

Introduction of modular kitchen (Fig 1)

Fig 1

- In general the kitchen plays an important role in the healthy living of people. In today's scenario people spend 2.5 to 3 hours in the kitchen everyday or on average it is but obvious that the kitchen should be well designed
- Modular kitchen originates from the idea of the module. Essentially, the module kitchen consist of small sections or modules which are accumulated together to from a complete kitchen.
- Modular kitchen is a con temporary. Concept of kitchen which comprises of drawers, cabinets and shelves organized in a manner that saves up on a lot of space.
- These kitchens are modern and convenient in terms of organizing limited spaces, especially in the apartment - style living paces of crowded cities.
- A modular kitchen refers to modern kitchen furniture that has been constructed in modules or units. These consist of cabinets with selected elements of standard sizes.
- Modular kitchen is usually a combination of wall units and base units.
- Modular kitchens are designed to maximize utility and allow for efficient space managements, especially for the smaller spaces.
- Modular kitchen each unit is made from diversified materials and comes with modular kitchen accessories to arrange the things in clutter free way.

Advantages of a modular kitchen

- Modular kitchens consist of wooden blocks that are specifically designed to keep your kitchen clutter - free and clean
- Every corner of you kitchen is properly utilized and each modular unit specifically designed for convenience
- Modular units can be sifted or rearranged so that everything, be it the hop, the sink, or your work area should be reachable
- Use every corner of your kitchen with help of space saving kitchen accessories such as racks, baskets, holders, Bing and trays
- Cost-effective as compared to the traditional kitchen modular kitchen are cheaper.
- modular kitchen unit are easy to repair and replace as each unit can be detached and removed from a modular kitchen cabinets.
- Modular kitchen adds good appearance to your home.

Purpose of installation in modular kitchen

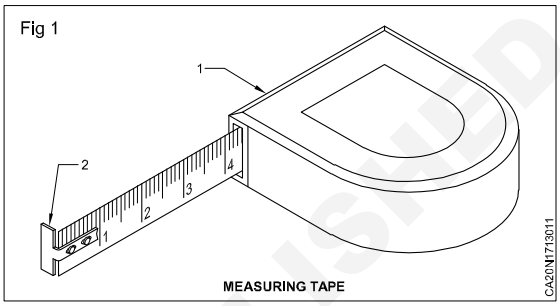
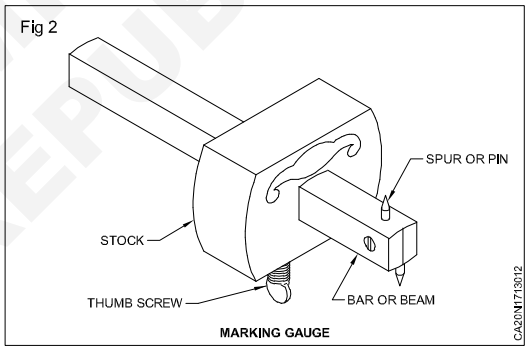
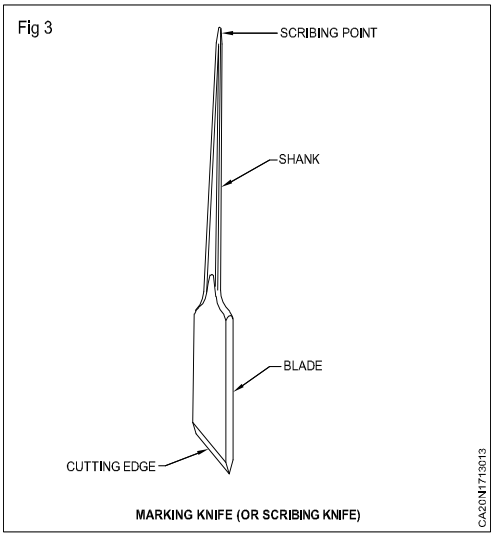
- Style and functionality
- Maximum utilization of space
- Wide range of choose from
- Easy to transport, assemble and install
- Easy maintenance
- Customization
- Beautiful appearance
- Smart design
- Upgraded appliances
- Remodelling the kitchen
- Easy to repair
- Maximizes customer satisfaction

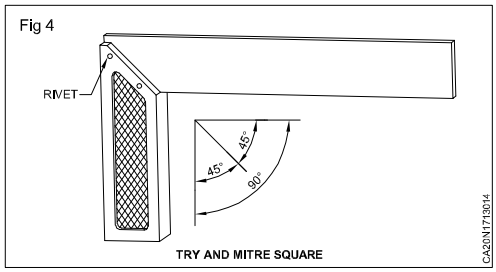
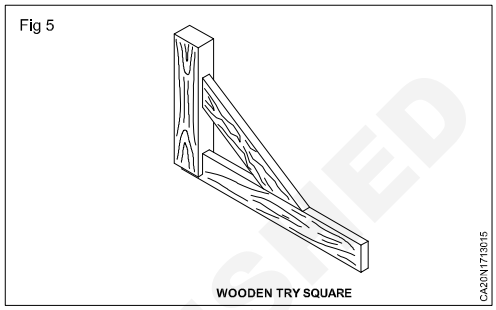
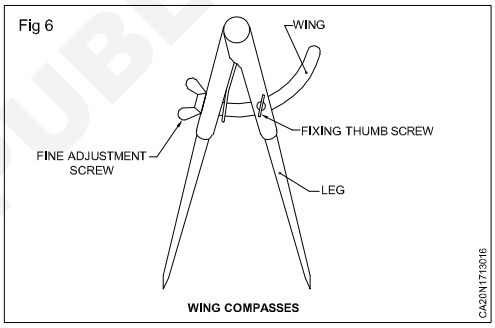
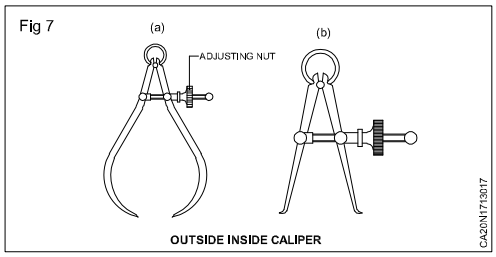
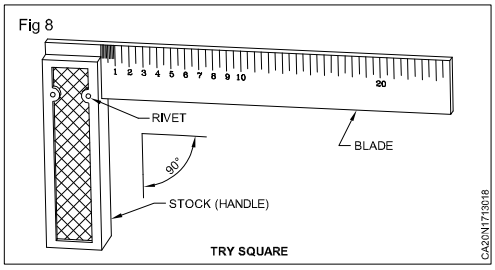
Modular kitchen making hand tools machineries and uses

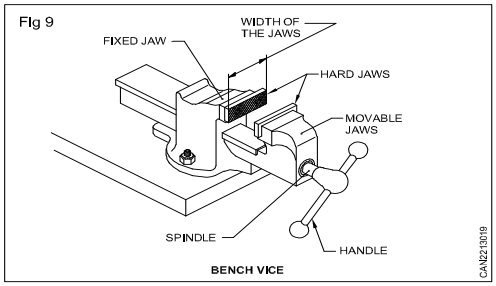
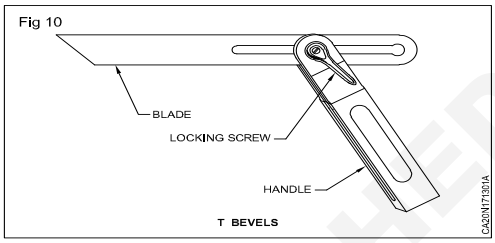
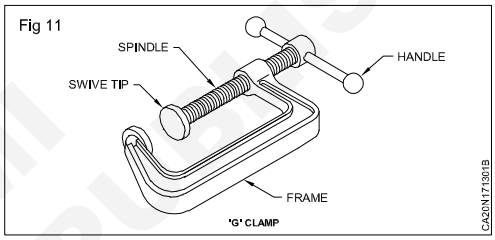
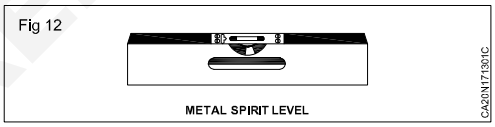
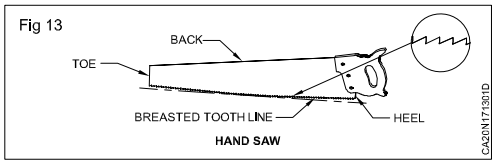
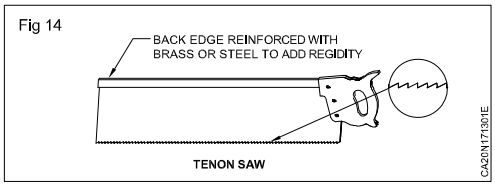
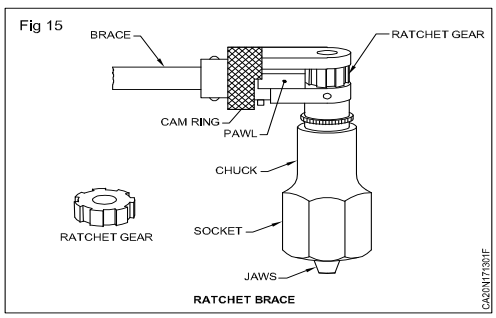
Objective: At the end of this lesson you shall be able to
- **state the different types hand tools used in modular kitchen making**

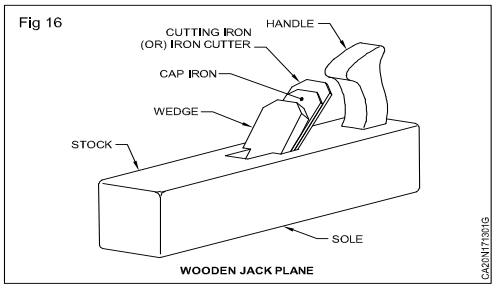
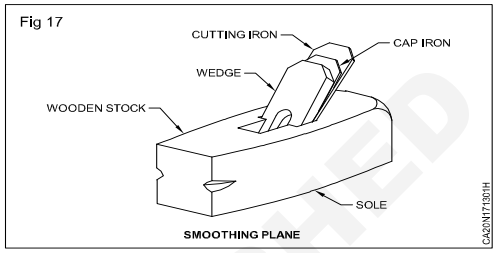
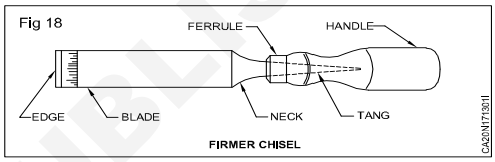
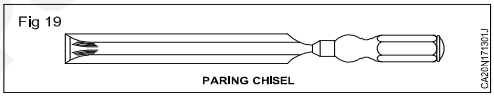
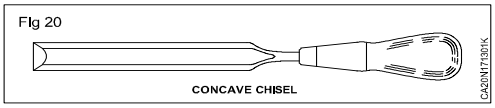
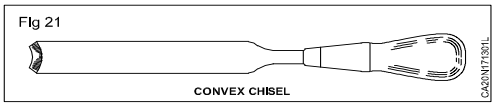
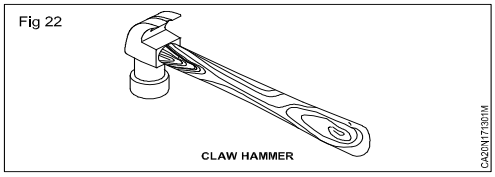
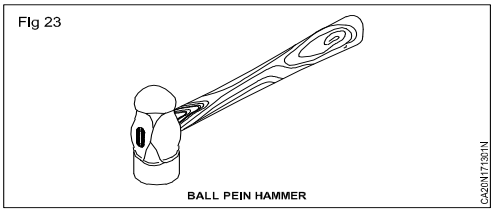
The hand tools used in modular kitchen making are same those used in general carpentry work described in early carpenter lessons except few tools.

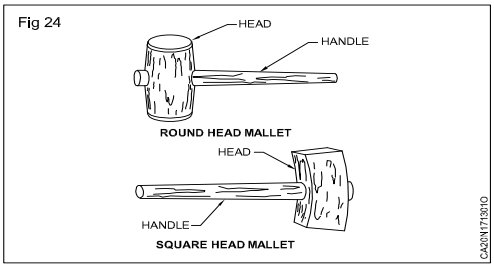
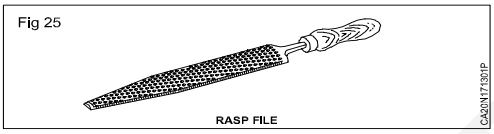
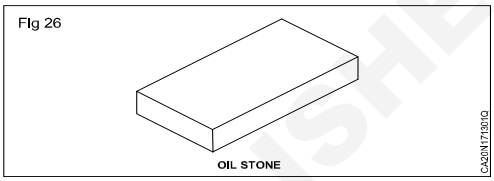
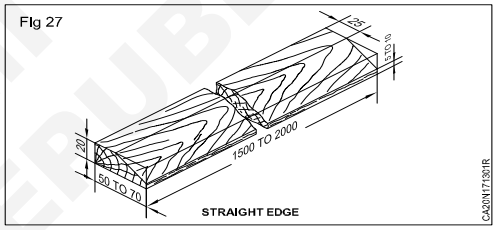
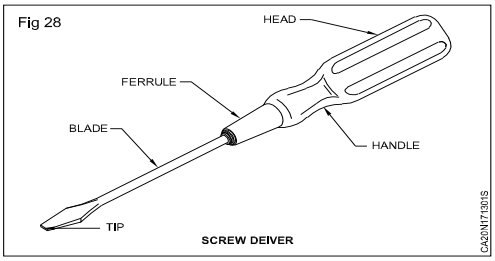
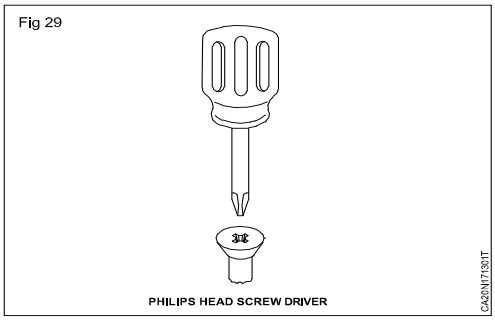
Example: general tools used in the modular kitchen making.

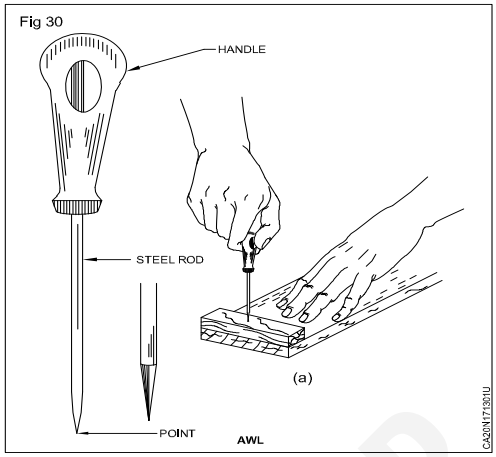
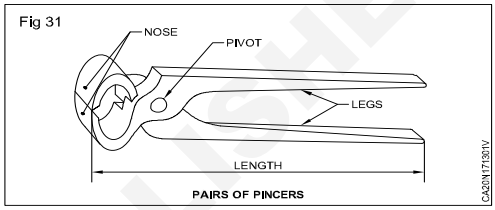
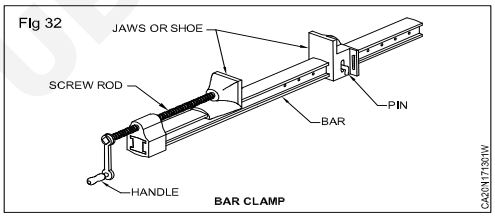
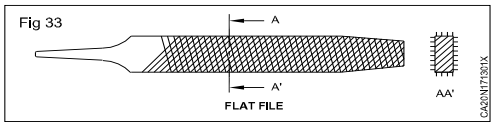
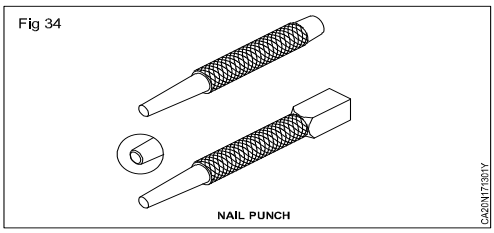
S.No.	Name of the tools and uses	Figures
1	**Measuring tape** • Tape measure are used for longer measurements • Tape measure has a sliding end piece for inside and outside measurements. (Fig 1)	Fig 1  MEASURING TAPE
2	**Marking gauge** Marking gauge is used for marking lines parallel to a face and edge (e.g.) gauging width and thickness. (Fig 2)	Fig 2  MARKING GAUGE
3	**Marking knife** Marking knife is used for marking distances and scribing lines	Fig 3  MARKING KNIFE (OR SCRIBING KNIFE)

S.No.	Name of the tools and uses	Figures
4	**Try and miter square** The try and miter square is also useful for angle 45°,90° and 135°	Fig 4  TRY AND MITRE SQUARE
5	**Wooden try square** The try square fully made of wood. Its handle is slightly heavier than blade. The design of blade is 600mm and width is 50mm. This is used carpentry works building construction works. Large and wide planks are use to scribe, guide as sawing work .	Fig 5  WOODEN TRY SQUARE
6	**Wing compass** Wing compass the setting out arcs of circles To transfer the measurement from measured rule to the job to mark curves.	Fig 6  WING COMPASSES
7	**Callipers** Callipers used for outside measurements are known as outside calipers. The callipers used for internal measurements are known as inside callipers	Fig 7  OUTSIDE INSIDE CALIPER
8	**Try square** Try square is used to check flatness and squareness of surface	Fig 8  TRY SQUARE

S.No.	Name of the tools	Figures
9	**Bench vice** Vice are used for holding work pieces. They are available in different types. The vice used for bench work in the bench vice or called engineer vice.	
10	**Bevel square** The bevel square is used for laying out dove tails, chambers, bevels and transferring angles from the drawing to the work pieces	
11	**'C' Clamp** Holding small joint and wooden gloving purpose	
12	**Spirit level** Spirit level is used to test the perpendicular of walls doors and cabinets	
13	**Hand saw** Hand saw is used for lighter sawing work	
14	**Tenon saw** Tenon saw is rectangular in shape It is used for tiner works like tenon Main use is making short and straight cuts	
15	**Ratchet brace** The brace is used for circular holes are drilled or bored in wood by means of drill. To penetrate into the wooden place it is necessary to use the drill to cut a hole.	

S.No.	Name of the tools	Figures
16	**Jack plane** This plane is used for planning the job to size quickly and truly.	Fig 16  WOODEN JACK PLANE
17	**Smoothing plane** This plan is used when the surface to be planed further to smoothness	Fig 17  SMOOTHING PLANE
18	**Bench firmer chisel** This chisel is used for general chiselling purpose.	Fig 18  FIRMER CHISEL
19	**Paring chisel** It is most suitable for all paring work such as finishing off joints	Fig 19  PARING CHISEL
20	**Gouge chisel (Concave)** This chisel is used for cut curves and hollows works.	Fig 20  CONCAVE CHISEL
21	**Gouge chisel (Convex)** This chisel is used for roughing out and heavy wood removed work	Fig 21  CONVEX CHISEL
22	**Claw hammer** Claw hammer face is used to drive the nails into the wood and other shirking purpose and the claw is used for extracting the nails out of the wood	Fig 22  CLAW HAMMER
23	**Ball pein hammer** This hammer is used for striking purpose it is called as engineers hammer	Fig 23  BALL PEIN HAMMER

S.No.	Name of the tools	Figures
24	**Mallet** Mallet are used for driving wood chisels and assembling and dismantling wooden artical.	
25	**Rasp file** The rasp is used for quick removal of a thick layer of wood	
26	**Oil stone** Oil stone is used for sharpening wood chisels and plane blades	
27	**Straight edge** used for testing the straightness of surface and edges in plane wood. Also used as a guide in using portable power circular saw machine.	
28	**Screw driver** Screw driver are used to tighten or loosen screws in wood working.	
29	**Philips screw driver** These are made with cruciform tips that are unlikely to slip from the matching slots. Used for tighten or loosen philips recess head screws in wood working	

S.No.	Name of the tools	Figures
30	**AWL** AWLs are used for marking or piercing holes in wood	
31	**Pincer** Pincer is used for pulling out and removing nails. It Is also used for cutting wire	
32	**Bar clamp** T - Bar clamp are used for clamping up wide works and large frames	
33	**Flat side** Flat file is used for filing the excess of bonding sun mica	
34	**Nail punch** The nail punch is used along with the hammer to drive the head of nails below the surface of wood and to clench nails that go through to the other side of the board and stick out.	

Modular kitchen making portable power machines

Objectives : At the end of this lesson you shall be able to
- **state the different types of portable power machine**
- **state the use of different types portable power machine in modular kitchen making.**

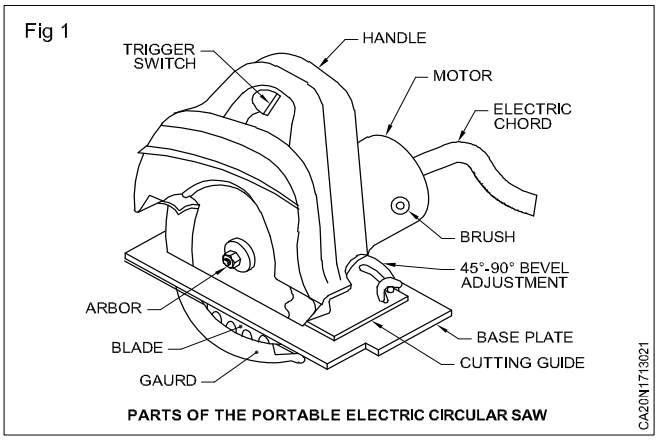
Portable power machine are made different shape and sizes.

They differ from each other in appearance, construction and operation

Types and uses.

The most important portable power machine used in modular kitchen making

Portable power circular saw (Fig 1)



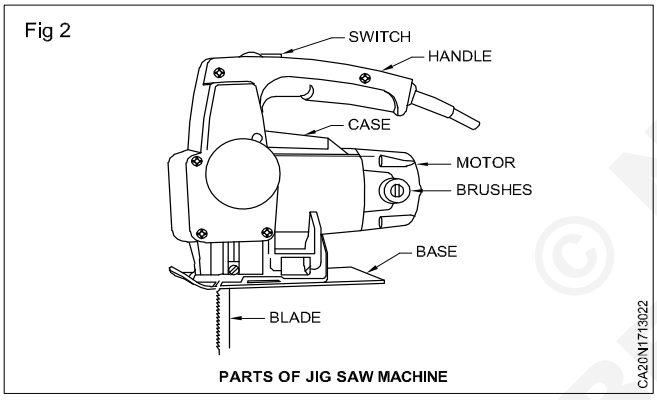
PARTS OF THE PORTABLE ELECTRIC CIRCULAR SAW

It is used extensively in modular kitchen making, modular furniture making and building construction. Works on the site and wood working workshops

This power machine has been improved with the development of built in blade brake.

It is also useful plywood, plank and sun mica cutting, grooves and re bates.

Portable electric jig saw machine (Fig 2)

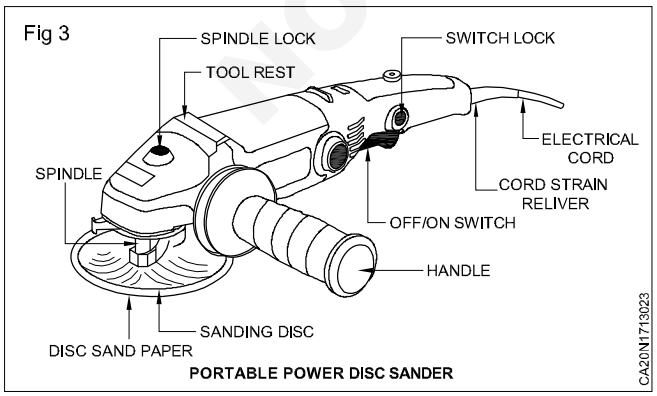


PARTS OF JIG SAW MACHINE

The portable jig saw is a very component machine for cutting wood, composition board veneer, plastics card boards

These broad ranges of possibilities are it is ideal portable electric saw for use in cabinet making shops, modular furniture factories.

Portable power disc sander machine (Fig 3)



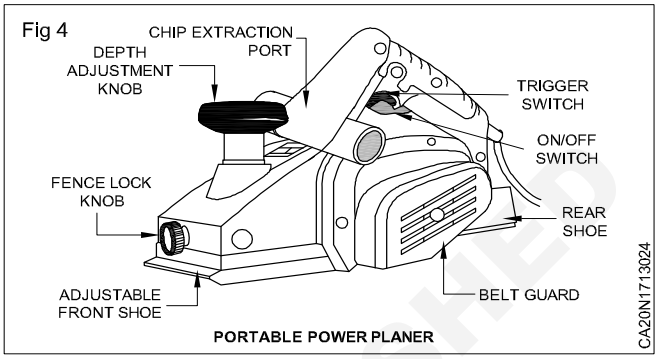
PORTABLE POWER DISC SANDER

Sanding is a general term applied to the smoothing of work using a coated abrasive.

Portable power tool used smoothing, polishing, or cleaning a surface as of wood, plastic, or metal.

Sanders are also used to rough surface in preparation for finishing. It is useful for removing old paint, varnish and polish. Smoothing for groove, curves, convex surface quickly.

Portable power planer machine (Fig 4)

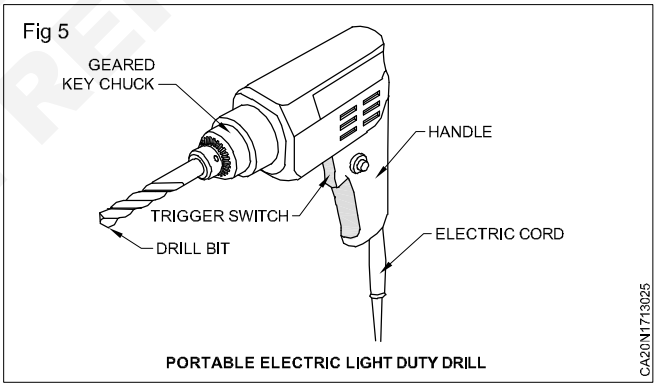


PORTABLE POWER PLANER

The portable power planer used for make sure the surface to be smooth planned in face and edge levelling joists, making stubborn doors close easily and for building projects in your workshop.

It is important that the planer should always be planning in the same direction as the grain of the wood

Portable electric drill light duty (Fig 5)



PORTABLE ELECTRIC LIGHT DUTY DRILL

The portable electric drill is usually the first power tool selected for the home workshop.

These are available in different forms.

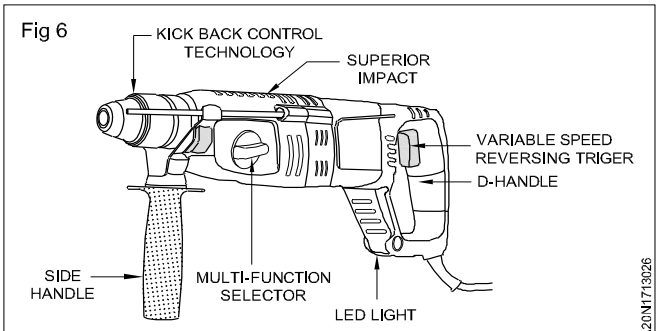
The portable drilling machines are used to drill small holes and are commonly used in the entire work shop this type of drill machine is operated by holding in a hand

Portable power heavy duty hammer drill machine (Fig 6)

Hammer drill is a convenient device to have in your tool box as you can use it for several different applications

These tools are handy and help in carrying out relatively light duty jobs. They are competent to drill holes in concrete, brick, wood, stone, and other hard materials.

Fig 6

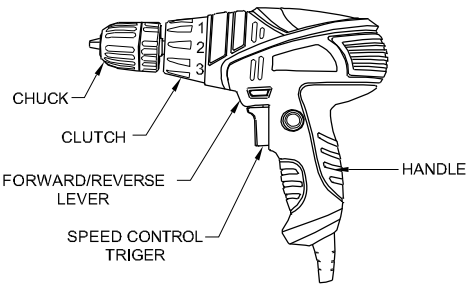


PORTABLE POWER HAMMER DRILL MACHINE

Hammer drill machine uses a standard drill chuck and round shank bits it can be used in the drill only mode to penetrate wood and metal as well as in the hammer and drill mode to penetrate concrete and brick.

Portable Electric screw driver (Fig 7)

Fig 7



ELECTRIC SCREW DRIVER

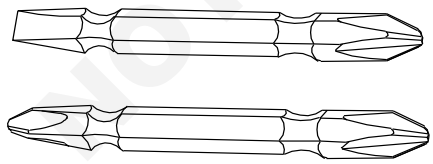
Electric screw driver is a portable electric driver that allows you to screw and unscrew effortlessly. The head of the screw driver is equipped with a bit holder which can be magnetic or have a quick release system. The bit holder allows you to quickly insert the bit that corresponds to the screw head.

Electric screw drivers also come with reverse action to remove screws if needed. Torque control on electric screw drivers it is possible to change the rotating force (known as torque) for more control bigger, heavier screws often read more force behind them than smaller lighter ones.

Pull the caller toward body of the screw driver with your fingers hold it against the front of the screw driver. This releases the bit pull the bit out of the screw driver.

Screw driver bit (Fig 8)

Fig 8



PHILIPS SCREW DRIVE DRILLBITS

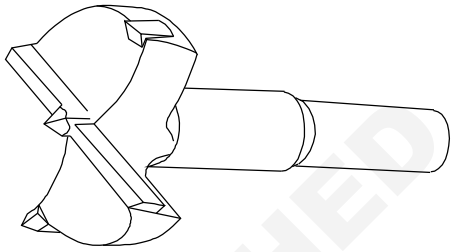
Screw driver bits are generally tools that are attached to the tip of an electric drill, pneumatic drill, or the like the tip is of a shape that fits the groove in the head of the screw drivers with flat tip are called flathead screw drivers and those with a cross - head (Philips head screw) screw drivers.

Wood hinge boring tool bit (Fig 9)

Wood boring tool bit made from I hardened steel is used for perforation/boring of wood products installation of spherical door knobs drawers' splint and frameless hinge etc. This hinge boring bit is specialized in drilling clean holes in soft and hard wood you can drill flat bottomed holes.

Two spurs and cantering point to give the perfect solution to repeated, clean and accurate hole cutting time after time. The sharp centre of your hole should be used with power drilling machine.

Fig 9



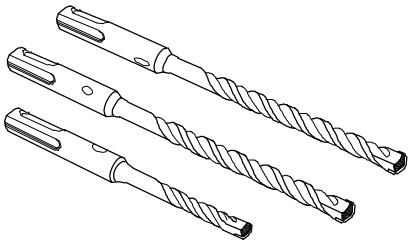
WOOD BORING TOOL BIT

Hammer drill bit (Fig 10)

Hammer drills are not typically used for production construction drilling but rather for occasional drilling of holes into concrete masonry or stone.

They are also used to drill holes in concrete footings to pin concrete wall forms and to drill holes in concrete floors to pin wall framing.

Fig 10



HAMMER DRILL BITS

A hammer drill uses a particular type of drill bit designed specifically for these tough materials.

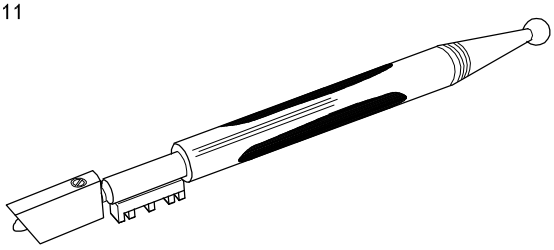
Diamond tipped glass cutter (Fig 11)

This cutter high quality diamond tipped glass cutter with wooden handle

This glass cutter is for cutting glass, mirrors and other types of glass

- Cutting thickness 3 - 10mm

Fig 11

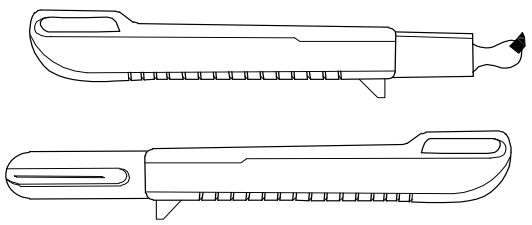


GLASS CUTTER

Sunmica cutter (Fig 12)

- This cutter made of stainless steel, plastic handle
- This cutter is used for sun mica sheet cutting
- Cutting gauge = 15 sheet
- Blade width = 2mm
- Blade length = 15 cm

Fig 12



SUNMICA CUTTER

CA20N171302C

Modular kitchen allocation or plan (layout)

Objectives : At the end of this lesson you shall be able to
- **state the meaning of modular kitchen layout**
- **state the advantages of modular kitchen layout.**

Allocation or plan (Layout)

- The first step on getting your dream modular kitchen is measuring your space
- This is a determinate for modular kitchen designs and price
- Layout is a full scale drawing with complete details of modular kitchen including for.
- Counter top materials
- Cabinet materials
- Cabinet finish
- Kinds of storage
- Colour scheme
- Electrical and plumbing concerns
- Hardware

The construction modular kitchen consist of two different stages first stage is to prepare a layout including sawing, planning and bonding allowance as per the dimension given in drawing

The second stage is to shape the different units (Base unit and wall unit) of modular kitchen

The layout preparation is consist of measuring marking and assembling all the dimensions on layout including all the allowances

Draw the working drawing carefully

Advantages of modular kitchen layout

- List the required material to prepare the modular kitchen
- Method of construction of modular kitchen becomes known as on seeing the layout
- Locate base unit, wall unit are clear and understand able
- Decides the type of modular kitchen
- Easy to prepare the modular kitchen cabinet
- Avoid mistake in construction of cabinet and save the materials
- Saves money
- Saves time
- Decide type of joints
- It becomes easy for the modular kitchen maker to make the cabinet
- It is useful in subsequent checking of the modular kitchen
- Minimise the cost of cabinet
- Calculation of the cost of modular kitchen become easier
- Chances of erring in construction of modular kitchen are much reduced.

Characteristics and applications of different modular kitchen material

Objectives : At the end of this lesson you shall be able to
- **state the characteristics of different modular kitchen material**
- **state the applications of different modular kitchen material.**

There are different types of modular kitchen material is used in constructing a modular kitchen.

Modular kitchen material	Characteristics	Application
BWP Plywood (Boiling water proof plywood)	• Can be cut into different shapes and patterns easily • Uniform thickness and flat surface • It is resistant to water • Extremely durable • This material not rot or crack with age • Easier to work	• The plywood is extensively used in modular kitchen, paneling and interiors external cladding and flooring. • Good for the fabrication of any kind of furniture or its part • It can be polished and laminated with ease to give a smooth finish • Plywood is relatively more economical than its counter parts. • Less than half the cost of solid wood • Labour cost will be reduced the work is completed in less time.
Medium - Density fibre board MDF	• Extremely dense and sturdy • MDF does not expand or contract or heat and humidity exposures: unlike solid wood • Hold on to the glue firmly and allows the veneers to be attached to it easily • It does not have knots that can make the paint look untidy or make it difficult for the components to attached • Good sustainability • Small amount of formaldehyde might be left on the surface which is harmful. • Weather - resistance • Lot of care • It does not hold the screw very well.	• The dimensions are stable and can be shaped into elaborate designs in a more feasible way than solid wood • It takes paint finely and looks smooth • An eco-friendly modular kitchen would be just perfect for every house • MDF Synthetic building material mostly use for kitchen cabinets and bathroom
High - density fibre board (HDF)	• HDF has a higher density them MDF • Versatile building material • Remains known for its durability and affordability • This does not have any splinters or voids • It is consistent trough out • It is easy cut boards with jig saw or any other instrument without tearing it out or splintering it	• Suitable for bathroom and kitchen cabinets and shelves • Making for furniture, flooring, decorative, items, doors and their frames etc. • This is more cost effective than solid wood • This can get a lavish modular kitchen on a minimum budget • It is easier to paint too

Modular kitchen material	Characteristics	Application
	• It absorbs liquid (water) easily and swells up • It has the least water resistance when compared to plywood, MDF or other any cabinet kitchen material. • High density • More weight	
Solid wood	• It has wood fibres all through out • It comes many shades • It suits every colour scheme • Storage and durable • It does not break down easily • It lasts for decades • Too much moisture • Very expensive • Take a lot of time to grow • Inconsistent grains	• It is natural wood without any artificial infiltrations • It is used for kitchen cabinet material and flooring material (Furniture) • Solid wood kitchen cabinet has extremely high aesthetic appeal • It looks elegant and gives a contemporary look to the modular kitchen • Most household furniture made out of solid wood is passed down from one generation to another.
High - pressure laminates (HPL)	• Highly durable • This is protective layer that makes it immune to strong impacts and scratches • The material brightness, smoothness and glow of the furniture remain retained for extended period of time • Most hygienic • Heat exposure	• Application area kitchen cabinets and table tops, counter top, flooring and furniture etc • Used for decorative purpose
Stainless steel	• Highly durable • Low maintenance • Eases to clean • Sleek design • It can be prone to fingerprints scratches and smudges • Limited design options	• Common applications areas kitchen industry kitchen accessories, kitchen furniture kitchen cookware moreover, appliances like refrigerators, counter tops, dish washers and freezers etc • Used for minimum space and gives you sample storage.
Chip board	• Low density • Rich look • Cheaper than MDF or plywood • Extremely smooth • Flat surface • Do not distort or dent easily • Environmentally friendly • Lower strength than other fibre boards • Damage easily possible • It does not support heavy weight • Moisture causes expansion and warping	• Application area kitchen cabinets kitchen work tops, flooring furniture etc. • Used in kitchen furniture

Modular kitchen assemble procedure

Objective: At the end of this lesson you shall be able to
- **state the modular kitchen assembly procedure.**

Assemble procedure

Customers just keep in mind that installation and assembles must be done by professional trainer then assembling of the kitchen to good appearance

Installation assembles method 1 direct wall mounting

- Take note of all utilities connections if installing base cabinets
- Draw lines using a spirit level for your cabinets on the wall
- Mark the location of the drill hole to make hold on your base cabinets
- Draw the outlines of your cabinets on the wall.
- Make the hole on the wall and using fastener
- Fixing the base unit cabinets on the wall
- Check their base unit alignment and then tighten them into place
- Repeat this process for the fixing wall unit cabinet

Installation and assembly - Method 2

Suspension rail mounting

- Take note of all connections if installing base cabinets
- Draw lines using a spirit level for where your suspension rails will go.
- Mark the location of the studs on your suspension rail lines.
- Draw the outlines of your cabinets on the wall.
- Putting up the suspension rails
- Cut the rails to the length you need using a hacksaw
- Fasten your base rail to the wall using a heavy-duty fastener.
- Use shims to make the rail flush with the wall if it is uneven.
- Check to make sure the rail is level.
- Repeat this process for the upper rail.
- Fixing the cabinets to the walls
- Make openings for utility connections if necessary.
- Then hang the upper corner cabinet on the suspension rail.
- Finally, hang the remaining upper cabinets on the suspension rail.
- Check their alignment and then tighten the screws.
- Fasten the upper cabinets together if applicable.
- Hang the corner base cabinet.
- Hang the remaining base cabinets.
- Check their alignment, and then tighten them into place.
- Fasten the base cabinets together if applicable.

Note: Work with a helper throughout the process to make everything easier.

Application of modular kitchen accessories and hardware's and different types of timber

Objectives : At the end of this lesson you shall be able to
- **state the application of modular kitchen accessories**
- **state the application of modular kitchen hardware.**

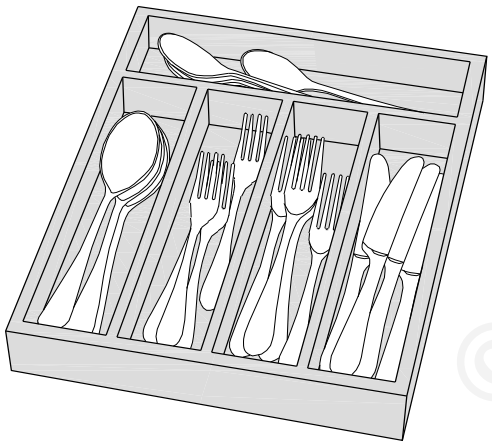
Modular kitchen accessories

- Modular kitchen accessories play an important role in enhancing the functionality and efficiency of the kitchen.
- The main advantage of these accessories is that they enhance the storage capacity.

Cutlery organise (Fig 1)

- Cutlery organise used for keeping smaller items like forks, spoons, tongs, spatulas and knives.

Fig 1



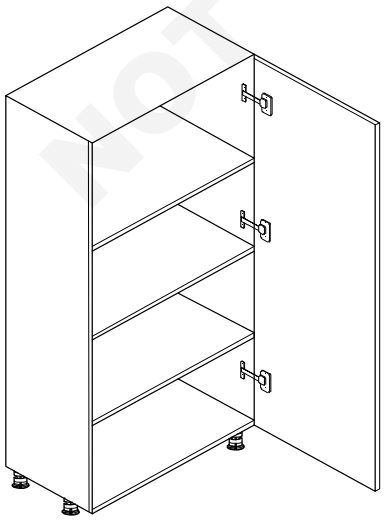
CUTLERY ORGANISE

CA20N1713411

Tall unit (Fig 2)

- Tall unit provides ample storage space and is perfect for storing. dry groceries, non-perishable kitchen ingredients and bulky utensils.

Fig 2

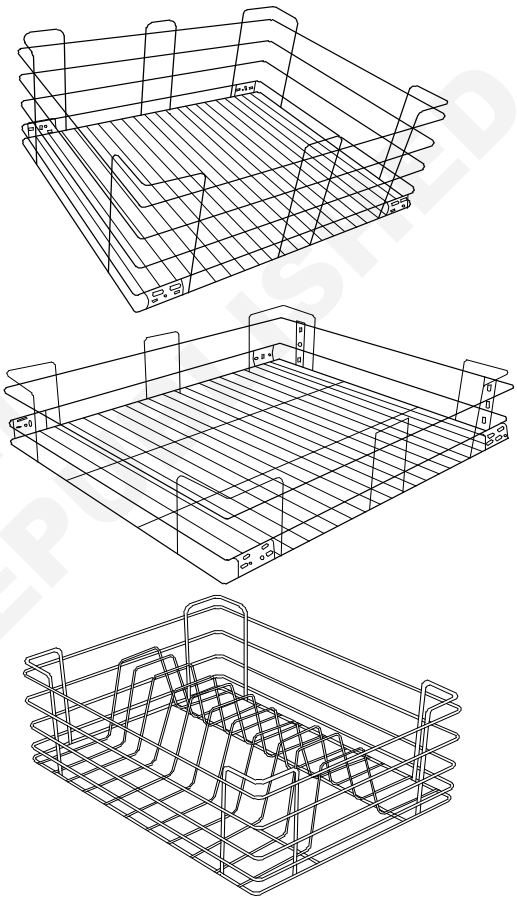


TALL UNIT

CA20N1713412

Kitchen basket (Fig 3)

Fig 3



BASKETS

CA20N1713413

- Kitchen basket one of the best ways of organise your utensils, pots, pans and jars
- It is available in different size which makes them perfect for deep and shallow storage.
- It is most popular kitchen baskets include cup and saucer baskets, utensil basket and plate racks.

Corner solutions (Fig 4)

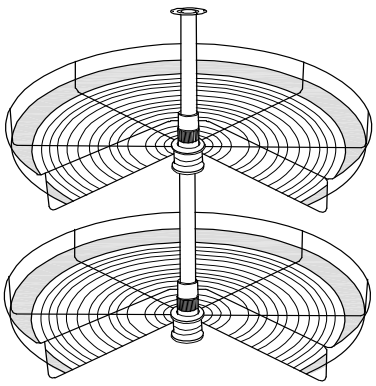
- Corner solution used for the hard - to reach corners of L - shaped and U - shaped kitchens so that they are easy to access

Bottle pulls outs (Fig 5)

- The bottle pullouts are narrow in width and comprise two or three shelves.

- It is can be used for storing cooking essentials like cooking oil, bottles, cans, suices and different types of sauces

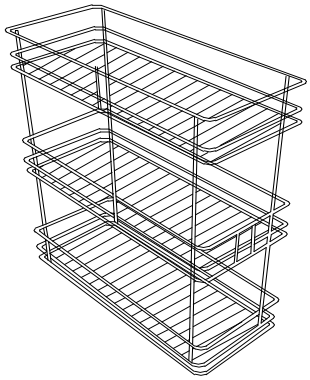
Fig 4



CORNER SOLUTIONS

CA20N1713414

Fig 5

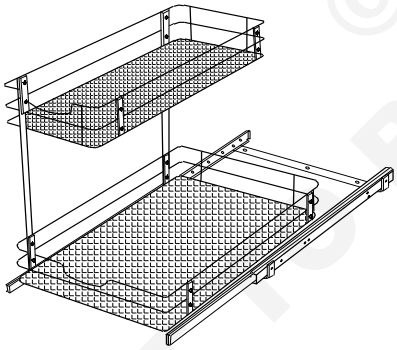


BOTTLE PULL OUT

CA20N1713415

Under - sink units (Fig 6)

Fig 6



UNDER SINK UNIT

CA20N1713416

- Since the area under the sink is usually under - utilized an under - sink unit for storing the kitchen cleaning supplies could be ideal.

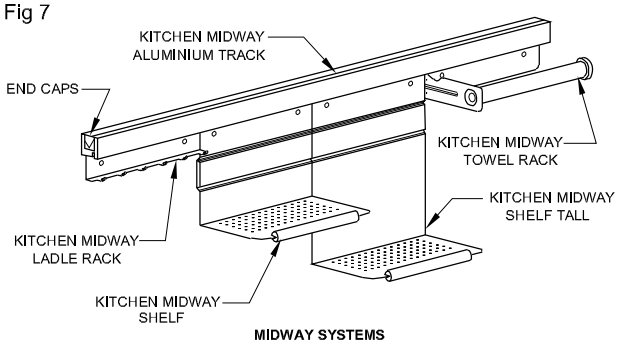
Midway systems (Fig 7)

- It is used for hanging glass holding hanging cup and saucer holder or a hanging multipurpose rack

Kitchen hardware

- The kitchen hardware holds signification weight towards shaping the design of the room. From doorknobs (or) cabinet handles elegant kitchen hardware polishes the room with subtle details. There are many factors to consider when selecting the finish and design of your kitchen hardware

Fig 7

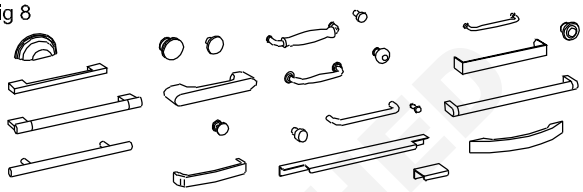


MIDWAY SYSTEMS

CA20N1713417

Handles and knobs (Fig 8)

Fig 8

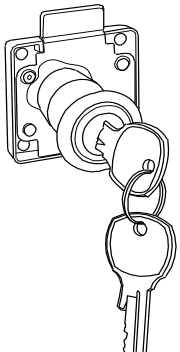


CA20N1713418

- There are many different uses for cabinet handles and knobs these are required kitchen cabinets and drawers, pantries, dressers and any other small storage areas in your home.
- They are secured by screw through the door or drawer front.

Multipurpose lock (Fig 9)

Fig 9



MULTI PURPOSE LOCK

CA20N1713419

- The lock used for drawers wardrobes cabinet and cupboard this made of mild steel with nickel plated

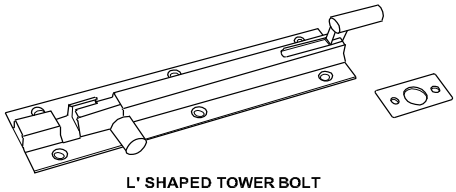
Tower bolt (Fig 10)

- It is mostly made of mild steel brass aluminium and stainless steel.
- It is commonly used for cupboard door in side top and bottom vertical of the door edge for security reasons these types should be attached with screws.

Magnetic door catch (Fig 11)

- It is used for cupboard and cabinet door
- It is consists of a strong permanent magnetic in a case attached to the cabinet wall and a steel plate fixed to the door in side.

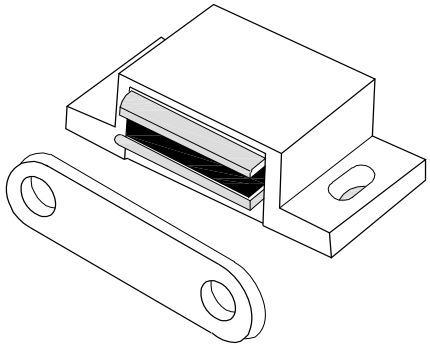
Fig 10



L' SHAPED TOWER BOLT

CA20N171341A

Fig 11



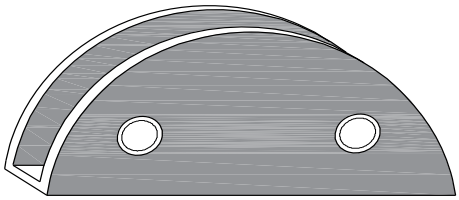
MAGNETIC DOOR CATCH

CA20N171341B

Glass fitting bracket (Fig 12)

- They are used for fixing glass in side cabinet (or) cup board middle.

Fig 12



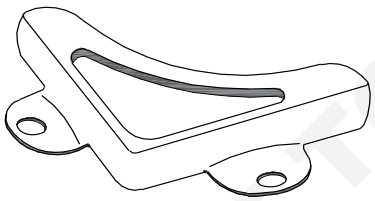
GLASS FITTING BRACKET

CA20N171341C

Glass corner fitting (Fig 13)

- It is used for size glass in the cabinet, wardrobe door frame.
- Easy to fit.

Fig 13



GLASS CORNER FITTING

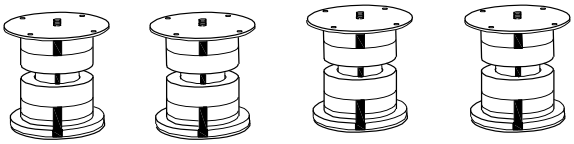
CA20N171341D

- To be used with 4mm to 6mm glass.

Metal furniture leg (Fig 14)

- It is used for fix leg in the cabinet wardrobe and sofa base
- Easy to fit
- Good appearance

Fig 14



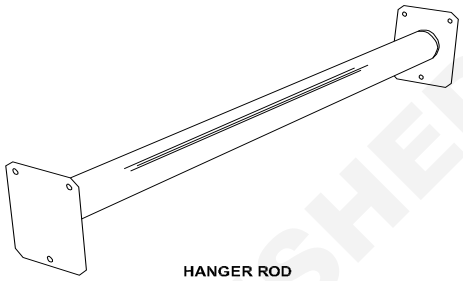
METAL LEG

CA20N171341E

Hanging rod (Fig 15)

- It is mostly made of mild steel aluminium and stainless steel
- It is commonly used for cupboard, wardrobe and showcase. These type should be attached with screw.

Fig 15



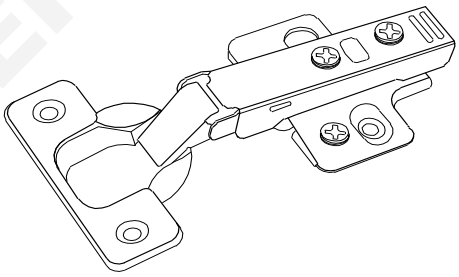
HANGER ROD

CA20N171341F

European or frameless hinge (Fig 16)

- The most popular choice for full overlay and unset doors although they are usable on face - frame cabinets as well
- It is installation very easily adjust align and level cabinet doors.

Fig 16

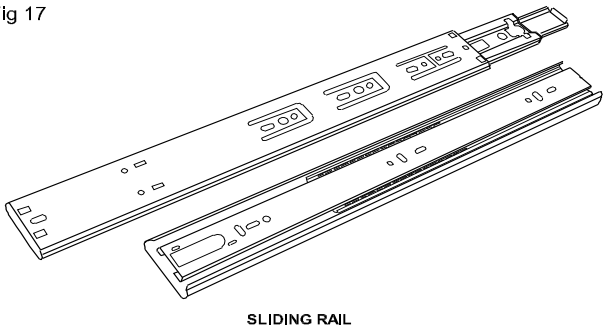


EUROPEAN FRAMELESS HINGES

CA20N171341G

Sliding rail (Fig 17)

Fig 17



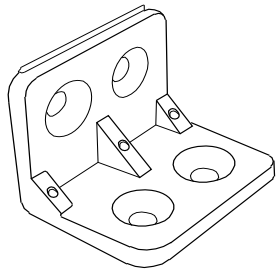
SLIDING RAIL

CA20N171341H

- The cabinet slides work by reducing friction that drawers can slide into and out of the furniture in which they are installed
- Installing a drawer directly into a piece of furniture won't work. Even if you still able to open and close the drawer doing so will create friction

"L" Bracket (Fig 18)

Fig 18



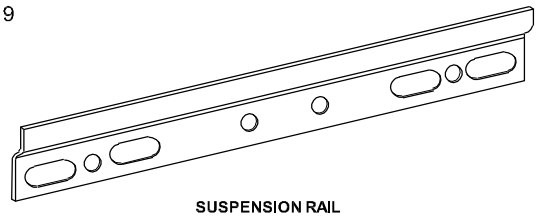
"L" BRACKET

CA20N1713411

- It is mostly used in fix the partition cabinet and wardrobe
- It is used in most place there are 90° bends in wooden
- It is mostly made of mild steel, aluminium and P.V.C

Suspension Rail (Fig 12): The rail makes it easy to mount your wall cabinets to the well. You can cut the rails or combine several to the desired length.

Fig 19



SUSPENSION RAIL

CA20N1713412

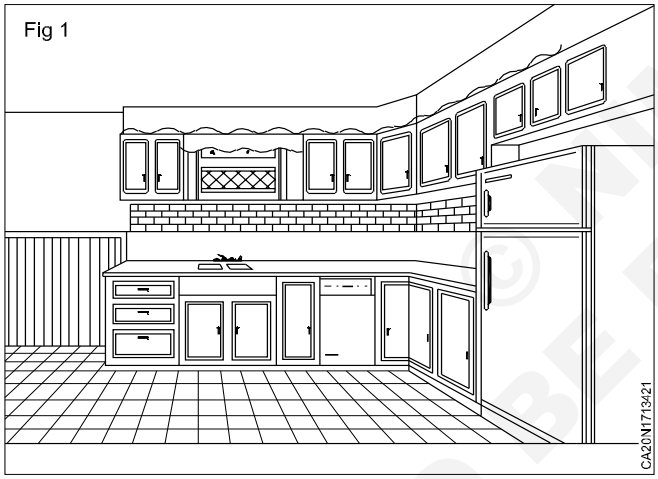
The rails have many holes so there is always a hole over a wall stud. You can adjust the wall cabinets horizantally before you look them in place on the rail.

Different types of timber used in modular kitchen

Objectives : At the end of this lesson you shall be able to
- **state the different types of timber used in modular kitchen construction.**

The main and common Indian varieties of timber used for making kitchen cabinet are (Fig 1)

Fig 1



CA20N1713421

Teak

- It is available in southern India
- It is in straight grains
- Lighter in weight strong and durable
- Easy to shape
- Dark in colour and has less tendency to break and warp
- It is a valuable timber the cost of material is more than other wood
- More suitable for making cabinets and furniture etc.

Pine

- It is generally used for in the construction of cabinet making furniture and doors and windows.
- It is cheapest and easiest hardwood
- Lighter in weight
- Easy to work
- It is adds rustic look to kitchen cabinet

Oak

- It is most common wood for kitchen cabinets
- It is easy to find
- It is fairly cheap and durable
- It takes paints and stains well

Hickory

- It is most durable
- It is also has a decently wide colour range.
- It is generally hard wood
- No cracks or moisture in the cabinet made of it

Cherry

- Cherry cabinets are cool because the more sun it gets the darker the wood turns
- It is durable
- Eases to work
- More expensive

Maple

- It is one of the best woods for kitchen cabinets
- This wood grains show up beautifully through paints and stains
- along with this beauty comes durability
- Higher in price

Kail

- It is an ever - green tree
- It is closely grained hard and durable
- It is soft and light
- It is generally used for cabinet making and furniture

Types of modular kitchen dressing (Finishing)

Objectives : At the end of this lesson you shall be able to
- **state the different type of kitchen cabinet finishing.**

Job Finishing

Finish refers to the final application colour or lamination that gives a cabinetry and modular furniture run its finalized appearance.

The finish on kitchen cabinets, furniture can be made by gluing and a finishing. layer of laminate to the wood used to construct it.

There are different methods for achieving different styles of finish to suit the desired texture and seen at any project.

Types of Finishing

- Painted
- Natural polish
- Laminates (sunmica)
- Veneer
- Lacquerpolish.
- Acrylic kitchen cabinets
- Glozed polish

Painted Finish

- A painted finish conceals all of the defects seen in wood grain.
- Apply the paint in flat surface to conceal the grain.
- Paint colours may enhance the appearance of the grains bringing it into prominence and attracting the views attention.
- Advantage of painting cabinets, furniture is the amount of control it gives you every other choice. You make in your kitchen as a result.

Natural polish Finish

- The natural polish appearance keeps things simple and does not hamper the beauty at the wood.
- Natural finishes are generally considered to be long-lasting.
- It is crucial to realise the certain woods are more durable then others.

Laminates Finish

- Laminate finish for the kitchen is a cost - effective and durable option.
- Laminate is an excellent choice.
- The laminate is hot-pressed in a machine (or) hand to remove air and bubbles from the shutters to prevent sharp corners in a modular kitchen and modular furniture.
- Laminates for the kitchen have two finishes to choose.
- One is a high gloss finish, and matte finish.
- Kitchen laminate sheets is very effective in concealing dents and defects and the evidence of wear and tear that may be seen on other types of cabinet finishes.

Veneer Finish

- Veneer are highly similar to laminates.
- Veneers are made of wood.
- Veneer finishes have a more natural wood appearance.

Lacquer Polish finish

- Lacquer layer has dried the cabinets will have a firm, non-porous surface, making them impervious to stains and grease .
- Cleaning your cabinets is made simpler as a result of this resistance.
- Advantage to employing a lacquer coat is that they are simple to clean.
- The surfaces are simple to clean and retain their lustre for an extended period.

Acrylic kitchen cabinets

- Acrylic finish comparable to lacquer in that it is non-toxic, shiny, and high gloss in appearance.
- It is acrylic modular kitchen a smooth look.
- It is available in various colours, and will give your kitchen cabinets a mirror-like impression when installed.
- Acrylic kitchen cabinets are a high-gloss alternative closer for high-end kitchens because of their premium appearance.
- Resistant acrylic coatings smooth and glossy look does not tarnish, determinate, or fade away with time.
- Instead they retain their original soft and polished appearance.

Glazed finish

- This kind of finish is most appropriate when the designer attempts to achieve a rustic impression.
- The most significant advantage of a glazed finish is the additional depth and intrigue.

Application of sunmica in different colour contrast in modular kitchen

Objectives: At the end of this lesson you shall be able to
- **state the application of sunmica colour combination.**

Sunmica: Sunmica is basically a decorative laminate that used over the furniture.

It is made by mixing resins with layers of paper and used as a finish for different surface like plywood and MDF.

Sunmica is available in an amazing range of colours and can be used for doors, cabinets table tops, wardrobes and wall panels etc.

There are various ways to mix and match the colours at laminates from whites, greys, browns even reds, greens and blues purple, pink etc.

They come in a wide variety of finishes.

Best sunmica combinations for home decorative

Modular kitchen colour combination	Application
Bright yellow and white colour sunmica	• Make kitchen look fresh
Wood sunmica colour and white sunmica combinations	• The combination of sunmica lend on earthy-yet-elegant appeal to the kitchen
Blue and cream sunmica colours	• The combination can make any kitchen look impressive
Red and grey sunmica	• lluminating the kitchen with fancy light fixtures and decorative metal handles
Green and brown sunmica colours	• Green and brown have made a huge come back in sunmica too with their close-to-nature feel
	• The soft pastel shades give the green colour kitchen a contemporary look
	• Green kitchen units instantly brighten up the kitchen area
Floral designed sunmica and plain sunmica	• Floral designed sunmica can add instant freshness to any kitchen decor
	• It instantly lends a cheery vide to the room interior
Granite looking sunmica with granite counter top	• The granite looking sunmica cabinets are apt to go with granite plat forms
	• Accentuate the kitchen with warm lights to make it more stylish
Black and white sunmica colours	• Black and white is a popular classic colour combination for kitchen sunmica
	• Black and white kitchens work great with open shelving too
Grey and yellow	• Grey and yellow sunmica is a harmonius combination for a bed room wardrobe.
	• This will make you bedroom space look livelier
Midnight blue and mustard yellow sunmica	• Design the wardrobe doors with horizontal bands of blue and yellow shade help to create the visual impression of a wider space

Wardrobe sunmica colour combination	Application
Earthy browns and beige	• Sunmica in neutral tones is sooting and attractive. • It is bedrooms is mostly or in any neutral shade, go for a two–colour. Sunmica combination for the wardrobe. • It is use same combination for the bedside table and dresser.
Mauve and off white colour	• Mauve is in trend in modern bedroom designs • Mauve goes well with creamy off-white to make an elegant and luxurious sunmica pairing • For the wardrobe stick to the abc tones and the subtile of mauve to create a sophisticated interior
Green and white sunmica colour	• The white sunmica colour it used in balanced combination with green sunmica, creates or airy feeling in the room

Bedroom sunmica colour combination	Application
White and red colour	• It is use crimson red sunmica to highlight the borders of the gloosy white. Wardrobe and add introduce bright cherry hue in burst with a luxurious red bed

Master bed room sunmica combination	Application
Shades of peach in two tones	• Peach sunmica is certainly one of the most sought – after shades for contemporary bedroom wardrobe designs as it helps in relaxation

Kids room sunmica combination	Application
Pink and white sunmica colour	• The combination is used for cupboards in the kids rooms • A tranquil effect use more white and add a touch of high gloss pink lamination in combination

Main door sunmica combination	Application
Brown and white sunmica colour	• Design the main door with sunmica combining colours such as brown and white • It is can create a unique pattern to complement the overall main doors visual appeal.

TV cabinet – wall designs sunmica combication	Application
Brown or black and white sunmica	• Mix and maton TV unit designs with colour steme at your sofa set to give your room a cohesive look. • These decorative sunmica sheets can be combined for two colour sunmica combinationsfor well panels and TV units, to elevate the aesthetic appeal.

General safety in fitting shop marking and cutting tools

Objectives: At the end of this lesson you shall be able to
- **list the general safety precautions to be observed in fitting shop.**

General safety in fitting shop

- Keep the floor and gang ways clean and clear.
- Move with care in the work shop, do not run.
- Use the correct tools for the job.
- Keep the tools at their proper place.
- Wipe out split oil immediately
- Sweep away the metal cuttings
- Keep a suitable fire extinguisher near by at all times. Ensure the fire extinguisher is in operable condition.
- Do not use blunt scriber
- Place a cork on the point when not in use to precent accidents.
- Do not use with out handle hack saw frame.
- Tight the hack saw blade with correct tension
- While selecting blades, make sure atleast two teeth of the blades will be in contact with the work at all times.
- Don't use the file without handle
- Don't use the file as lever
- Don't use the mushroom head chisel while chipping
- Do not use oil or grease surfaced hammer while chipping
- Use correct punch for punching witness marks.
- Use always sharp pointed punch.

Marking tools

Engineer's steel rule

Objectives: At the end of this lesson you shall be able to
- **State the constructional features of an engineer's steel rule**
- **State the use of steel rule**

When dimensions are given in a drawing without any indication about the tolerance, it has to be assumed that measurements are to be made with a steel rule.

Steel rules are made of spring steel or stainless steel.

The edges are accurately ground to form straight edges.

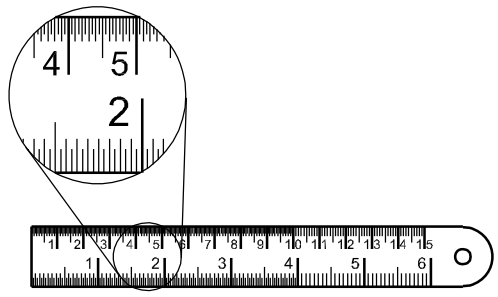
The surface of the steel rule is satin-chrome finished to reduce glare, and to prevent rusting.

Sizes of steel rules: Steel rules are available in different lengths, the common sizes being 150 mm, 300 mm and 600 mm.

The engineer's steel rule is graduated in 10 mm, 5 mm, 1 mm and 0.5 mm.

The accuracy of steel rule is 0.5 mm. (Fig 1)

Fig 1



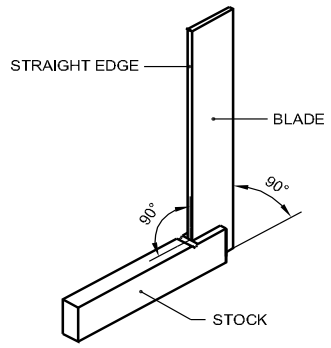
Try square

objectives: At the end of this lesson you shall be able to
- **name the parts of a try square**
- **State the uses of a try square**

The try square is a precision instrument which is used to check squareness (angles of 90°) of a surface.

The accuracy of measurement by a try square is about 0.002 mm per 10 mm length, which is accurate enough for most workshop purposes. The try square has a blade with parallel surfaces. The blade is fixed to the stock at 90°. (Fig 1)

Fig 1



USES

The try square is used

- To check the squareness of machined or filed surfaces
- Check flatness of surfaces
- Mark lines at 90° to the edges of work pieces.

Scriber

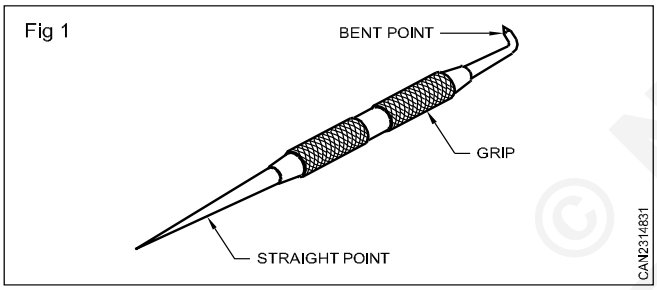
Objectives: At the end of this lesson you shall be able to
- **State the features of scribers**
- **State the uses of scribers**

In layout work, it is necessary to scribe lines to indicate the dimensions of work pieces to be filed or machined.

The scriber is a tool used for this purpose. It is made of high carbon steel which is hardened. For drawing clear and sharp lines, a fine point is ground at one end.

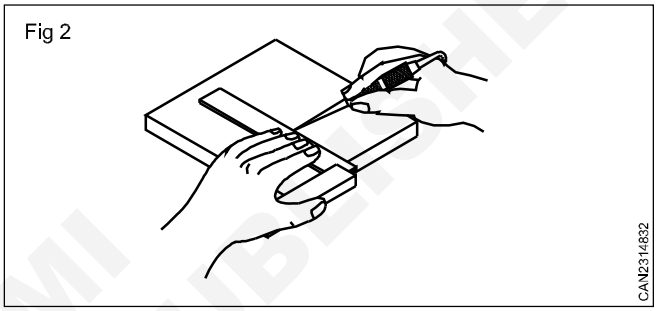
Scribers are available in different shapes and sizes. The one most commonly used in the plain scriber. (Fig 1)

Fig 1



While scribing lines, the scriber is used like a pencil so that the lines drawn are close to the straight edge. (Fig 2)

Fig 2



The point of the scriber should be ground and honed frequently for maintaining its sharpness.

Scriber points are very sharp, and they are to be handled very carefully. Do not put the scriber in your pocket. Place a cork on the point when not in use to prevent accidents.

Dividers

Objectives: At the end of this lesson you shall be able to
- **identify the parts of a divider**
- **state the uses of dividers**
- **state the specifications of dividers**
- **state the important aspects to be considered in respect of divider points.**

Dividers are used for scribing circles, arcs and transferring and stepping of distances. (Figs 1, 2 and 3).

Dividers are available with firm joints and spring joints. The measurements are set on the dividers with a steel rule. (Fig 4).

The sizes of dividers range between 50mm to 200mm. The distance from the point to the centre of the fulcrum roller (pivot) is the size of the divider. (Fig 5)

For the correct location and seating of the divider legs, prick punch marks of 30° are used. (Fig 6)

Fig 1 Fig 2

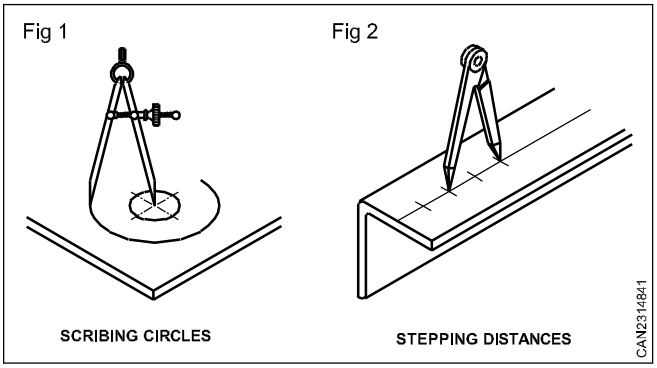


Fig 3

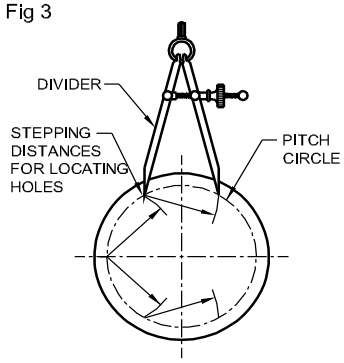
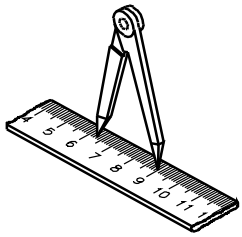


Fig 4



CAN2314843

Both the legs of the divider should always be of equal length.

Dividers are specified by the type of their joints and length.

The divider point should be kept sharp in order to produce fine lines. Frequent sharpening with an oil stone is better than sharpening by grinding. Sharpening by grinding will make the points soft.

Do not sharpen the divider points on grinding wheels.

Fig 5

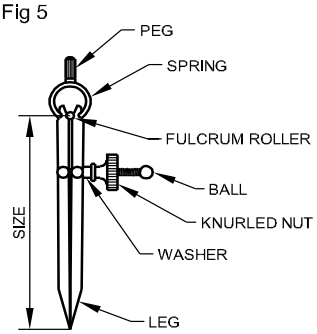
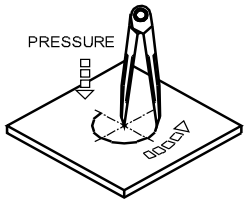


Fig 6



CAN2314842

Calipers

Objectives: At the end of this lesson you shall be able to
- **name the commonly used calipers**
- **state the advantages of spring joint calipers.**

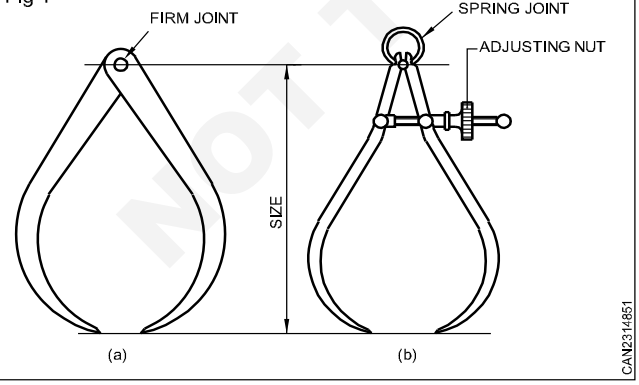
Calipers are indirect measuring instruments used for transferring measurements from a steel rule to a job, and vice versa.

Calipers are classified according to their joints and their legs.

Joint

- Firm joint calipers (Fig 1)
- Spring joint calipers (Fig 2)

Fig 1

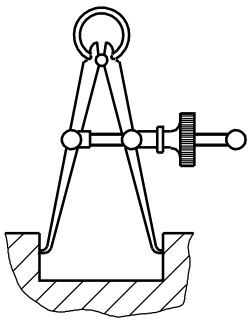


CAN2314851

Uses

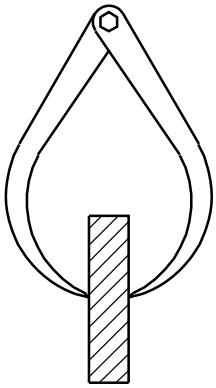
- Inside caliper for internal measurement.
- Outside caliper for external measurement.

Fig 2



CAN2314852

Fig 3



CAN2314853

Calipers are used along with steel rules, and the accuracy is limited to 0.5 mm; parallelism of jobs etc. can be checked with higher accuracy by using calipers with sensitive feel.

Spring joint calipers have the advantage of quick setting with the help of an adjusting nut. For setting a firm joint caliper, tap the leg lightly on a wooden surface.

Types of marking punches

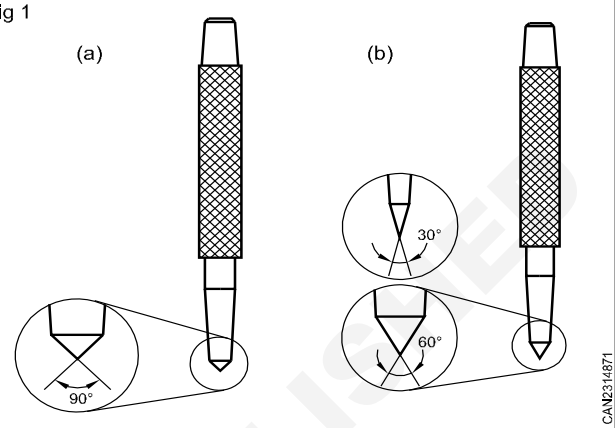
Objectives: At the end of this lesson you shall be able to
- **name the different punches in marking**
- **state the features of each punch and its uses.**

Punches are used in order to make certain dimensional features of the layout permanent. There are two types of punches. They are centre punch and prick punch made of high carbon steel, hardened and ground.

Centre Punch: The angle of the point is 90° in a centre punch. The punch mark made by this is wide and not very deep. This punch is used for locating centre of the holes. The wide punch mark gives a good seating for starting the drill. (Fig 1a)

Prick punch/Dot punch: The angle of the prick punches 30° or 60° (Fig 1b) The 30° point punch is used for marking light punch marks needed to position divider

Fig 1

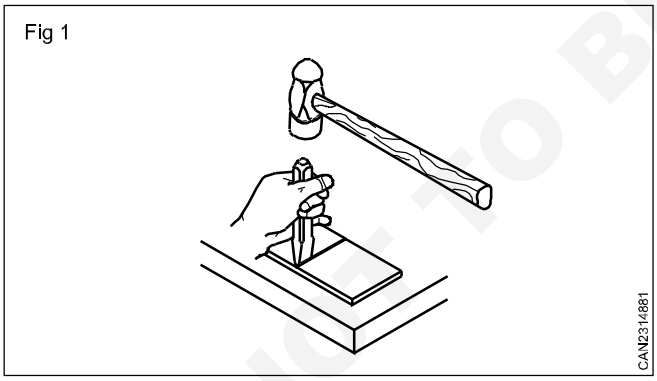


Hammer

Objectives: At the end of this lesson you shall be able to
- **state the uses of an engineer's hammer**
- **identify the parts of an engineer's hammer and state their functions**
- **name the types of engineer's hammers**
- **specify the engineer's hammer.**

An engineer's hammer is a hand tool used for striking purposes while (Fig 1)

Fig 1



- punching
- bending
- straightening
- chipping
- forging
- riveting.

Major parts of a hammer

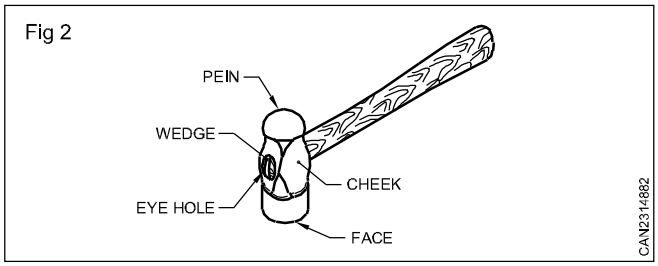
The major parts of a hammer are a head and a handle.

The head is made of drop-forged carbon steel, while the wooden handle must be capable of absorbing shock.

The parts of a hammer head are the (Fig 2)

- face
- peen
- cheek
- eyehole.

Fig 2



The face is the striking portion. Slight convexity is given to it to avoid digging of the edge.

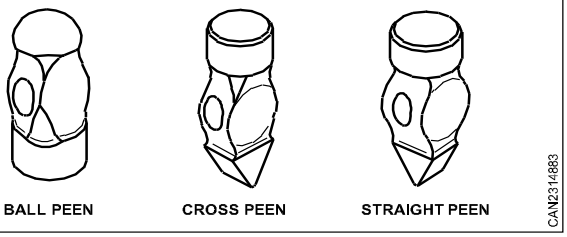
The peen is the other end of the head. It is used for shaping and forming work like riveting and bending. The peen is of different shapes like the

- ball peen

- cross-peen
- straight peen.

The face and the peen are hardened. (Fig 3)

Fig 3



Cheek

The cheek is the middle portion of the hammer-head. The weight of the hammer is stamped here.

This portion of the hammer-head is left soft.

Eye hole

An eyehole is meant for fixing the handle. It is shaped to fit the handle rigidly. The wedges fix the handle in the eyehole. (Figs 4 and 5)

Fig 4

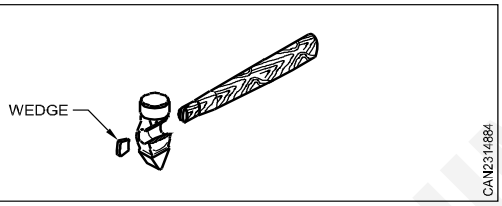
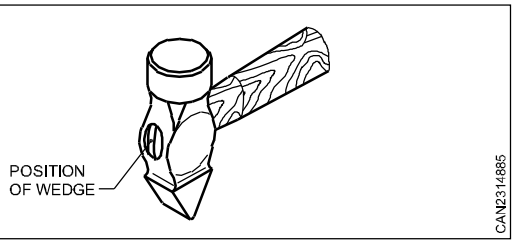


Fig 5



Specification

An engineer's hammers are specified by their weight and the shape of the pein. Their weight varies from 125 gms to 1.5kg.

The weight of an engineer's hammer, used for marking purposes, is 250gms.

The ball peen hammers are used for general work in a machine/fitting shop.

Before using a hammer

- **Make sure the handle is properly fitted**
- **Select a hammer with the correct weight suitable for the job**
- **Check the head and handle for any cracks**
- **Ensure the face of the hammer is free from oil or grease.**

Marking off and marking off table

Objectives : At the end of this lesson you shall be able to
- **state why marking off is necessary**
- **state the function of witness marks**
- **state the features of marking tables**
- **write the uses of marking tables**
- **state the maintenance aspects concerning marking tables.**

Marking off

Marking off or layout is carried out to indicate the locations of operation to be done, and provide guidance during rough machining or filing.

Witness marks

The line marked on metal surfaces is likely to be erased due to handling. To avoid this, permanent marks are made by placing punch marks at convenient mark intervals along the marked line. Punch marks act as a witness against inaccuracies in machining and hence, they are known as witness marks.

Marking off table (Figs 1 and 2)

A marking table (marking-off table) is used as a reference surface for marking on workpieces.

Marking tables are of rigid construction with accurately finished top surfaces. The edges are also finished at right angles to the top surface.

Marking tables are made of cast iron or granite, and are available in various sizes. These tables are also used for setting measuring instruments, and for checking sizes, parallelism and angles.

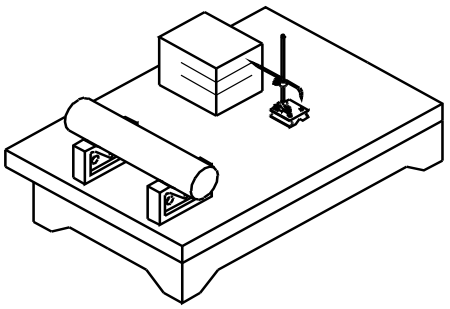
Care and maintenance

A marking table is very precise equipment, and should be protected from damage and rust.

After use, the marking table should be cleaned with a soft cloth.

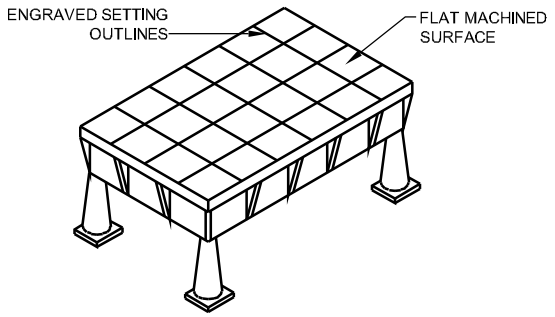
The Surface of the marking table, made of cast iron, should be protected by applying a thin layer of oil.

Fig 1



CAN2314891

Fig 2



CAN2314892

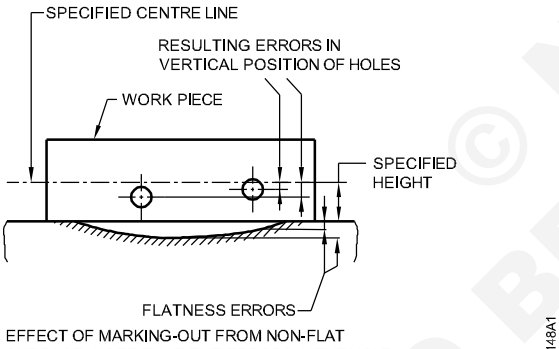
Surface plates

Objectives: At the end of this lesson you shall be able to
- **state the necessity of surface plate**
- **state the material of surface plate**
- **state the specification of surface plate.**

Surface plates - their necessity

When accurate dimensional features are to be marked, it is essential to have a datum plane with a perfectly flat surface. Marking using datum surfaces which are not perfectly flat will result in dimensional inaccuracies. (Fig 1) The most widely used datum surfaces in machine shop work are the surface plates and marking tables.

Fig 1



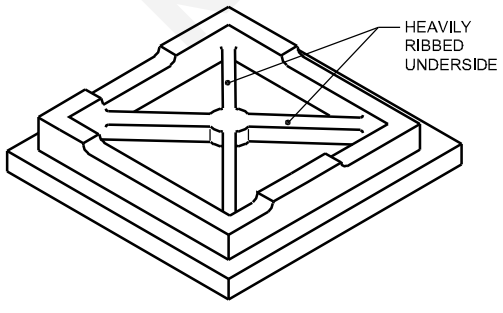
EFFECT OF MARKING-OUT FROM NON-FLAT SURFACE. NOTE THAT THE ERRORS IN THE HOLE POSITIONS ARE EQUAL TO THE FLATNESS ERRORS

CAN23148A1

Materials and construction: Surface plates are generally made of good quality cast iron which are stress-relieved to prevent distortion.

The work-surface is machined and scraped. The underside is heavily ribbed to provide rigidity. (Fig 2)

Fig 2

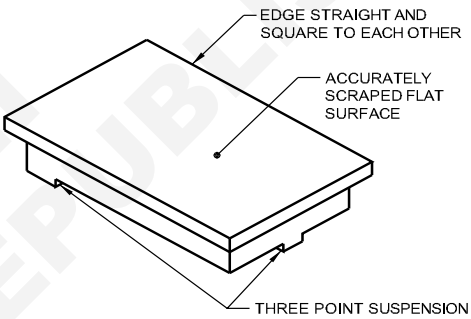


CAST IRON SURFACE PLATE

CAN23148A2

For the purpose of steadiness and convenience in levelling, a three point suspension is given. (Fig 3)

Fig 3



CAN23148A3

Smaller surface plates are placed on benches while the larger surface plates are placed on stands.

Other materials used

Granite is also used for manufacturing surface plates. Granite is a dense and stable material. Surface plates made of granite retain their accuracy, even if the surface is scratched. Burrs are not formed on these surfaces.

Classification and uses

Surface plates used for machine shop work are available in three grades - Grades 1, 2 and 3. The grade 1 surface plate is more acceptable than the other two grades.

Specifications: Cast iron surface plates are designated by their length, breadth, grade and the Indian Standard number.

Example

Cast iron surface plate 2000 x 1000 Gr1. I.S. 2285.

Care & maintenance

- Clean before and after use.
- Do not keep job on the surface plate.
- Don't keep any cutting tool on the table.

Marking media

Objectives: At the end of this lesson you shall be able to
- **state the purpose of marking media**
- **name the common types of marking media**
- **select the correct marking medium for different applications.**

Purpose of marking media

In marking off/Layout, the surface of the job/workpiece is coated with a medium to show the marked lines clear and visible. To get clear and thin lines, the best layout medium is to be selected.

Different marking media

The different marking media are Whitewash, Marking blue, Prussian Blue, Copper Sulphate and Cellulose Lacquer.

Whitewash

Whitewash is prepared in many ways.

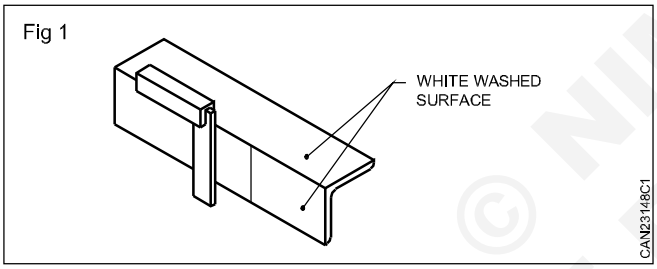
Chalk powder mixed with water

Chalk mixed with methylated spirit

White lead powder mixed with turpentine

Whitewash is applied to rough forgings and castings with oxidised surface. (Fig 1)

Fig 1



Whitewash is not recommended for workpieces of high accuracy.

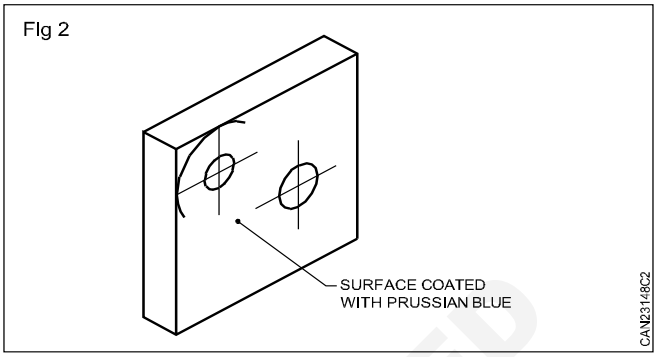
Marking blue

A Chemical dye, blue based colour mixed with methylated spirit used for marking on workpieces which are reasonably machined surface.

Prussian blue

This is used on filed or machine-finished surfaces. This will give very clear lines but takes more time for drying than the other marking media. (Fig 2)

Fig 2



Copper sulphated: The solution is prepared by mixing copper sulphate water and a few drops of nitric acid. The copper sulphate is used on filed or machine-finished surfaces. Copper sulphate sticks to the finished surfaces well.

Copper sulphate needs to be handled carefully as it is poisonous. Copper sulphate coating should be dried before commencing marking, as otherwise, the solution may stick on the instruments used for marking.

Cellulose lacquer: This is a commercially available marking medium. It is made in different colours and dries very quickly.

The selection of marking medium for a particular job depends on the surface finish and the accuracy of the workpiece.

In present days, marking media used are readily available in aerosol container, which can be applied by spraying on to any surface, which needs marking.

Readymade solutions of marking dye/ink which are quick drying and thin layer to mark precise dimensions and clear visible lines. Also permanent marker pens are available in different. colours, which are quick drying and used for smaller workpieces of metal, wood and plastics.

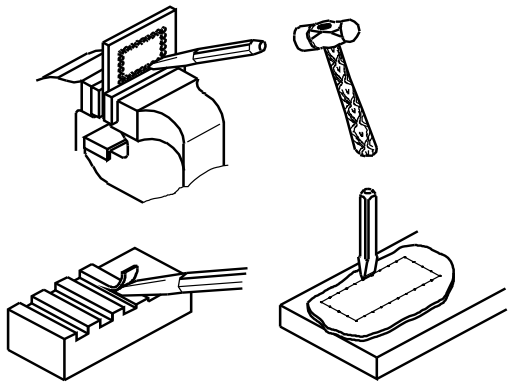
Cutting Tools (Cold chisel)

Objectives: At the end of this lesson you shall be able to
- **list the uses of a cold chisel**
- **name the parts of a cold chisel**
- **state the different types of cold chisels.**

Methods of material cutting: The cold chisel is a hand cutting tool used by fitters for chipping and cutting off operations. (Fig 1)

Chipping is an operation of removing excess metal with the help of a chisel and hammer. Chipped surfaces being rough, they should be finished by filing.

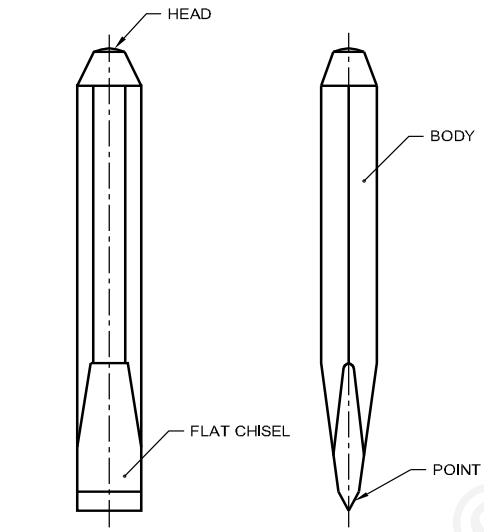
Fig 1



CAN23148D1

Parts of a chisel (Fig 2)

Fig 2



CAN23148D2

A chisel has the following parts.

- Head
- Body
- Point or cutting edge

Chisels are made from high carbon steel or chrome vanadium steel. The cross section of chisels is usually hexagonal or octagonal. The cutting edge is hardened and tempered.

Common types of chisels

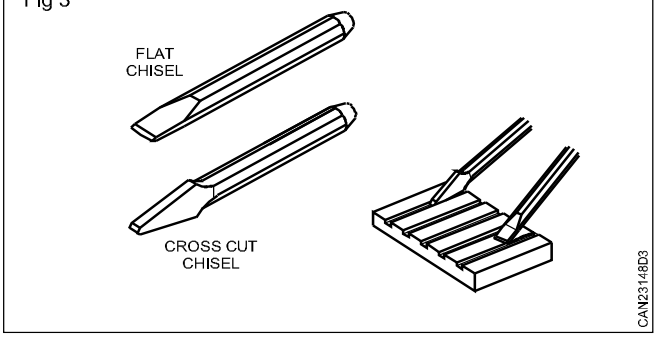
There are four common types of chisels.

- Flat chisel
- Cross cut chisel
- Half round nose chisel
- Diamond point chisel.

Flat chisels (Fig 3): They are used to remove metal from large flat surfaces and chip excess metal of weld joints and castings.

Cross-cut or cape chisels (Fig 3): These are used for cutting keyways, grooves and slots.

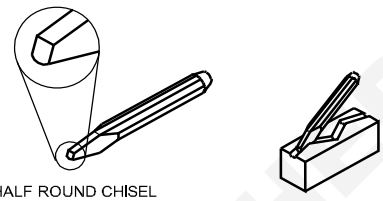
Fig 3



CAN23148B3

Half round nose chisels (Fig 4)

Fig 4

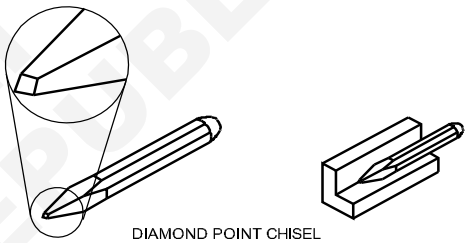


CAN23148D4

They are used for cutting curved grooves (oil grooves).

Diamond point chisels (Fig 5)

Fig 5

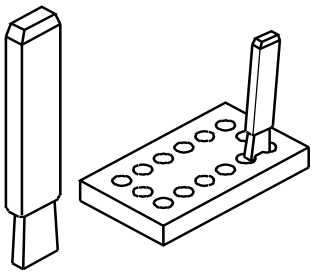


CAN23148D5

These are used for squaring materials at the corners.

Web chisels/punching chisels (Fig 6)

Fig 6



CAN23148D6

These chisels are used for separating metals after chain drilling.

Chisels are specified according to their

- length
- width of cutting edge
- type
- cross-section of body.

The length of the chisels ranges from 150 mm to 400 mm. The width of the cutting edge varies according to the type of chisels.

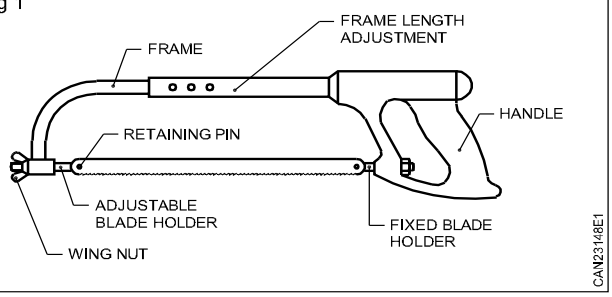
Hacksaw frame and blade

Objectives: At the end of this lesson you shall be able to:
- **identify the parts of a hacksaw frame**
- **specify hacksaw frames**
- **state the different types of hacksaw frames and their uses.**

The hand hacksaw is used along with a blade to cut metals of different sections. It is also used to cut slots and contours.

The parts are identified in Fig 1.

Fig 1



Types of hacksaw frames

The two different types of hacksaw frames are solid frame and adjustable frames.

Solid frame

Only a particular standard length of blade can be fitted to this frame.

Adjustable frame (Flat type)

Different standard lengths of blades can be fitted to this frame.

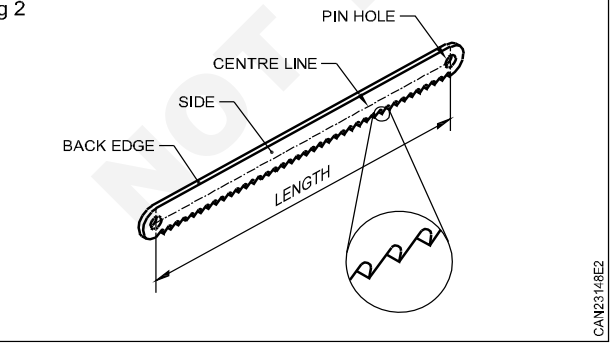
Adjustable frame (Tubular type)

This is the most commonly used type. It gives a better grip and control, while sawing.

For proper working, it is necessary to have frames of rigid construction.

Hacksaw blades (Fig 2)

Fig 2



A hacksaw blade is a thin narrow steel band with teeth, and two pin holes at the ends. It is used along with a hacksaw frame. The blade is made of either low alloy steel (LA) or high speed steel (HS) and is available in standard lengths of 250 mm and 300 mm.

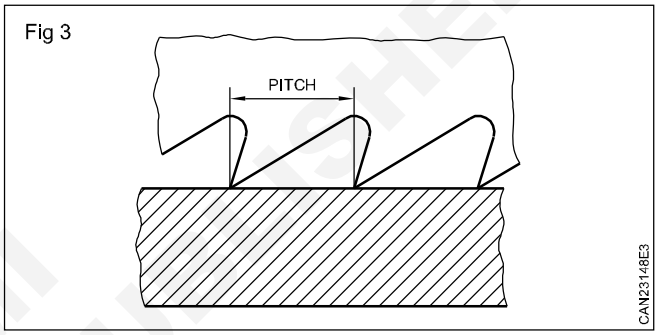
Types of hacksaw blades: Two types of hacksaw blades are available - all hard blades and flexible blades.

All hard blades: These are hardened to the full width between the pin- holes.

Flexible blades: For these types of blades, only the teeth are hardened. Because of their flexibility, these blades are useful for cutting along curved lines.

Pitch of the blade (Fig 3): The distance between adjacent teeth is known as the 'pitch' of the blade.

Fig 3



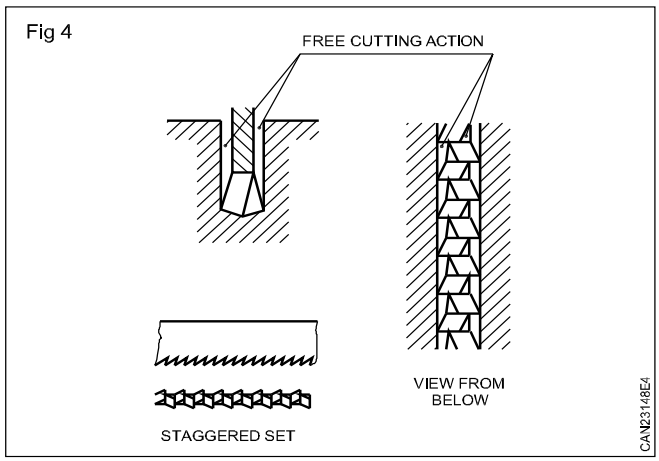
Classification	Pitch
Coarse	1.8mm
Medium	1.4mm & 1.0mm
Fine	0.8mm

Hacksaw blades are designated according to their length, pitch and type.

Setting of the saw: To prevent the saw blade binding when penetrating into the material, and to allow free movement of the blade, the cut is to be broader than the thickness of the saw blade. This is achieved by the setting of the saw teeth. There are two types of saw teeth settings.

Staggered set (Fig 4)

Fig 4



Alternate teeth or groups of teeth are staggered. This arrangement helps for free cutting, and provides for good chip clearance.

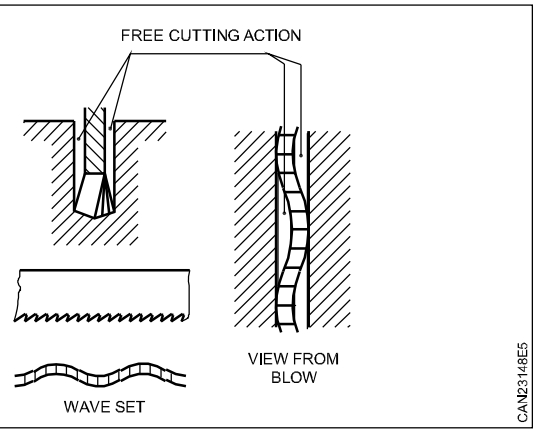
Wave set (Fig 5): In this, the teeth of the blade are arranged in a wave form.

Sets of blades can be classified as follows.

Pitch	Type of set
0.8mm	Wave-set
1.0mm	Wave or staggered
Over 1.0mm	Staggered

For the best results, the blade with the right pitch should be selected and fitted correctly.

Fig 5



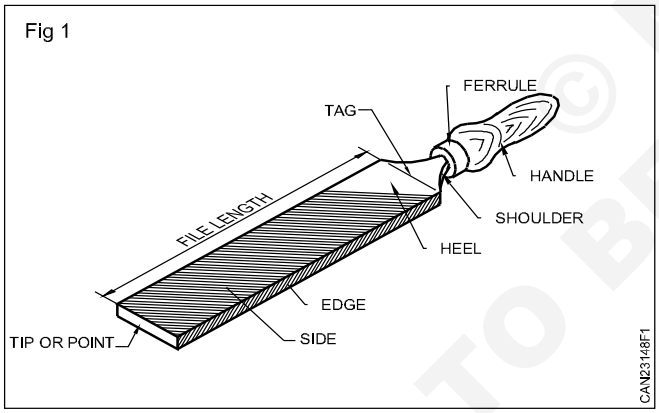
Files

Objectives: At the end of this lesson you shall be able to:
- **identify the parts of a file**
- **name the types of file**
- **state the uses of files**
- **state the correct shape of files for different profiles.**

Filing is a method for removing excess material from a workpiece by using a file which acts as a cutting tool. Files are available in many shapes and sizes.

Parts of a file (Fig 1)

Fig 1



The parts of a file as can be seen in figure 1, are.

Tip or point

The end opposite to tang.

Face or side

The broad part of the file with teeth, cut on its surface.

Edge

The thin part of the file with a single row of parallel teeth.

Heel

The portion of the broad part without teeth.

Shoulder

The curved part of the file separating tang from the body.

Tang

The narrow and thin part of a file which fits into the handle.

Handle

The part fitted to the tang for holding the file.

Ferrule

A protective metal ring to prevent cracking of the handle.

MATERIALS

Generally files are made of high carbon or high grade cast steel. The body portion is hardened and tempered. The tang is however, not hardened.

Common files of different shapes

Flat file

Hand file

Square file

Round file

Half round file

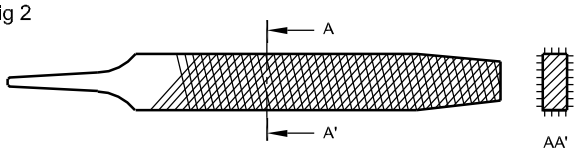
Triangular file

Knife-edge file

Flat files

These files are of a rectangular cross-section. The edges along the width of these files are parallel upto two-thirds of the length and then they taper towards the point. The faces are double cut and the edges single cut. These files are used for general purpose work. They are useful for filing and finishing external and internal surface. (Fig 2)

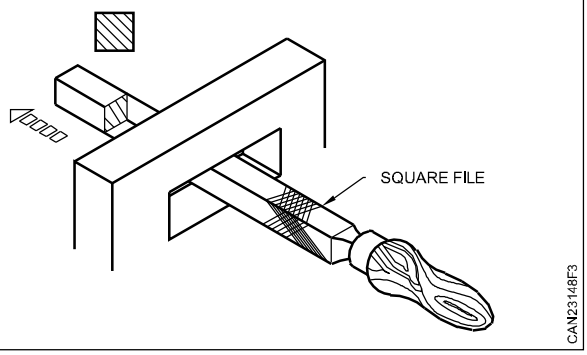
Fig 2



Square file

The square file is square in its cross-section. It is used for filing square holes, internal square corners, rectangular openings, keyways and splines. (Fig 3)

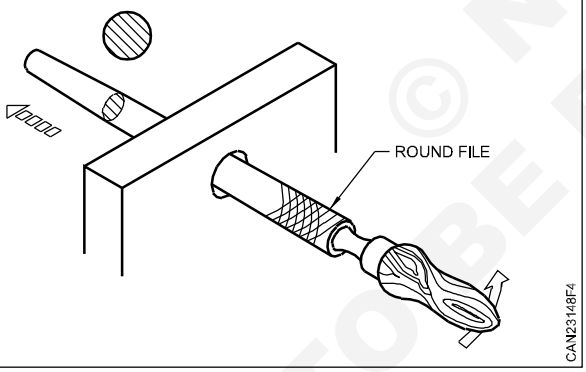
Fig 3



Round file

A round file is circular in its cross-section. It is used for enlarging the circular holes and filing profiles with fillets. (Fig 4)

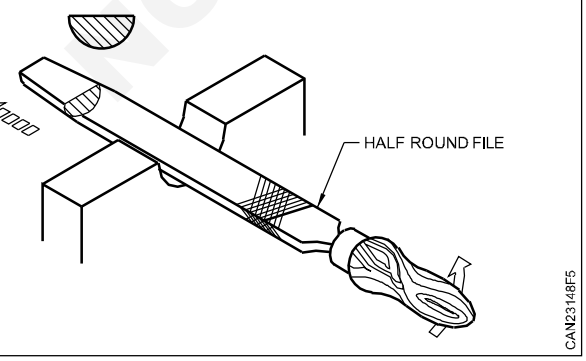
Fig 4



Half round file

A half round file is in the shape of a segment of a circle. It is used for filing internal curved surfaces. (Fig 5)

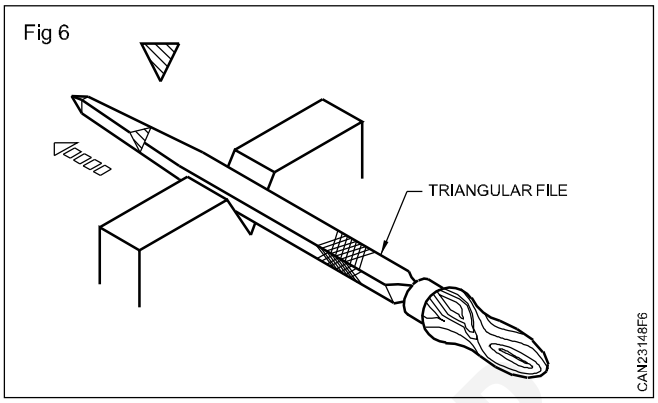
Fig 5



Triangular file

A triangular file is of a triangular cross-section. It is used for filing corners and angles which are more than 60°. (Fig 6)

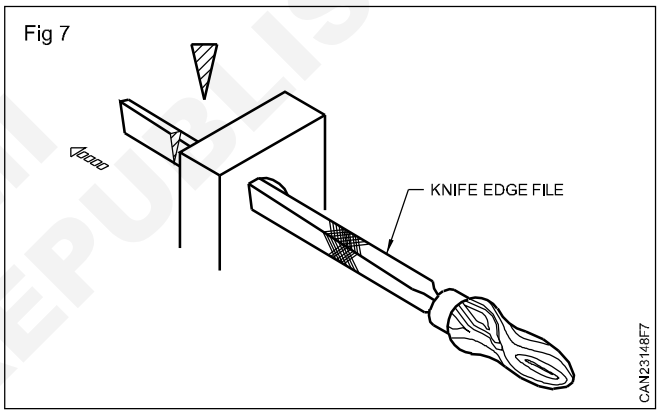
Fig 6



Knife-edge file

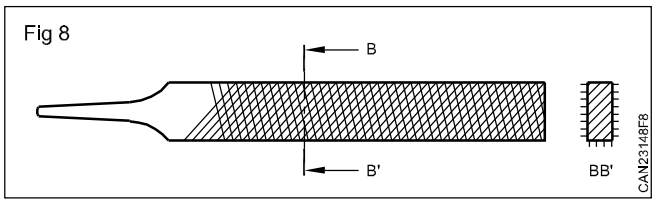
A knife-edge file has the cross-section of a sharp triangle. It is used for filing narrow grooves and angles above 10°. (Fig 7)

Fig 7



Hand files (Fig 8)

Fig 8



These files are similar to the flat files in their cross-section. The edges along the width are parallel throughout the length. The face are double cut, one edge is single cut where as the other is safe edge. Because of the safe edge they are useful for filling surfaces which are at right angles to surfaces already finished.

The above files have one third of their lengths tapered. They are available both in single and double cuts.

Square, round, half round and triangular files are available in lengths of 100, 150, 200, 250, 300 and 400 mm. These files are made in bastard, second cut and smooth grades.

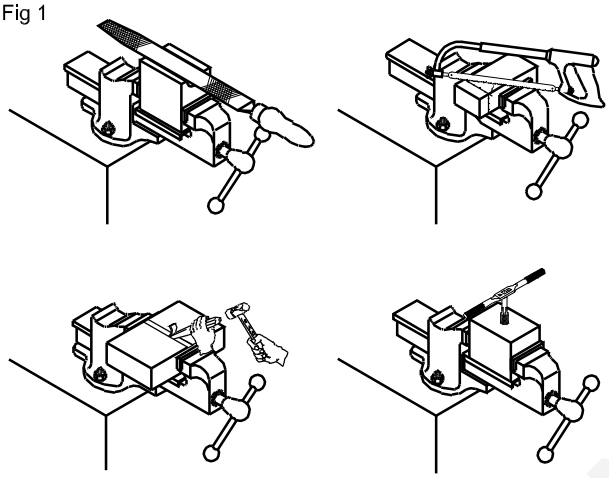
Application of bench vice

Objectives: At the end of this lesson you shall be able to
- **state the application of bench vice**
- **specify the size of the bench vice**
- **name the parts of the bench vice**
- **state the uses of vice clamps.**
- **mention the care and maintenance of vices**

Vices are used for holding the work pieces. They are available in different types. The vice used for bench work is the bench vice or called Engineer's vice.

A bench vice is made of cast iron or cast steel and it is used to hold work for filing, sawing, threading and other hand operations. (Fig 1)

Fig 1



The size of the vice is stated by the width of the jaws.eg. 150mm parallel jaw bench vice

Parts of a bench vice (Fig 2)

The following are the parts of a vice.

Fixed jaw, movable jaw, hard jaws, spindle, handle, box-nut and spring are the parts of a vice.

The box-nut and the spring are the internal parts.

Vice clamps or soft jaws (Fig 3)

To hold a finished work use soft jaws (vice clamps) made of aluminium over the regular jaws. This will protect the work surface from damage.

Do not over-tighten the vice as, the spindle may be damaged.

Fig 2

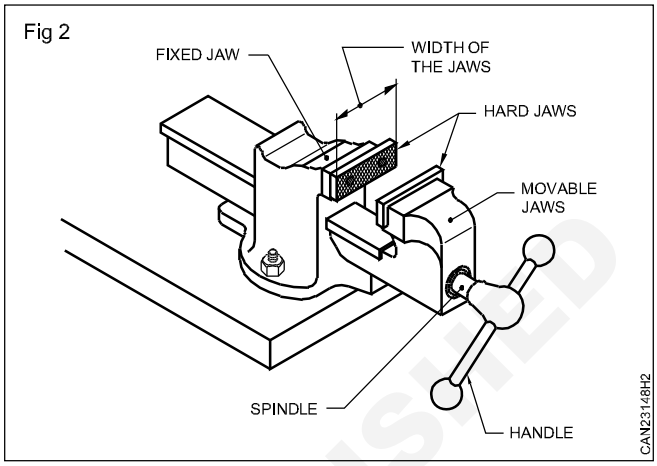
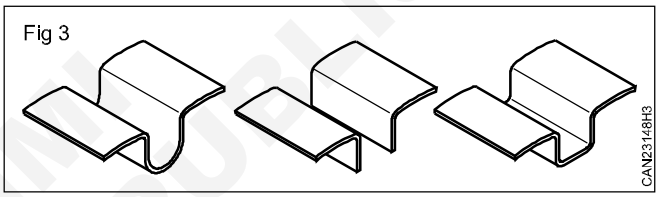


Fig 3



Care and maintenance of vices

- Always keep all threaded and moving parts clean by wiping the vice with a cloth after each use.
- Make sure to oil and lubricate the joints and sliding parts.
- To oil the sliding section, open the jaws completely and apply a layer of grease to the screen.
- Remove the rust if appears on the vice using rust remover chemical.
- When the vice is not in use bring the jaws lightly gap together and place the handle in a vertical position.
- Avoid striking the handle of the vice by a hammer for tightening fully, otherwise the handle will become bend or damaged.

Corner braces

Objective: At the end of this lesson you shall be able to
- **state the construction and uses of corner braces, hang plates, brackets, lid supports, table leg supports, table leg supports and hanging plates.**

Corner braces

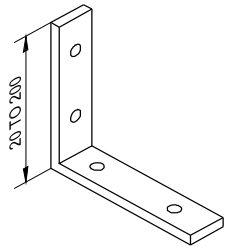
Corner braces are of two kinds.

1 Narrow type (Fig 1)

2 Wide type (Fig 2)

The size of the narrow type varies from 20mm to 200mm and made of steel or brass.

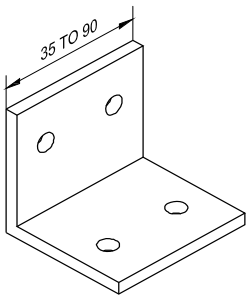
Fig 1



NARROW CORNER BRACE

CA230611

Fig 2



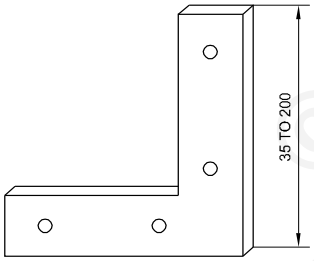
WIDE CORNER BRACE

CA230612

It is mostly used in fixing the partition screens, helps in fixing table, side rails and legs steadily without any shake. It is used in most places where there are 90° bends in wooden and steel parts. Two pipes can be fitted at 90° to each other.

Plates (Fig 3 & 4)

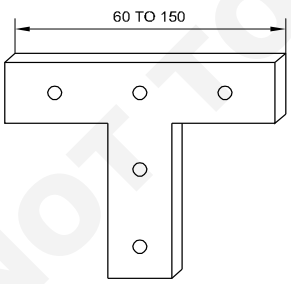
Fig 3



FLAT OR 'L' CORNER

CA230613

Fig 4



'T' PLATES

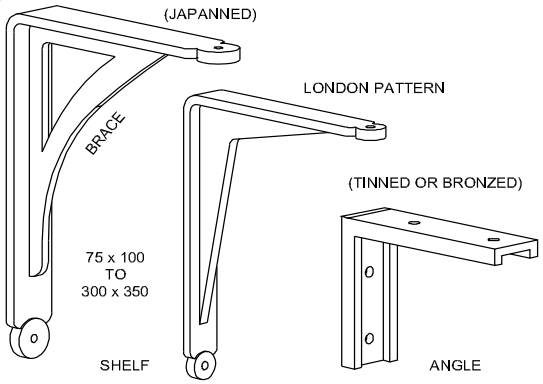
CA230614

It is available in two types flats such as L-flat or T-flat and are useful in fastening two frames which are at 90°. And also used in large frame corners. In partition screens, racks, benches it is mostly used, and its size varies from 35 to 200. These are available in sizes 60 to 150mm and are made of steel or brass.

T-flats are used in the centre legs of large benches and long table to make the furniture to keep them without shake.

Brackets (Fig 5)

Fig 5



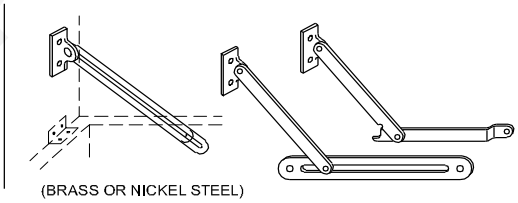
BRACKETS

CA230615

Brackets are of various types such as braced type, shelf type and angle type. And in pattern there are two such ones known a Japanese pattern and London pattern. Japanese pattern consists of a brace connecting the horizontal and vertical flats and it is sturdy to bear more weights and pressure. It is made of tinned bronze. London pattern brackets are used in light works. Its size varies from 75 to 100, in similar range and in maximum range from 300 - 350mm. It can also be used shelf supports and in supporting columns.

Lid supports (Fig 6)

Fig 6



LID SUPPORTS

CA230616

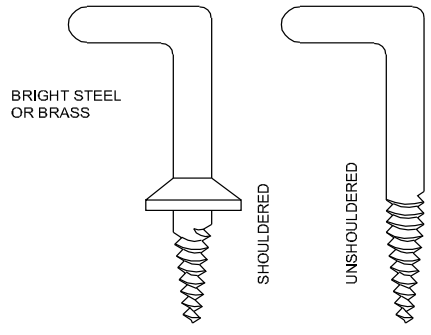
Lid supports are made of brass or nickel steel.

In large doors also this is fixed which helps the doors to stay without moving.

In workshops large and lengthy supporting wives are hooked with the help of this and is tied in the other end.

Square hooks (Fig 7)

Fig 7



SQUARE HOOKS

CA230617

This is made of bright steel bars or brass. In shouldered type, square hook the available dimension is 25mm x 35mm. In unshouldered type also the hooks of same measurements are available, used in keeping the display boards fixed on the wall.

Table leg supports (Fig 8)

Fig 8

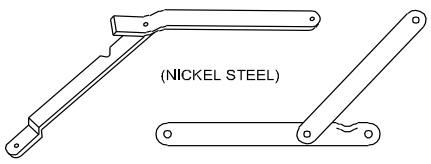


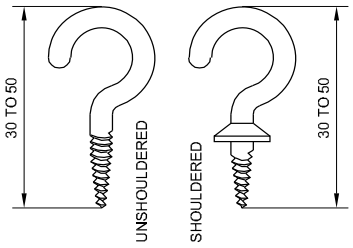
TABLE LEG SUPPORT

CA230618

This is made of nickel steel or sometimes in steel only. This is mostly used in folding table, folding chairs, folding cots and in places where larger furnitures are folded and kept thus saving the space.

Screw hooks (Fig 9)

Fig 9



CUP HOOKS

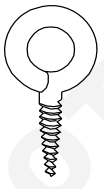
CA230619

This is of two or more types such as cup hooks, screw hooks. Cup hooks are of unshouldered and shouldered types. The size of unshouldered varies from 30 to 50mmm and the size of the shouldered is 50mm x 50mm and is made of bright steel or brass.

Screw eye (Fig 10)

It is made of steel or brass. It is used in fixing wire ropes and screens and for hanging purpose.

Fig 10

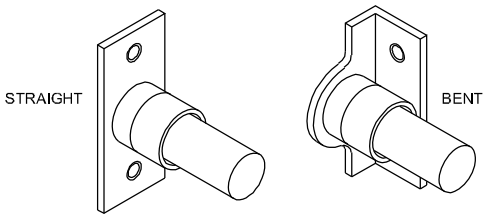


SCREW EYE

CA230614A

Rod brackets (Fig 11)

Fig 11



ROD BRACKETS

CA230613B

It is of two types

1 Straight type

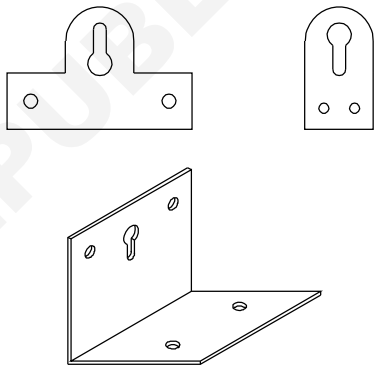
2 Bend type

It is used to make towel rail fixed in the brackets on both sides. Large screens are also fixed using these rod brackets.

Hanging plates (Fig 12)

Hanging plates are made of steel, brass, stainless steel and aluminium. Used in hanging photo frames, large pictures, and other utilities.

Fig 12



HANGING PLATES

CA230611C

Types of drill bits, counter boring tool, taps and dies

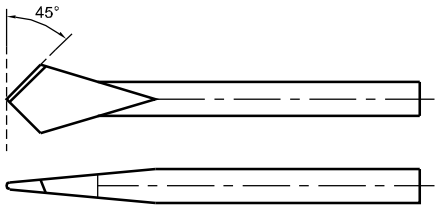
Objectives: At the end of this lesson you shall be able to
- **state the different types of drills**
- **identify the parts of a drill**
- **state the functions of each part of a drill.**

Drilling is a process of making holes on work pieces. The tool used for drilling is a drill and it is rotated with a downward pressure causing the tool to penetrate into the material.

Flat or spade drill (Fig 1)

This type of drill is used where the required size of twist drill is not available. It is made from a round tool steel piece which is forged to shape and ground to size, and then hardend and tempered. This type of drill is used for hand drilling (without power) or with a ratchet brace.

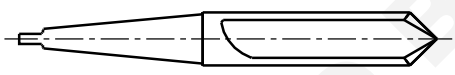
Fig 1



Straight fluted drill (Fig 2)

It has grooves or flutes running parallel to the drill axis. It is mainly used in drilling brass, copper or soft materials. This type of drill is inconvenient in standard practice as the chips do not come out from the hole automatically. It is used to drill sheet metals and cores in the castings.

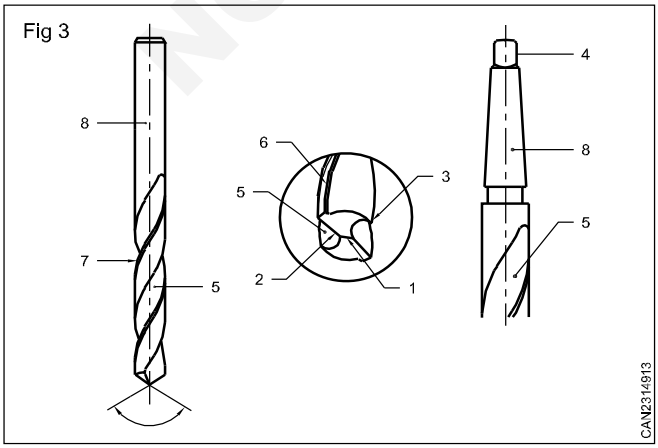
Fig 2



Twist drills (Fig 3)

In this type, two spiral flutes or grooves run lengthwise around the body of the drill. It is the most common type of drill used for all purposes, and especially for faster drilling of accurate holes and for harder materials - in comparision with the other drills.

Fig 3



Parts of a twist drill (Fig 3)

Point

The cone shaped end which does the cutting is called the point. It consists of a dead centre (1), lips or cutting edge (2) and a heel (3).

Tang (4)

This is provided only on taper shank drills, for driving (giving torque to) the drill, which when overloaded, becomes twisted to gets sheared off.

Flutes (5)

Flutes are the spiral grooves which run to the length of the drill. The flutes help:
- to from the cutting edges
- to curl the chips and allow these to come out
- the coolant to flow to the cutting edge.

Shank (8)

This is the driving end of the drill which is fitted on to the machine. Shanks are of two types.

Taper shank, with Morse taper provided, is used for large diameter drills, and the straight shank is used for smaller diameter drills.

Land / Margin (6)

The land/margin is the narrow strip which extends to the entire length of the flutes. The diameter of the drill is measured across the land/margin.

Body clearance (7)

Body clearance is that part of the body of the which is reduced in diameter to cut down the friction between the drill and the hole being drilled.

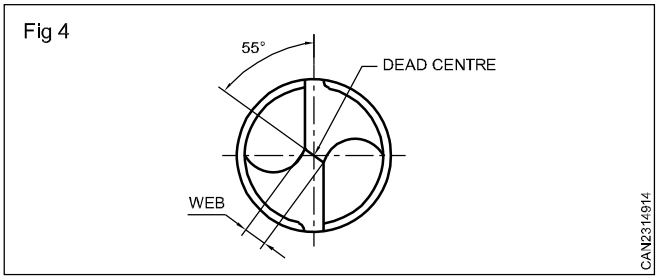
Web (Fig 4)

Web is the metal column which separates the flutes. It gradually increases in thickness towards the shank.

Material of twist drills

Twist drills, used in a machine shop, are usually made out of high speed steel. For drilling hard materials at higher cutting speeds, there are drills with carbide tips, brazed at the lips of the drill.

Fig 4



Counter sinking

Objectives: At the end of this lesson you shall be able to
- **state what is counter sinking**
- **list the purposes of counter sinking**
- **state the angles of counter sinking for different applications**
- **name the different types of counter sinks and their applications.**

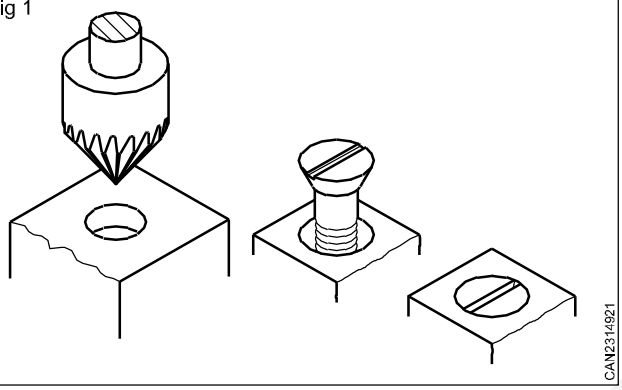
Counter sinking

Countersinking is an operation of beveling the end of a drilled hole. The tool used is called a countersink.

Counter sinking is carried out for the following purposes.

- To provide a recess for the head of a counter sink screw, so that it is flush with the surface after fixing. (Fig 1)

Fig 1



- To deburr a hole after drilling
- To accommodate counter sink rivet heads.
- To chamfer the ends of holes for thread cutting and other machining processes.

Angles for counter sinking

Counter sinks are available in different angles different uses.

75° Counter sink riveting.

80° Counter sink self-tapping screws.

90° Counter sink head screws and for deburring.

120° Chamfering ends of holes to be threaded or other machine processes.

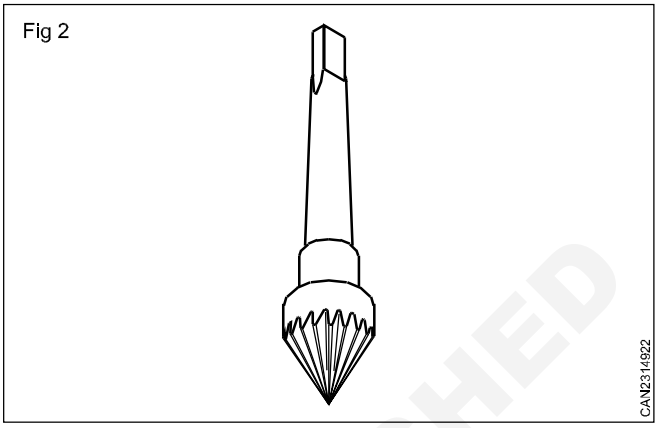
Counter sinks

Counter sinks of different types are available.

The commonly used counter sinks have multiple cutting edges and are available in taper shank (Fig 2) and straight shank.

For counter sinking small diameter holes special counter sinks with one or two flutes are available. This will reduce the vibration while cutting.

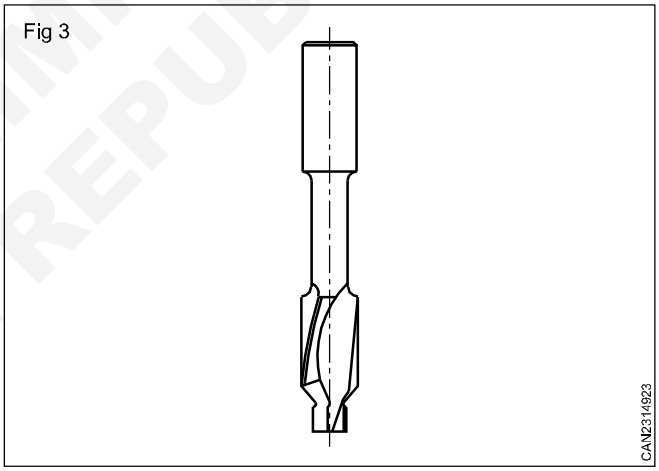
Fig 2



Counter sinks with pilot (Fig 3)

For precision counter sinking, needed for machine tool assembling and after machining process, counter sinks with pilots are used.

Fig 3



They are particularly useful for heavy duty work.

The pilot is provided at the end for guiding the counter sink to the hole.

Counter sinks with pilots are available with interchange able and solid pilots.

Counter sink hole sizes

The counter sink holes according to Indian Standards IS 3406 (Part 1) 1986 are of four types.

Type A

Type B

Type C

Type E

These types are used for different purposes.

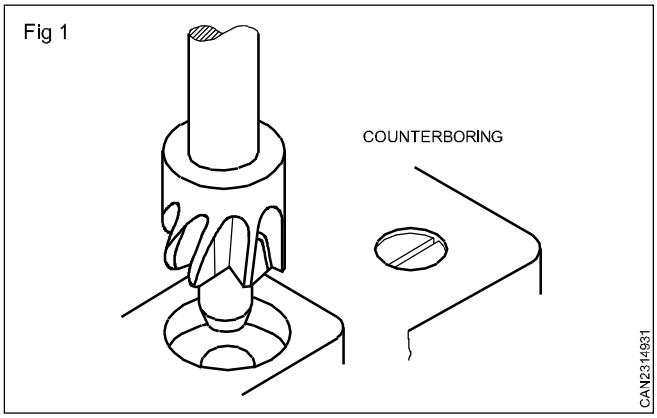
Counter boring and spot facing

Objectives: At the end of this lesson you shall be able to
- **differentiate between counter boring and spot facing**
- **state the various types of counter bores and their uses**
- **determine the correct counter bore sizes for different holes.**

Counter boring

Counter boring is an operation of enlarging a hole to a given depth, to house heads of socket heads or cap screws with the help of a counter bore tool. (Fig 1)

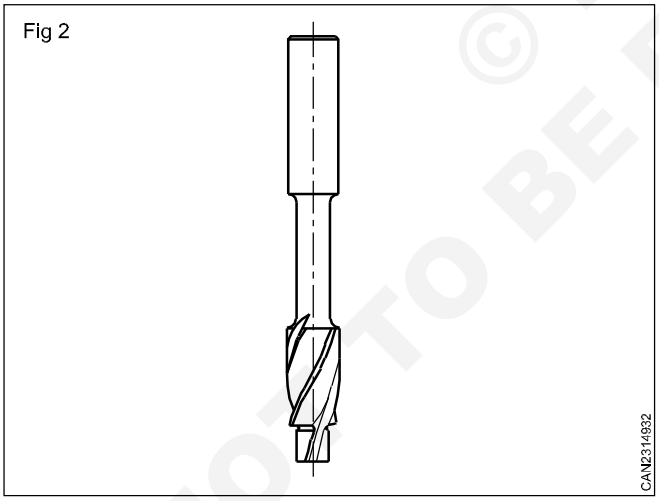
Fig 1



Counter bore (tool)

The tool used for counter boring is called a counter bore. (Fig 2) Counter bores will have two or more cutting edges. At the cutting end, a pilot is provided to guide the tool concentric to the previously drilled hole. The pilot also helps to avoid chattering while counter boring. (Fig 3)

Fig 2



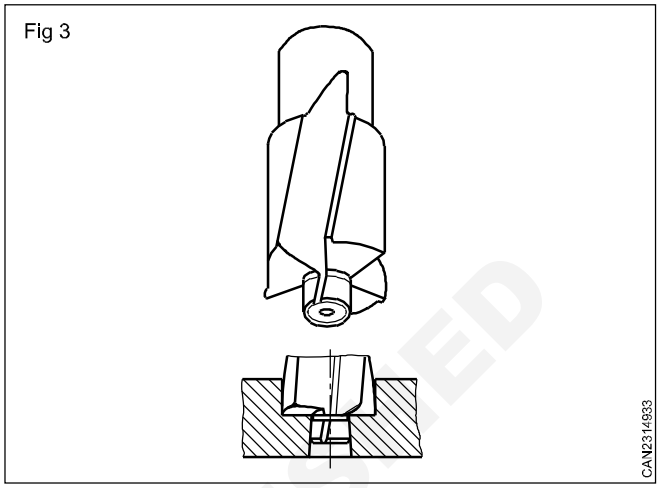
Counter bores are available with solid pilots or with interchangeable pilots. The inter-changeable pilots provide flexibility of counter boring on different diameters of holes.

Counter bores: sizes and specification

Counter bore sizes are standardized for each diameter of screws as per BIS.

There are two main types of counter bores. Type Hand Type K. These types are used for different purposes.

Fig 3



Spot facing

Spot facing is a machining operation for producing a flat seat for a bolt head, washer or nut at the opening of the drilled hole.

The tool is called a spot facer or a spot facing tool. Spot facing is similar to counter boring, except that the hole is shallower. Tools that are used for counter boring can be used for spot facing as well. (Fig 4) Spot facing is also done by fly cutters by end cutting action. The cutter blade is inserted in the slot of the holder, which can be mounted on to the spindle. (Fig 5)

Fig 4

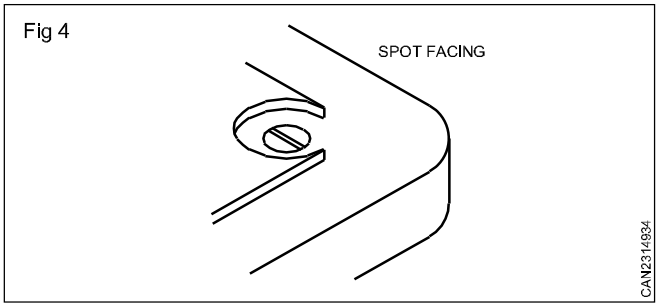
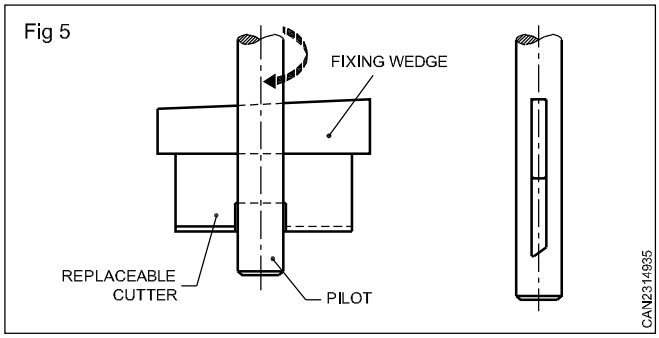


Fig 5



Hand taps and wrenches

Objectives: At the end of this lesson you shall be able to
- **state the uses of hand taps**
- **state the features of hand taps**
- **distinguish between the different taps in a set**
- **name the different types of tap wrenches**
- **state the uses of the different types of wrenches.**

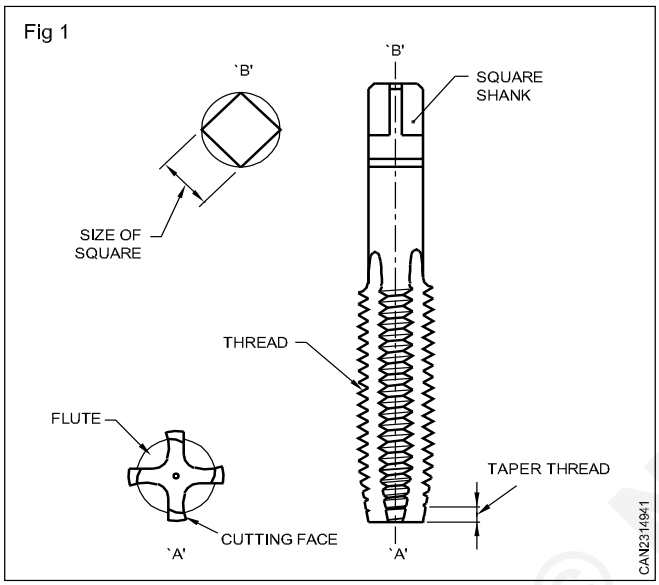
Use of hand taps

Hand taps are used for internal threading of components.

Features (Fig 1)

They are made from high carbon steel or high speed steel, hardened and ground.

Fig 1



The threads are cut on the surface, and are accurately finished.

To form the cutting edges, flutes are cut across the thread.

The end of the shank of the tap is made of square shape for the purpose of holding and turning the taps.

The ends of the taps are chamferred (taper lead) for assisting, aligning and starting of the thread.

The size of the taps, the thread standard, the pitch of the thread, the dia. of the tapping hole are usually marked on the shank.

In certain cases, the pitch of the thread will also be marked.

Markings are also made to indicate the type of tap i.e.first, second or plug.

Types of taps in a set

Hand taps for a particular thread are available as a set consisting of three pieces. (Fig 2)

These are:

- first tap or taper tap
- second tap or intermediate tap
- plug or bottoming tap.

These taps are identical in all features except in the taper lead.

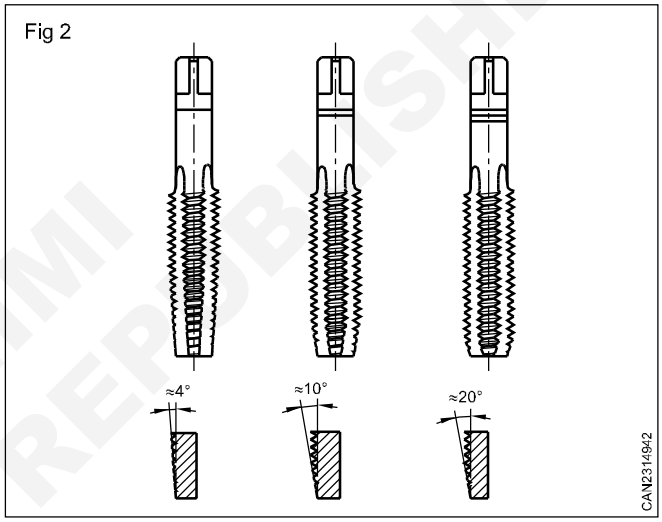
The taper tap is to start the thread. It is possible to form full threads by the taper tap in through holes which are not deep.

The bottoming tap (plug) is used to finish the threads of a blind hole to the correct depth.

For identifying the type of taps quickly the taps are either numbered 1,2 and 3 or rings are marked on the shank.

The taper tap has one ring, the intermediate tap has two and the bottoming tap has three rings. (Fig 2)

Fig 2



Tap wrenches

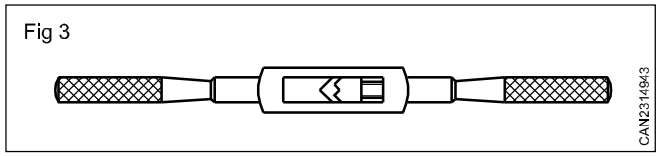
Tap wrenches are used to align and drive the hand taps correctly into the hole to be threaded.

Tap wrenches are of different types, such as double ended adjustable wrench, T-handle tap wrench solid type tap wrench etc.

Double-ended adjustable tap wrench or bar type tap wrench (Fig 3)

This the most commonly used type of tap wrench. It is available in various sizes -175,250,350 mm long. These tap wrenches are more suitable for large diameter taps, and can be used in open places where there is no obstruction to turn the tap. It is important to select the correct size of wrench.

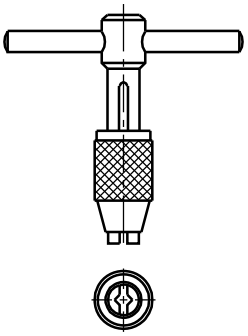
Fig 3



T-handle tap wrench (Fig 4)

These are small, adjustable chucks with two jaws and a handle to turn the wrench.

Fig 4



CAN2314944

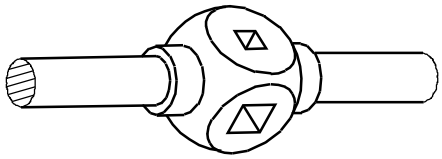
This tap wrench is useful to work in restricted places, And is turned with one hand only. Most suitable for smaller sizes of taps.

Solid type tap wrench (Fig 5)

These wrenches are not adjustable.

They can take only certain sizes of taps. This eliminates the use of wrong length of the tap Wrenches and thus prevents damage to the taps.

Fig 5



CAN2314945

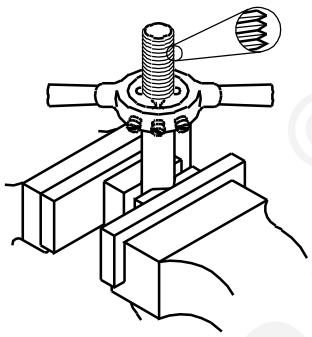
Die and die stock

Objectives: At the end of this lesson you shall be able to
- **identify the different types of dies**
- **state the features of each type of die**
- **state the uses of each type of die**
- **name the type of die stock for each type of die.**

Uses of dies

Threading dies are used to cut external threads on cylindrical work pieces. (Fig 1)

Fig 1



CAN2314951

Types of dies

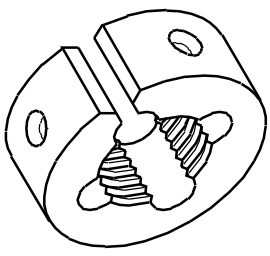
The following are the different types of dies.

- Circular split die (button die)
- Half die
- Adjustable screw plate die

Circular split die/button die (Fig 2)

This has a slot cut to permit slight variation in size.

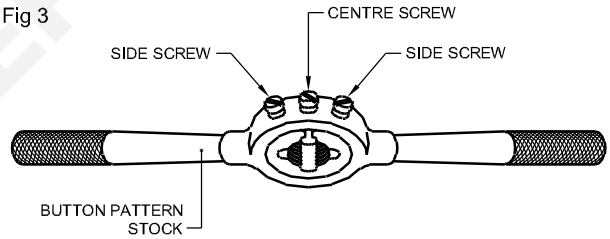
Fig 2



CAN2314952

When held in the die stock. variation in the size can be made by using the adjusting screws. This permits increasing or decreasing of the depth of cut. When the side screws are tightened the die will close slightly. (Fig 3)

Fig 3



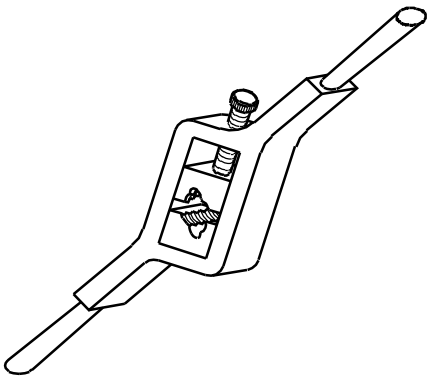
CAN2314953

For adjusting the depth of cut, the centre screw is advanced and locked in the groove. This type of die stock is called the button pattern stock.

Half die (Fig 4)

Half dies are stronger in construction.

Fig 4



CAN2314954

Adjustments can be made easily to increase or decrease the depth of cut.

These dies are available in matching pairs and should be used together.

By adjusting the screw of the die stock, the die pieces can be brought closer together or can be moved apart.

They need a special die-holder.

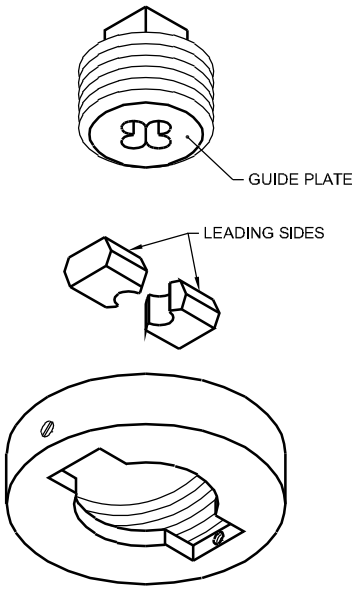
Adjustable screw plate die (Fig 5)

This is another type of a two-piece die similar to the half die.

This provides greater adjustment than the split die.

The two die halves are held securely in a collar by means of a threaded plate (guide plate) which also acts as a guide while threading.

Fig 5



QUICK CUT STOCK

When the guide plate is tightened after placing the die pieces in the collar, the die pieces are correctly located and rigidly held.

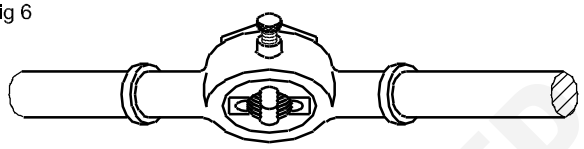
The die pieces can be adjusted, using the adjusting screws on the collar.

The bottom of the die halves is tapered to provide the lead for starting the thread. On one side of each die head, the serial number is stamped.

Both pieces should have the same serial numbers.

This type of die stock is called quick cut die stock. (Fig 6)

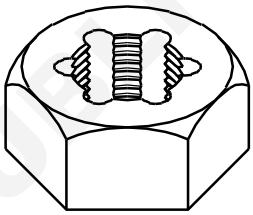
Fig 6



Die nut (Solid die) (Fig 7)

The die nut is used for chasing or reconditioning the damaged threads.

Fig 7



Die nuts are not to be used for cutting new threads.

The die nuts are available for different standards and sizes of threads.

The die nut is turned with a spanner.

Threaded fasteners - Machine screws, bolts, nuts and washers

Objectives: At the end of this lesson you shall be able to
- **state the results of poor selection of fasteners**
- **state the various types of fasteners in industrial use**
- **state the types of thread fasteners and their uses - machine bolts, machine screws, cap screws and set screws.**

In the industrial field much depends on the proper choice of fasteners to be used in each job.

- A poorly selected fasteners might greatly lead to unsafe condition.
- Increase the assembly cost.
- Products are inferior quality.

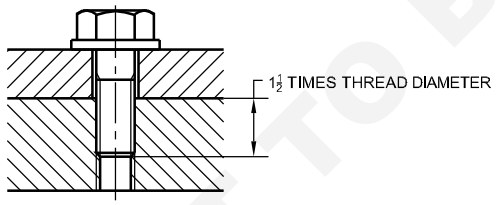
Various types of fasteners

- Threaded fasteners
- Rivets
- Pins
- Retaining ring or circlips
- Keys
- Staples
- Adhesives.

Threaded fasteners

Fasteners: Fasteners that fall into category utilize the wedging action of screw thread for clamping pressures. To achieve maximum strength, a threaded fasteners should screw into its mating part a distance equal to 1.5 times (minimum) the diameter of thread. (Fig 1)

Fig 1



Machine screws: Machine screws are used for general assembly work. (Fig 2) It is manufactured in both COARSE and FINE series, fitted with either a slotted or recessed head. (Fig 3)

Sizes vary in diameter from 1.5 mm to 12 mm and in length 2 mm to 75 mm.

Fig 2

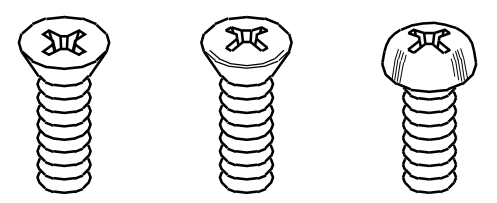
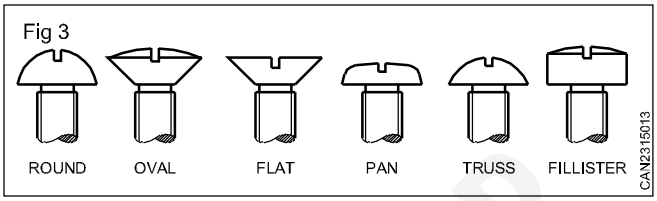


Fig 3



Machine bolts: Machine bolts (Fig 4) are manufactured with square and hexagonal heads. They are used where a close tolerance assembly is not required. Available in diameter 6 mm to 75 mm and in length 12 mm to 300 mm. Tightening the nut on machine bolt (Fig 5) produce clamping action.

Fig 4

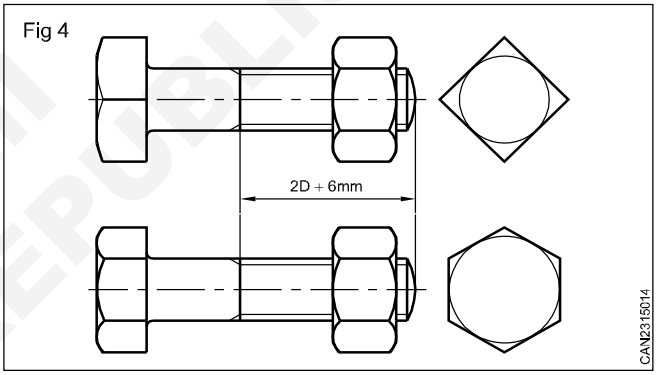
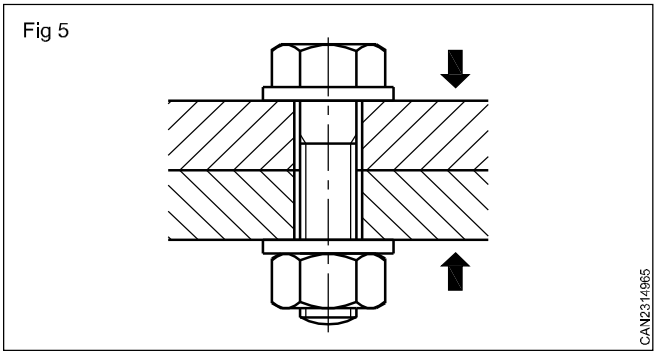


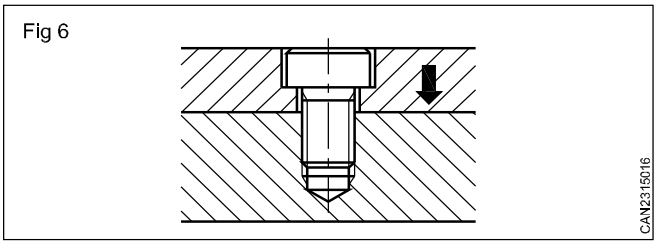
Fig 5



Cap screws: Cap screws are used when assembly requires a stronger, more precise and better appearing fastener. A cap screw is fitted through a clearance hole in one of the piece and screws into a threaded hole.

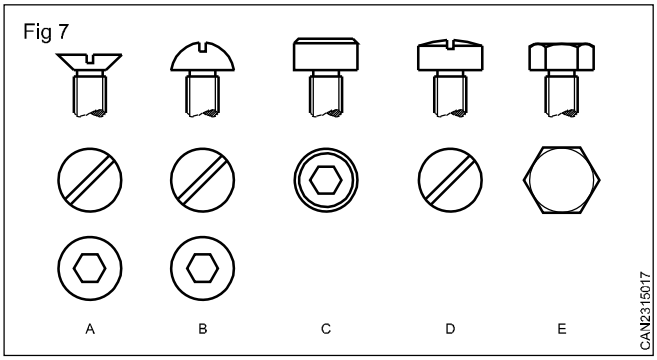
A clamping action is developed by tightening the cap screws. (Fig 6)

Fig 6



Cap screws are manufactured to closer tolerance than machine bolts and produced with semi-finished bearing surface. They stocked in aluminium, brass, bronze, mildsteel, alloy steel (Heat treated), stainless steel and titanium and in coarse in fine and special thread series (Fig 7).

Fig 7



Cap screws are available in diameter from 6 mm to 50 mm and in length from 10 mm to 200 mm. Nuts are not included with cap screws.

Set screws: Set screws are used to prevent pulleys from slipping on shafts, positioning and holding collars in place, on shafts and holding shafts in place in assemblies. (Fig 8)

Headless set screws have either a slotted or socket head and threaded entire length. Screw points are available in various styles and their recommended use. (Fig 9)

Uses

A Flat point set screw is used on parts requiring frequent adjustment.

Fig 8

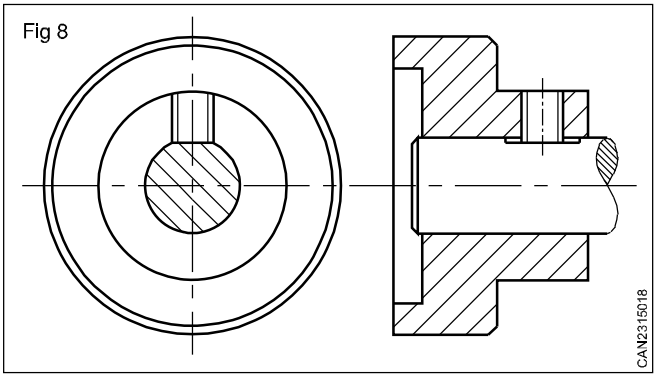
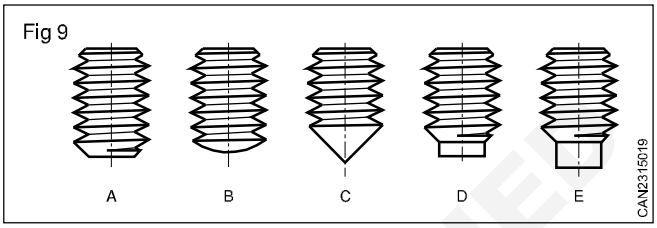


Fig 9



B Oval point set screw is used against a shaft that has been spotted to receive it.

C Cone point set screw is used for setting machine parts permanently on shaft and it is used as a pivot or hanger and for adjustment.

D The half dog point set screws is probably one of the most useful and it can be used as a dowel. A hole is drilled to receive the point.

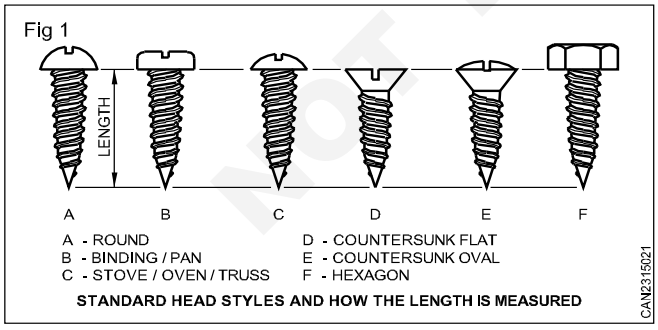
E The full dog point set screw is suitable for use as a key that slides in a key way.

Types of screws, nuts and washers

Objectives: At the end of this lesson you shall be able to
- **state the various types of fastening screws and their uses**
- **state the various types of nuts and their uses**
- **state the various types of washers and their specific applications.**

Self tapping screw: To eliminate the cost of tapping, a thread forming screw has been derived. These are designed to form a thread as they are driven. (Fig 1)

Fig 1



Thread cutting screws: Thread cutting screws which are hardened, actually cut rather than form threads.

Type F: Cuts a standard machine thread used in castings and forgings. (Fig 2)

Type BF: This screw is recommended for die castings and plastics. (Fig 3)

Fig 2

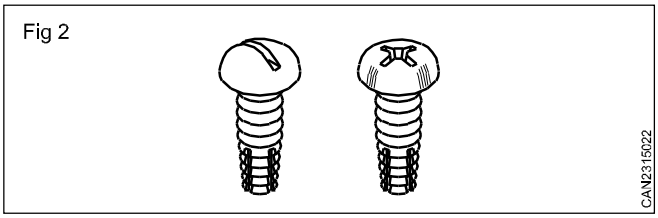
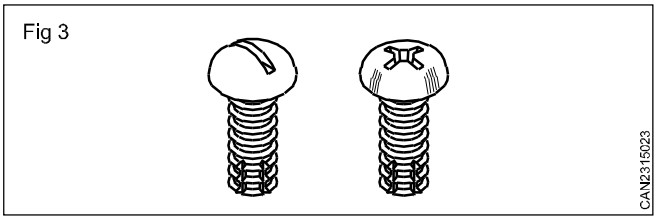


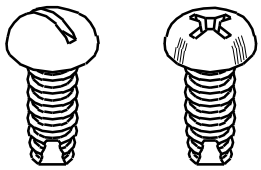
Fig 3



Type L: Widely used with plastics. (Fig 4)

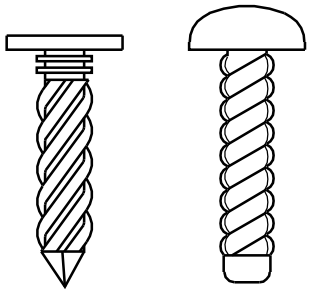
Driver screws: Driver screws are simply hammered into a drilled hole or punched hole of the proper size. They make a permanent joints. (Fig 5)

Fig 4



CAN2315024

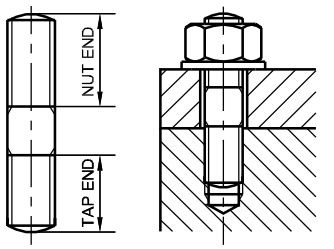
Fig 5



CAN2315025

Stud bolts: Stud bolts are threaded on both ends. One threaded end is designated for semi-permanent installation in a tapped hole while the other end threaded for standard nut assembly to clamp the pieces together. (Fig 6)

Fig 6

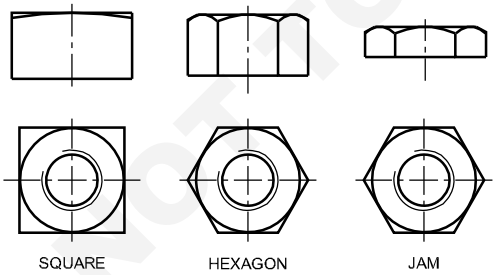


CAN2315026

Nuts: Nut utilise a hexagonal or square head and are used with bolts with the some head shapes. They are available in various finish.

Regular is unfinished (not machined) except on the thread. (Fig 7)

Fig 7



CAN2315027

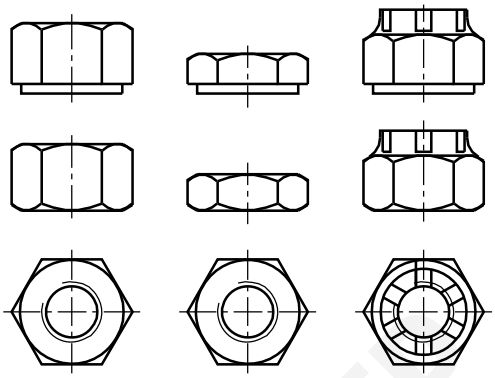
Regular semi finished is machined on the bearing face to provide a truer surface for the washers. (Fig 8)

Heavy semi finished are identical in finish to the regular semi-finished nut, however, the body is thicker for additional strength. (Fig 9)

The jam nut/check nut is used where the strength of the full nut is not needed. They are frequently used in pairs or with standard nuts for locking action. (Fig 8B, 9B)

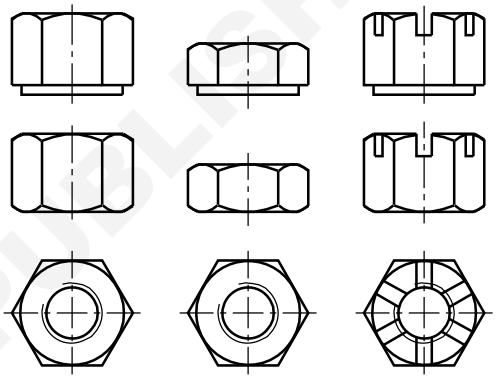
Castle and slotted nut have milled slots across the flats. So that can be locked with a cotter pin/split pin or safety wire that is inserted through the slot and a hole drilled in the bolt to prevent the nut from turning loose. (Fig 8C, 9C)

Fig 8



CAN2315028

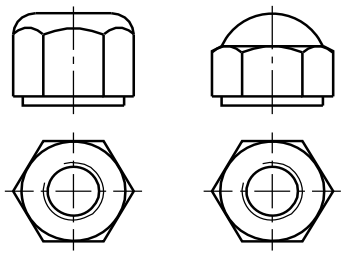
Fig 9



CAN2315029

A corn nut/Cap nut are used when appearance is of primary importance or where projecting threads must be protected. They are available in low or high crown styles. (Fig 10)

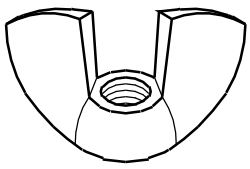
Fig 10



CAN2315502A

The wing nut is used where frequent adjustment or removal is necessary. It can be loosened or tightened rapidly without the need of a wrench. Nut are manufactured in the same material as the bolts. (Fig 11)

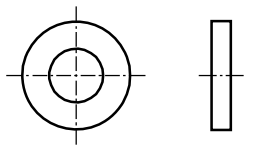
Fig 11



CAN2315028

Washers: Washers are used to distribute the clamping pressure over a larger area, and prevent the surface damaged (marking). They are also provide an increased bearing surface for bolt heads and nuts. Washers are manufactured in light, medium, heavy and extra heavy series. (Fig 12)

Fig 12

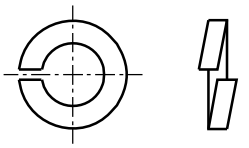


CAN231502C

Lock washers: A lock washer is used to prevent a bolt or nut from loosening under vibration.

The split ring lock washer is being rapidly replaced by lock washers designed for specific applications. (Fig 13)

Fig 13



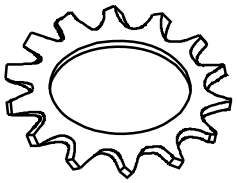
CAN231502D

Tooth type lock washers: These washers have teeth that bite deep into both screw head and work surface. Their design is such that they actually lock lighter as vibrations increase.

External type: Should be used where possible as it provides the greatest resistance. (Fig 14)

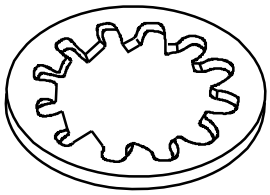
Internal type: Used with small head screws and where it is desirable to hide the teeth either for appearance or to prevent snagging. (Fig 15)

Fig 14



CAN231502E

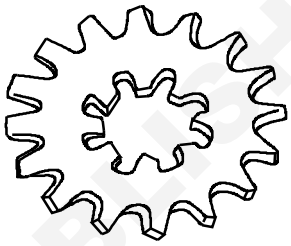
Fig 15



CAN231502F

Internal and external type: Used when the mounting holes are over size. (Fig 16)

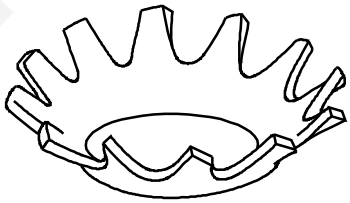
Fig 16



CAN231502G

Countersunk type: For use with flat or oval type head screws (Fig 17).

Fig 17



CAN231502H

Introduction of modular furniture

Objectives: At the end of this lesson you shall be able to
- **state the Introduction of modular furniture**
- **state the advantage of modular furniture.**

Introduction of modular furniture (Fig 1)

Fig 1

Modular furniture is a set of furniture items; that can be tailored to flexible workspace so that fit your house and company.

Modular furniture refers to modern furniture that has been constructed modules or types. These consist of furniture with selected elements of standard sizes.

Modular furniture is usually two types of movable furniture and fixed furniture.

Modular furniture are designed to maximize utility and allow for efficient space management, modular furniture each type is made from diversified materials

Advantage of modular furniture

- Modular furniture items are high quality and durable.
- A friendly, modern office gives the right vice when outsiders visit your office.
- Comfortable work environment.
- Redecorate without spending a time.
- You can change your office space look in a matter of minutes.
- A wide range of furniture and colours are available to choose from.
- Readymade units are easily available, so you don't waste time with carpentry.
- Cleaning and maintenance is simpler.
- A pleasant, modern décor ensures employee satisfaction.
- Improves efficiency as things are more organized.
- You can utilize every corner of your office area.
- The collaborative environment amongst staff will improve their rapport and productivity.
- There is continuity in the supply of extra items of furniture.
- Modular tables accommodate cables, so you can be free of unnecessary wire and cables

Different modular furniture hand tools and machineries and application

Objectives: At the end of this lesson you shall be able to
- **state the different hand tools used in modular furniture**
- **state the application of hand tool**
- **state the different machineries in modular furniture and application**

Refer Exercise No.1.7.131

Characteristics and application of different modular furniture material

Objectives: At the end of this lesson you shall be able to
- **state the characteristics of different modular furniture material**
- **state the applications of different modular furniture material.**

Refer Exercise No.1.7.132

Modular furniture allocation or plan (Layout)

Objectives: At the end of this lesson you shall be able to
- **state the meaning of modular furniture layout**
- **state the advantage of modular furniture plan (layout).**

Allocation or plan (layout)

The first step to getting your dream modular furniture is measuring your space

- This is a determinate for modular furniture designs and price.
- Layout is a full scale drawing with complete details of modular furniture including for:
- Movable furniture materials.
- Fixed furniture materials.
- Furniture finishers.
- Kinds of storage.
- Colour scheme
- Accessories.
- Hardware

The construction modular furniture consist of two different stages. First stage is to prepare a layout including sawing ,planning and bonding allowance as per the dimension given in drawing.

The second stage is to shape the different types (movable furniture, fixed furniture) of modular furniture

The layout preparation is consist of measuring, marking and assembling all the dimensions on layout including all the allowances.

Study the working drawing carefully.

Advantages of furniture layout

- List the requires material to prepare the furniture
- Method of construction of furniture becomes known on seeing the layout.
- Locate loose furniture, fixed furniture are clear and under-standable.
- Decides the type of modular furniture.
- Easy to prepare the modular furniture.
- Avoid mistake in construction of furniture and save the materials.
- Saves money.
- Saves time.
- Decide type of joints.
- It becomes easy for the furniture maker to make the furniture.
- It is useful in subsequent checking of the furniture.
- Minimise the cost of furniture.
- Calculation of the cost of modular furniture becomes easier.
- Chances of erring in construction of furniture are much reduced.

Modular furniture assemble procedure

Objective: At the end of this lesson you shall be able to
- **state the assembly procedure of modular furniture.**

Assemble procedure

Customers must keep in mind that installation and assembling must be done by professional installers.

If the installers are professional trainer then assembling of the modular furniture to good apperance.

This guide explains requirements for furniture installation.

Before installation check building plan and building permit

A building plan check is required prior to obtaining a building permit if the installation a part of any of the following.

- A new building or structure
- Addition to a building
- Structural alteration to building
- Interior modification/change of floor plan (i.e., cubide layouts (see furniture requirements above), removing or adding walls)
- " Walls, Partitions (Including modular or temporary partitions and cubicles)

A building permit is required when the installation is part of a larger project that involves building, Constructing, Remodelling, Repairing, Demolishing, removing, or moving any building or structure, including garages, partitions, fence, accessory buildings, etc.

Installation of movable furniture

Movable furniture (i.e., not attached to a floor, wall or ceiling; easily moveable) is allowed nearly anywhere and does not require plan check or permit with the following exceptions.

- Movable furniture should not be placed where it will reduce an aisle to less than a 90 cm clearance (in some cases, a wider aisle is required, but 90 cm is the normal requirement)
- Movable furniture should not be placed within a 150 cm by 150 cm zone on the side of a door opening where the door opens into that area. The opposite side of a door opening must have a 190 cm by 120 cm clear area.
- Movable furniture may not be placed in exit corridors or lobbies, including main entrance lobbies and elevator lobbies. There may be some exceptions to this requirement. It must be consulted on a case - by - case basis to make the determination.

Fixed Furniture Installations

Fixed furniture (i.e., attached in some manner to a floor, walls or ceiling, is allowed subject to the following:

- Cubicles, movable or temporary partition walls, glass walls, cases, counters, etc., are allowed without plan check or permit as long as they are no taller (measured from the floor) than 172cm and the configuration of such items does not violate any other code requirement for aisle widths, exit pathways, encroachment in mandatory clear floor areas and similar.
- All of the same clearance are required as noted in Movable furniture installation, above in some cases the clearance may need to be even greater.
- Subject to many restrictions, fixed furniture can sometimes be placed in exit corridors and lobbies
- Items taller than 172 cm, including even those with a pre - approved Research Report will require details drawings, clear indication of aisles and exit paths, identification and drawing of the entire disabled access pathway through the building to / from the building entrance and all the way to the required disabled parking space on campus. This typically means that an architect has to be hired to prepare and assembles the necessary documentation to submit for plan check and permit.

Application of modular furniture hardware and different types of timber used

Objectives: At the end of this lesson you shall be able to
- **state the application of modular furniture accessories**
- **state the application of modular furniture hardware**
- **state the different type of timber used in modular furniture.**

Refer Exercise No.1.7.134

Types of modular furniture dressing (Finishing)and application of sunmica in different colour contrast

Objectives: At the end of this lesson you shall be able to
- **state the different type of modular furniture finishing**
- **state the application of sunmica colour combination.**

Refer Exercise No.1.7.135 & 136

Introduction to building Wood & Carpentry

Objectives: At the end of this lesson you shall be able to
- **parts of a building**
- **list the sequence of construction**
- **explain the levels of different parts of building**
- **draw and indicate the parts**
- **explain the location of doors and windows.**

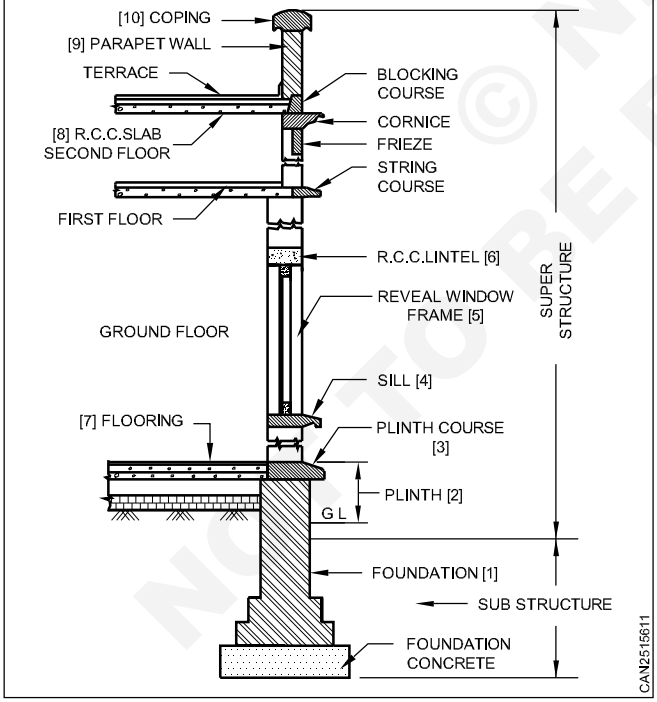
Introduction

A building consist of sub-structure and superstructure. Foundation, plinth, walls, floors and roofs are the main structural components of the building. Each of these components is an essential part of a building and requires due consideration in design and construction for their functional performance.

Parts of a building (Fig 1)

The sectional view of a building shows all the constructional details from the foundation level to the top of roof such as total height and different levels i.e depth of foundation, plinth level ground floor level, thickness of wall, window sill level, floor to ceiling height, window/door height, chajja level, roof top level, parapet level and coping.

Fig 1



The sequence is listed form foundation

1 Foundation

2 Plinth

3 Plinth course

4 Sill

5 Door & window

6 Lintel

7 Floors

8 Roof

9 Parapet

10 Coping

1 Foundation

It is the lowest artificially prepared part, below the surface of the surrounding ground, which is in direct contact with sub-starter and transmits, all the loads to the sub-soil.

2 Plinth

It is the middle of the strucure, above the surface of the surrounding ground up to the surface of the floor, immediately above the ground.

3 Plinth course

It is top most course at plinth level which is finished flush with the surface of ground floor.

4 Sill

It is the horizontal member comprising concrete, stone or wood to give support to the vertical members of wooden window. It helps in shedding train water from face of wall.

5 Door & window

Door is a frame work of wood, steel glass. The purpose of door to give access to the users of the structure and free movement into and outside the structure. The door provide a good ventilation. Windows are constructed for providing light and ventilation in the building.

6 lintel

A horizontal member of stone, wood, brick, steel, rein forced brick, R.C.C. etc above the opening to support the masonry or load above, it is called lintel.

7 Floors

Floors are horizontal elements of a building structure which divide the building into different levels for the purpose of creating more accommodation.

8 Roof

A roof is the upper most part of a building which is supported on structural members and covered with a roofing material. The main function of a roof is to enclose the building and to protect the same from the damaging effects of weather such as rains, wind, snow etc.

9 Parapet

It is the wall built around a flat roof which acts as a protective wall for the users of the terrace. In case of pitched roof, the parapet wall is used to conceal to gutter at coves level.

10 Coping

The coping is covering of bricks or stones which is placed on the exposed top of on external wall to prevent seepage of water through joints of top most course in a wall.

Maintenance and preservation: Preparation of maintenance programme to maintain livability throughout the life of the building by observing effect of Sun, Rain,Wind, and Human Behavior on building materials and construction.

Location of doors and windows:

The following points should be kept in mind while locating doors and windows.

1 The number of doors in a room should be kept minimum since large number of doors causes obstruction and consume more over area in circulation.

2 The location of door should meet functional requirements of a room. It should not be located in the centre of the length of a wall. A door should preferably be located near the corner of a room, nearly 20 cm away from the corner.

3 If there are two doors in a room, Then they should preferably be located in opposite walls facing each other, so as to provide good ventilation and free air circulation in the room.

4 The size and number of windows should be decided on the basis of important factors, such a distribution of light control of ventilation and privacy of occupants.

5 The location of a window should also meet the functional requirements of the room such as interior decoration, arrangement of furniture etc.

6 A window should be located in opposite walls, facing a door or another window, so that cross ventilation is achieved.

7 Form the point of view of fresh air, a window should be located on the northern side of a room or located in the prevalent direction of wind.

8 The sill of a window should be located about 70cm-80cm above floor level of the room.

Types of doors

Objectives: At the end of this lesson you shall be able to
- **state the different types of doors**
- **determine size of doors**
- **state the use and function of door.**

Types of door

- Ledged door
- Ledged and Braced door
- Ledged and framed door
- Ledged, framed and braced door

Ledged door (Fig 1)

This is the simplest type of the door and it is used for narrow opening where the strength and appearance are not important.

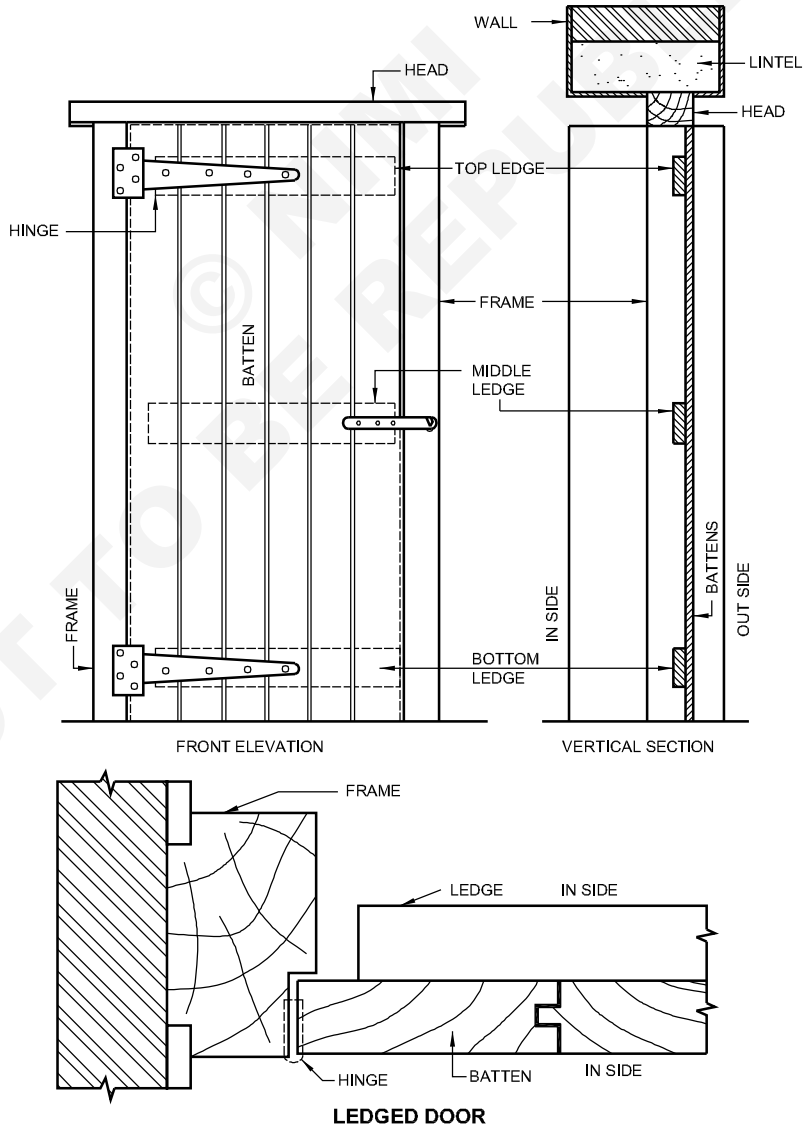
The door consists of vertical pieces called battens.

The battens are usually tongued and grooved and are joined together by using horizontal support pieces.

The horizontal support pieces are called the “LEDGES”.

The common batten sizes are 100 mm to 150 mm wide and 20 mm to 30 mm in thickness.

Fig 1



The ledges are 100 mm to 200 mm wide and 25 mm to 30 mm thickness.

Three ledges are generally used as top, middle and bottom on battens.

The door is hung on 'T' hinge which are fixed on ledges using by suitable wood screws.

Ledged and braced door (Fig 2)

These doors differ from ledged door except that the diagonal or inclined member called "Braces" are provided to give more strength

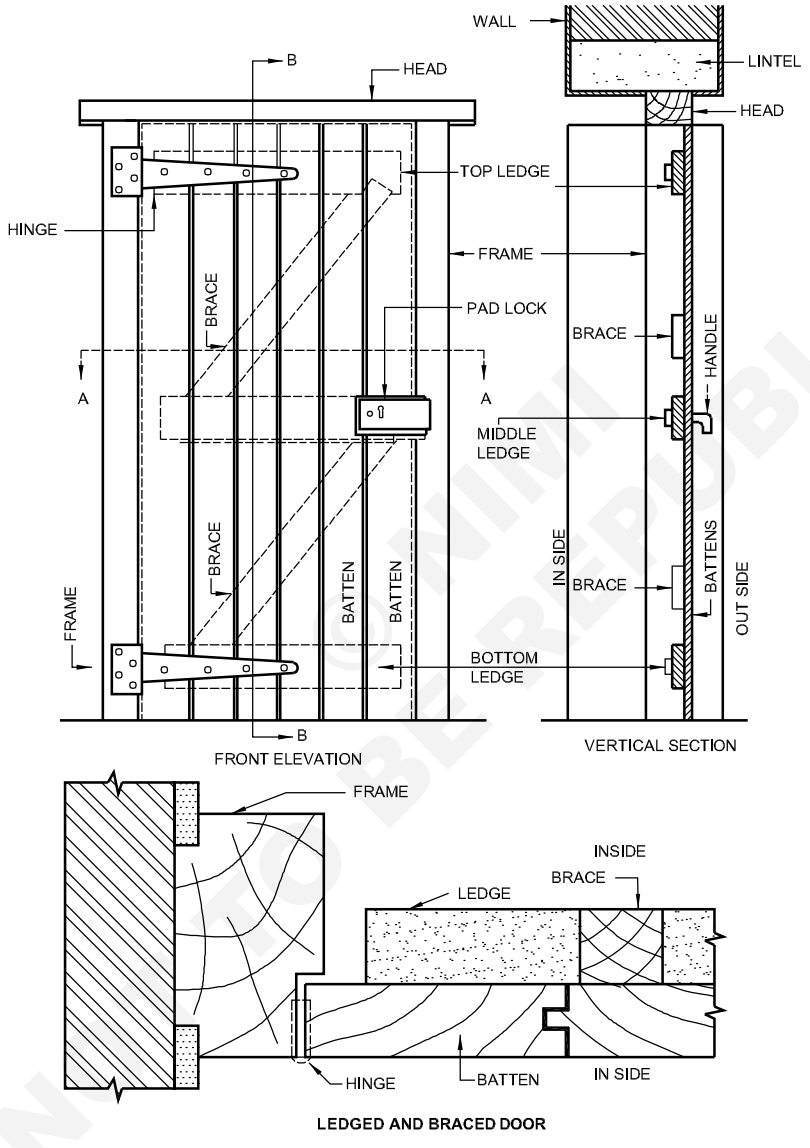
These doors can be used where the wide-opening are required.

The braces are generally 10 cm to 15 cm wide and 2.5 cm to 3 cm thickness.

The braces are usually housed in the ledges.

It is important that the braces must slope upwards from the hanging side, as they have to work in compression and not in tension.

Fig 2



LEDGED AND BRACED DOOR

CAN2515712

Ledged and framed door (Fig 3)

These doors are modified and differ from the ledged door.

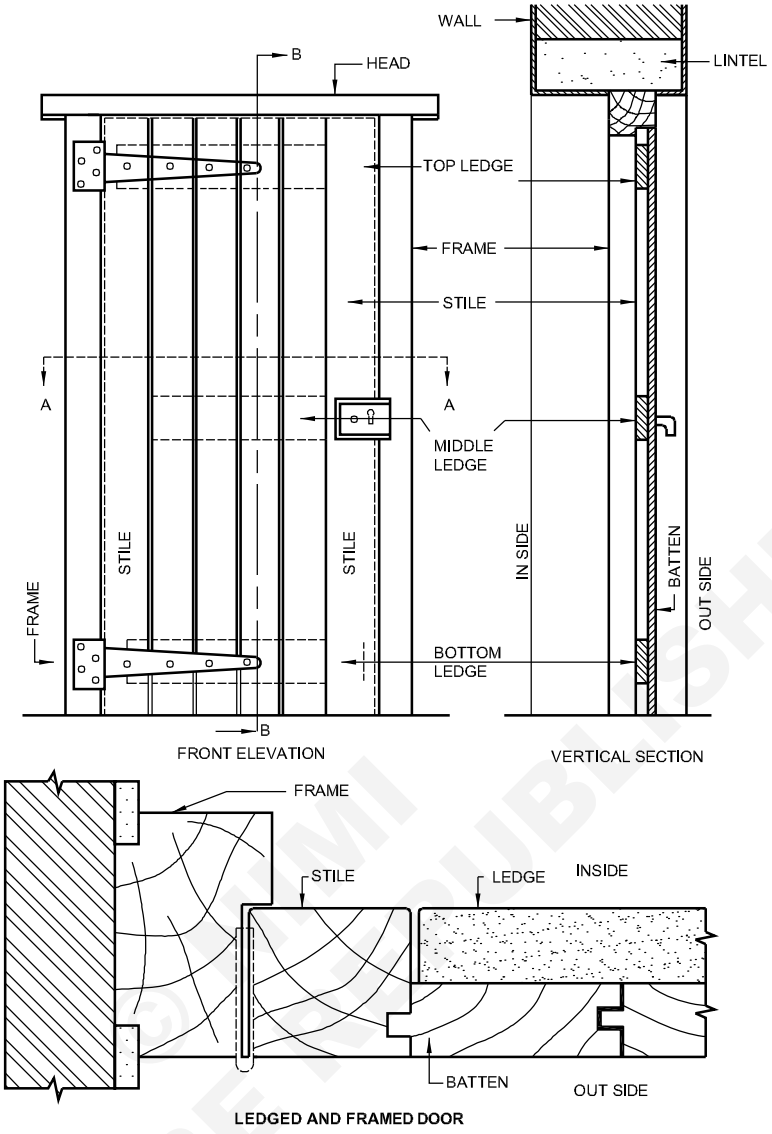
A frame work for the shutter is provided in the form of vertical pieces called "STILES" to make the door stronger and good in appearance.

The stiles are generally 10 cm wide and 4 cm thick.

The battens and three ledges are provided as usual.

The thickness of stiles are equal to the thickness of ledges and the thickness of battens.

Fig 3



Ledged, braced and framed door (Fig 4)

These doors differ from the above three doors.

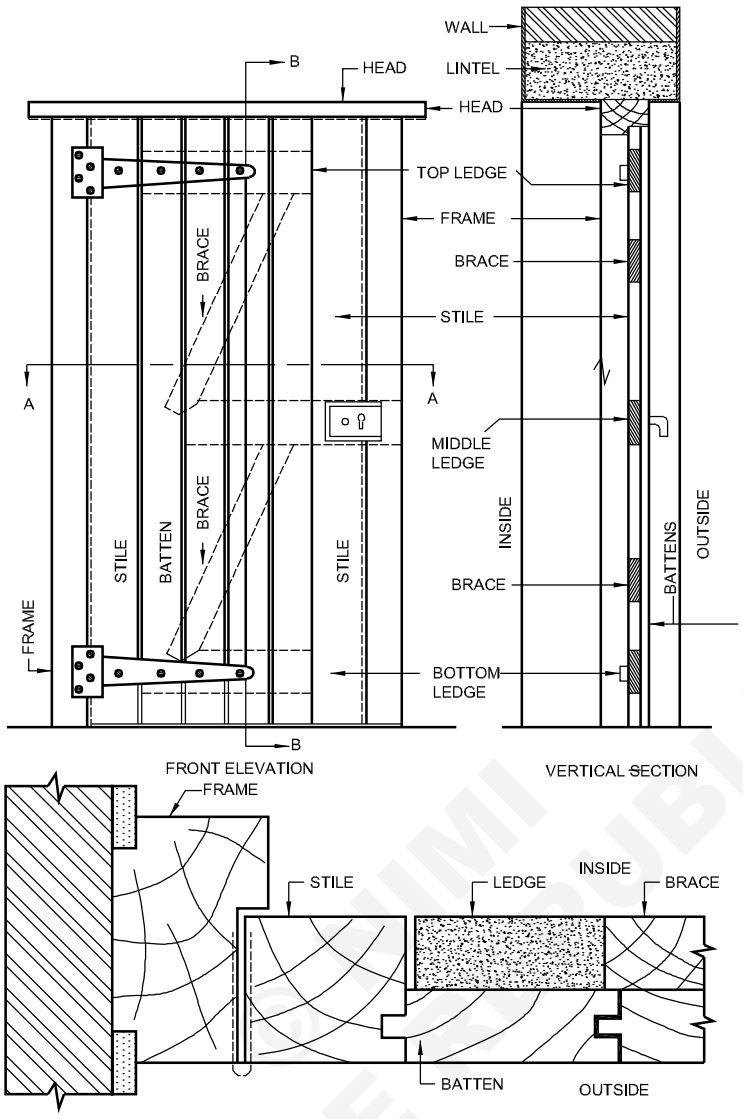
An additional braces provide diagonally between the ledges to increase more strength, good appearance and more durability of the door.

These doors consist of two stiles, three ledges and two braces.

The battens are joined together used by tongued and grooved and 'V' joints.

The braces are normally housed into the ledges at about 3.5 cm to 4.5 cm from the stiles of the door.

Fig 4



LEDGED-BRACED AND FRAMED DOOR

CAN2515714

Types of panel doors

Objectives: At the end of this lesson you shall be able to
- **state the different types of panel doors**
- **determine size of doors**
- **state the use and function of panel door**
- **select the correct wood, block board, plywood, and glass.**

These type of doors are widely used in almost all type of buildings since they are strong and give better appearance than battened doors. This door consists, of frame-work in the form of vertical members called stiles and horizontal member called rails which are grooved along the inner edge of the frame to receive the panels. The panels are made from timber, plywood, block boards, A.C sheet or even glasses. Panelled doors are of various types such as.

Framed and panelled door (Figs 1 & 2)

This is the common type of door used in all kinds of buildings.

This door consists of a frame work with vertical members called "STILES" and the horizontal members called "RAILS".

The stiles and rails are grooved along their inner edges of the frame work to receive the panels.

This type of doors strong, gives a good appearance and reduces the tendency of shrinkage.

The panels are made from wood, plywood and glass etc.

A door can have one panel to multipanel as required.

In the vertical sub division of panels, the vertical pieces are called "MULLIONS"

The stiles are continuous from top to bottom and they are in a single piece.

The top rail, middle or lock rail and bottom rail are joined to the stiles.

The stiles and rails are joined by using the mortise and tenon joint.

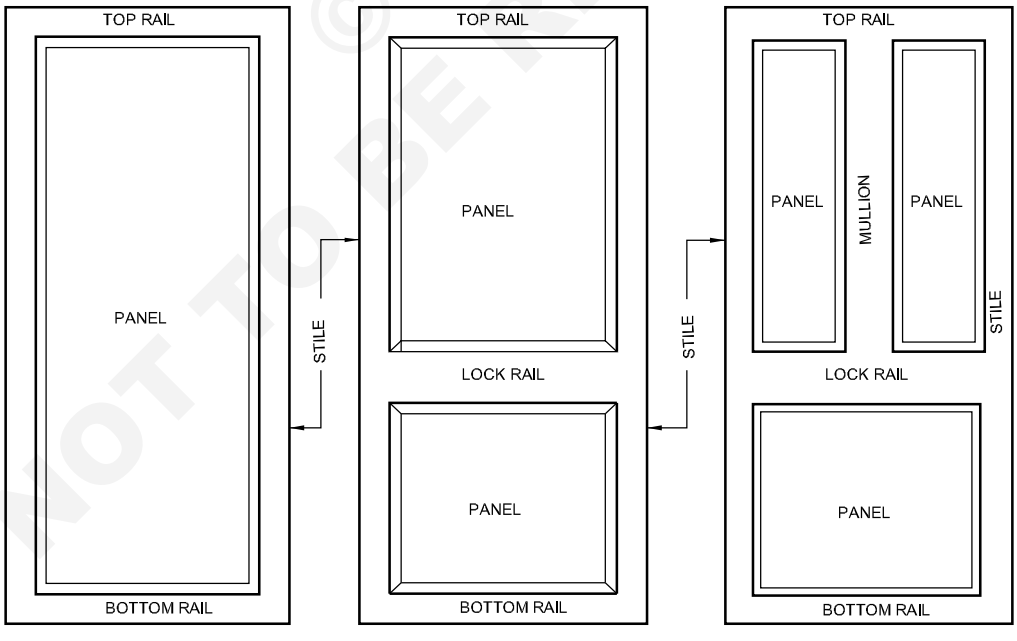
The bottom and lock rails are made wider than the top rail.

The thickness of the stiles usually about 3cm to 4cm.

The thickness of the panel is about 20mm.

For small opening the single leaf shutter and the large openings the double leaf shutters are used.

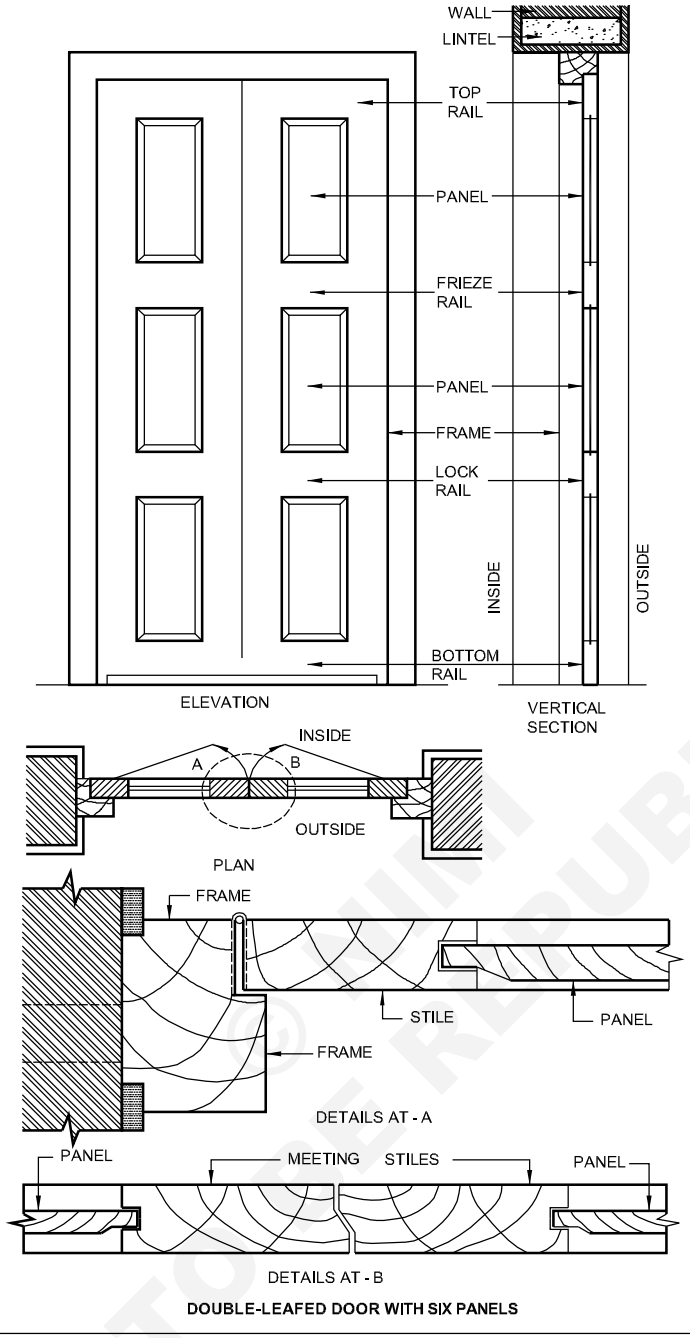
Fig 1



FRAMED AND PANELLED DOOR

CAN25159I1

Fig 2



DOUBLE-LEAFED DOOR WITH SIX PANELS

CAN2515912

Glazed or sash door (Fig 3 a,b,c)

These doors are provided where the additional light is required to be received to the room through the doors and windows.

These doors may be fully glazed or partly panelled and partly glazed.

These doors are useful for residential house, office, hospital, school, college, show room, shopping etc.

The ratio of the glazed portion to panelled portion is 2:1.

The bottom 1/3 height is panelled and the top 2/3rd height is glazed.

The glass is placed into rebates provided with wooden bars fixed by wire nails, putty or wooden beads are fixed to the frame.

To increase the space of the glazed portion the width of the middle rail (lock rail) is decreased.

This lock level is called as the diminished stiles or gunstock stile.

Flush door (Figs 4 & 5)

The flush door consists of a frame work of stiles, rails and it is covered with plywood.

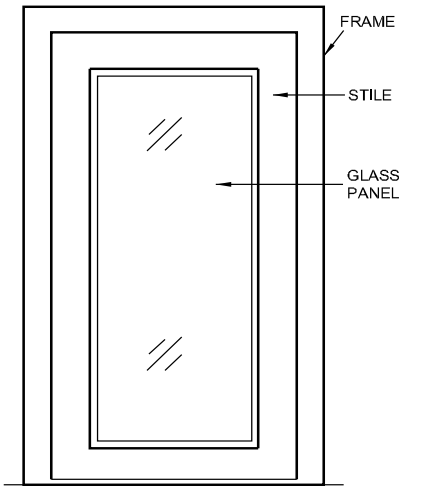
The framed flush door consists of stiles, top rail, lock rail, bottom rail, horizontal ribs vertical ribs and plywood.

Holes are provided in horizontal ribs for air circulation.

The top and bottom rails are used for holding the cores.

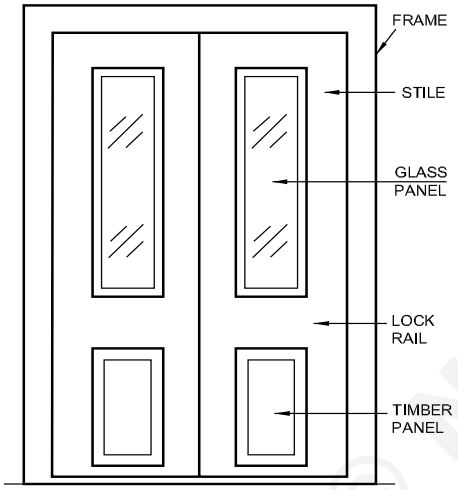
The vertical ribs rest on rails.

Fig 3



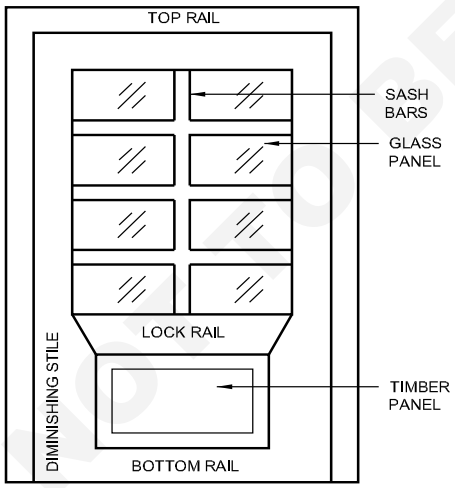
(A)

FULLY GLAZED DOOR



(B)

PARTLY PANELLED AND PARTLY DOOR



(C)

DOOR WITH DIMINISHING STYLES

GLAZE DOOR

CAN2515913

The core strips of timber glued together under the pressure and the plywood sheets are faced on both the sides of the frame.

Sometimes block board, partial board are faced with plywood sheets.

The laminates of wood (core) are glued together under great pressure.

The laminated flush door is heavy and it requires more material for constructions.

The flush doors are available in market from various standard sizes.

The thickness of ply wood facing is about 4mm to 6mm on both the sides.

The total thickness of a flush door varies from 25mm to 40mm.

The flush door are economical, good in appearance, strong enough, not much affected by moisture, termite and crack proof.

For the manufacture of flush door the timber should be properly seasoned and the moisture content should be reduced.

The termites proof treatment should be given in all the timber work.

The flush door should be suitable heated and pressed in hot pressure

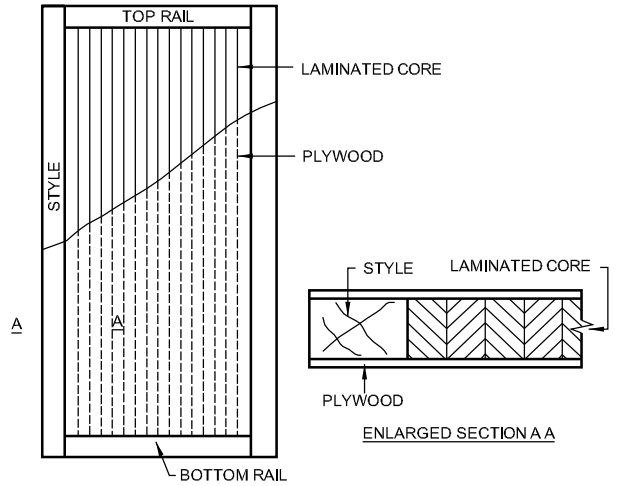
In case of laminated flush door it is not necessary to provide lock block and hinge block.

In case of framed flush door it is necessary to provide lock block and hinge block

Now a days the flush doors are becoming popular because of their good appearance, construction, strength and durability.

These doors reconsists of solid, semi-solid and skeleton core covered on both the sides using with plywood.

Fig 5



LAMINATED FLUSH DOOR

CAN2515915

Louvered doors (Fig 6)

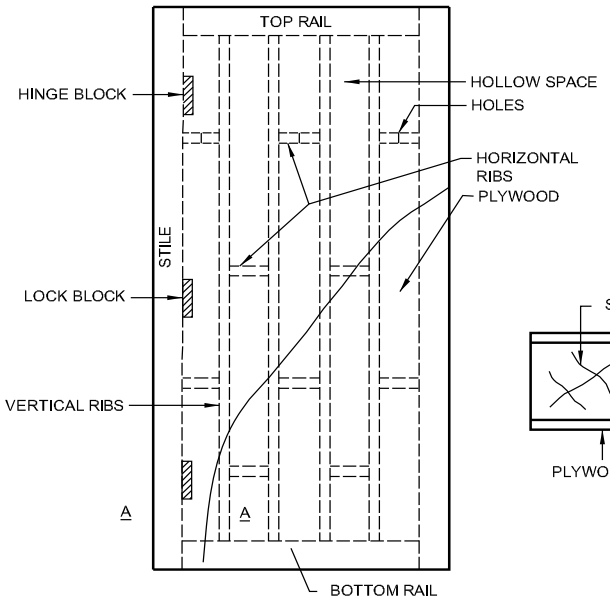
In this types of doors the shutters are provided with Louvers.

The doors may be louvered either to its full length or partially with panelled.

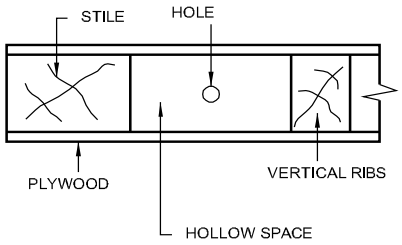
The louvers are arranged at an inclinations that the horizontal vision is obstructed.

The upper back edge of the louvers is higher than the lower edge of the louvers just above it.

Fig 4



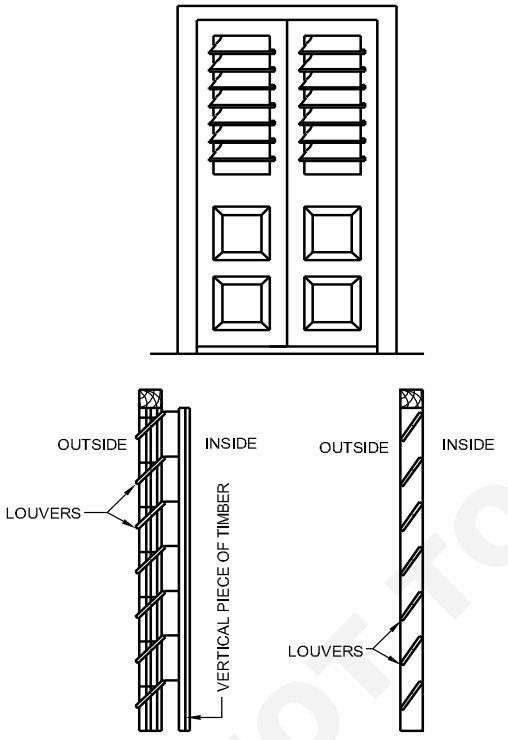
FRAMED FLUSH DOOR



ENLARGED SECTION ON AA

CAN2515914

Fig 6



LOUVERED OR VENITIAN DOOR

CAN2515916

The louvers may be either fixed or movable. In case of movable the louvers are attached with the movable vertical wooden piece through hinges.

The movements of louvers can be carried out by the vertical piece of wood.

The louvers are made of either by glass, wood or plywood.

The louvered doors allow free ventilations and at the same time be maintain sufficient privacy of the room.

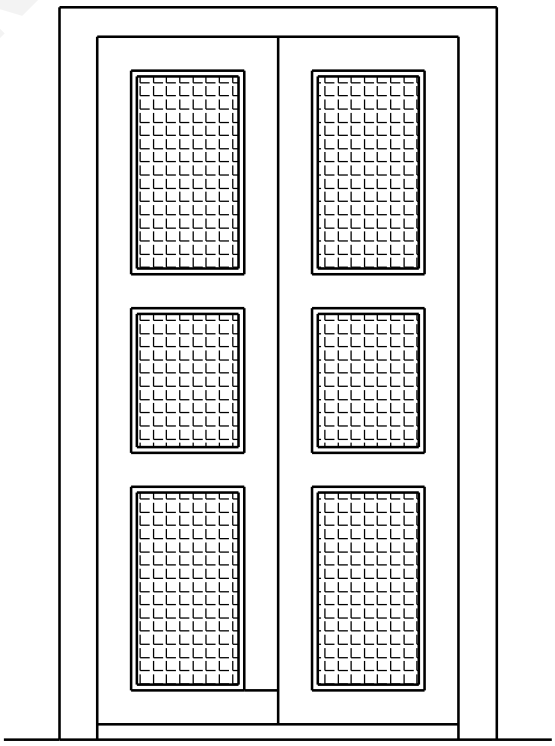
The arrangements of louvers prevents the entry of moisture from out side.

The louvered doors are used mostly for public places (sanitary blocks) and residential building (bathroom and latrin)

These doors collect the dust easily and very difficult to clean it.

Wire gauged doors (Fig 7)

Fig 7



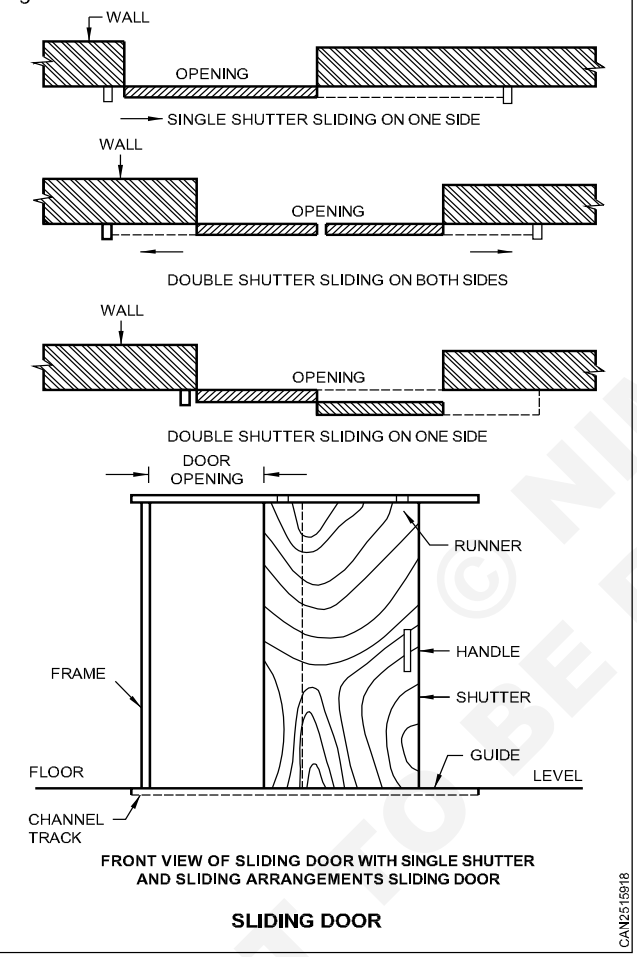
WIRE GAUGED DOOR

CAN2515917

These types of doors are provided to check the entry of flies, mosquitoes, insects etc. Wire mesh is provided in the panels and therefore they permit free passage of air. Such doors are commonly used for refreshment room,hotels, cup-boards containing eatables in sweet shops etc. The door is formed of wooden framework consisting vertical stiles and horizontal rails and the panel openings are provided with fine mesh of galvanized wire gauges. The wire gauge is fixed by means of nails and timber beadings. Generally the door has two shutters. The inner shutter is fully panelled and the outer shutter is fully panelled and the outer shutter has wire gauged panels.

Sliding doors (Fig 8)

Fig 8



In sliding doors the shutter slides on the sides with the help of runners and guide rails.

The shutters may have one or more leaves and it can slide either one side or both the sides.

The sliding door doesn't cause any obstruction during the movements.

The sliding doors are used for the entrance of the godown, sheds, shops and show rooms etc.

These doors are provided with handle, locking arrangements and stopper.

Swing door (Fig 9)

The swing doors are provided with special hinge called as "DOUBLE ACTION SPRING HINGE".

The shutters of the door always held in closed position when the door is not in used.

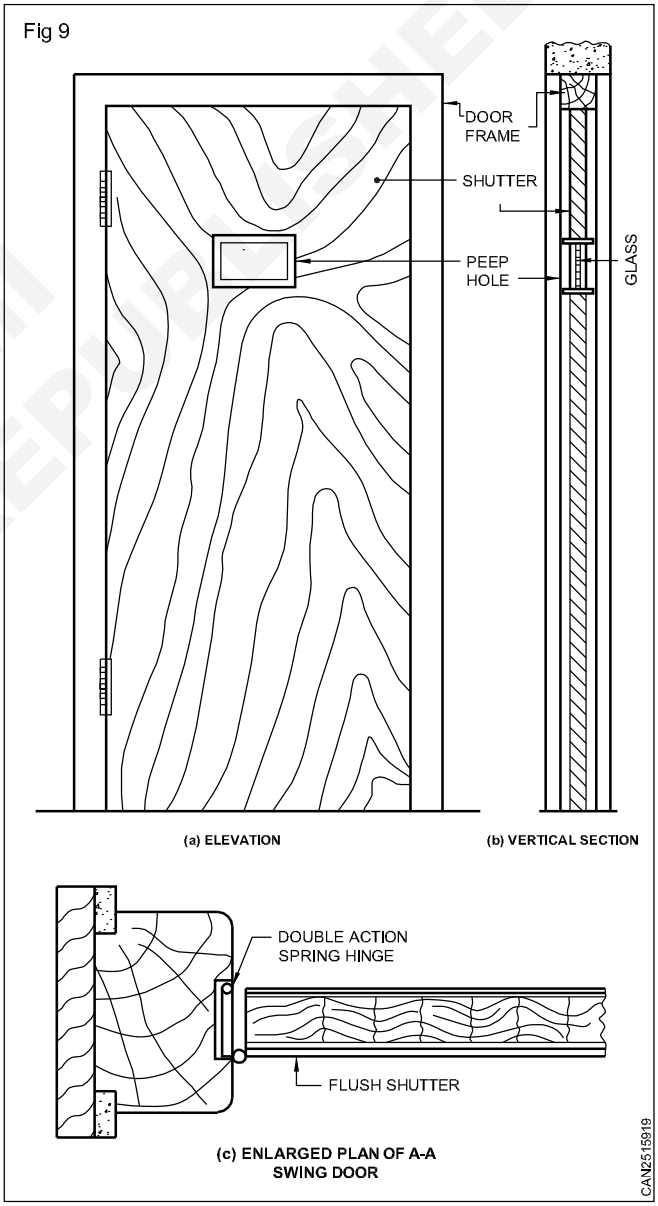
The door can move both inward and outward direction as desired.

When the door is to be used, a slight push is made and then the action of spring hinge bring the shutter open or closed position.

As the turn of the shutter is with force, it is desirable to provide glazed shutter.

To avoid the accident to the door users it is necessary to provide a peep hole at the eye level.

Fig 9



Window frame and shutter - uses

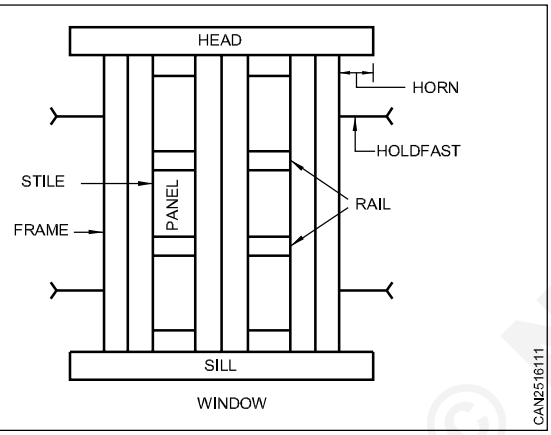
Objectives: At the end of this lesson you shall be able to
- **state the constructional details of window frame and window shutter**
- **state the types and uses of window shutters.**

A window consists of a window frame and a window shutter frame or sashes.(Fig 1).The window frame are fixed to the opening in the wall by means of suitable hold fast.

The shutter frame or sashes are fixed to the window frame by means of hinges. The bottom piece of the window frame is called 'Sill'.

The windows are used to get the light and air to the room through it. Different types of windows are used based on the nature of shutter movement, material used for the building.

Fig 1



Recommended dimensions for Windows

No.	Designation	Size of opening (mm)	Size of window (mm)
1	6 WS 12	600 x 1200	590 x 1190
2	10 WT 12	1000 x 1200	990 x 1190
3	12 WT 12	1200 x 1200	1190 x 1190
4	6 WS 13	600 x 1300	590 x 1290
5	10 WT 13	1000 x 1300	990 x 1290
6	12 WT 13	1200 x 1300	1190 x 1290

Recommended designation for windows- Note :

a 6 WS 12 Denotes a window opening with single shutter (WS) having width equal 6 modules i.e., 600mm and height equal to 12 modules i.e., 1200mm

b 10 WT 13 Denotes a window opening with double shutters (WT) having width equal to 10 modules i.e., 1300mm.

Types of windows

- Casement window
- Pivoted window
- Sliding window
- Glazed or sash window
- Louvered window
- Bay window
- Corner window
- Dormer window
- Skylight window
- Clear storey window
- Lantern window
- Ventilators
- Gable window

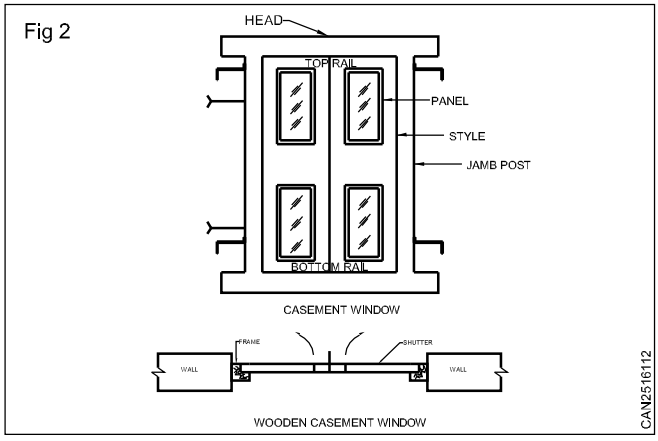
Casement window (Fig 2)

These windows are common type of windows used in building construction. The construction of this window is similar to the door construction.

The shutter of this window open is like the shutter of the door. The shutter consist the stiles, top and bottom rails, panels and mullion.

The panel may be fully glazed, partly glazed or unglazed. The window frame is rebated or groveed to receive the window shutters.

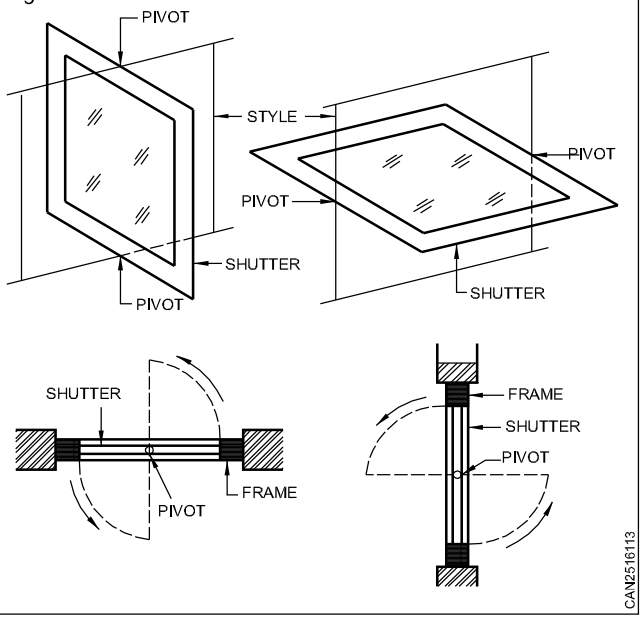
Fig 2



Pivoted window (Fig 3)

The pivoted window is similar to the casement window except that no rebates are provided in this construction.

Fig 3



The window shutters are allowed to swing round the pivots. The shutters can be swing or rotate either vertically or horizontally round the pivots. These windows can clean easily and it gives more lights to the room. These windows are used in hospitals, offices, and residential houses.

Sliding windows

These windows are similar to the sliding doors. The shutters slide on either horizontally or vertically on the roller bearings.

Necessary opening or grooves are provided in the frame to receive the shutters when they are slided to open the window. These windows are used in banks, office counters, buses and trains etc.

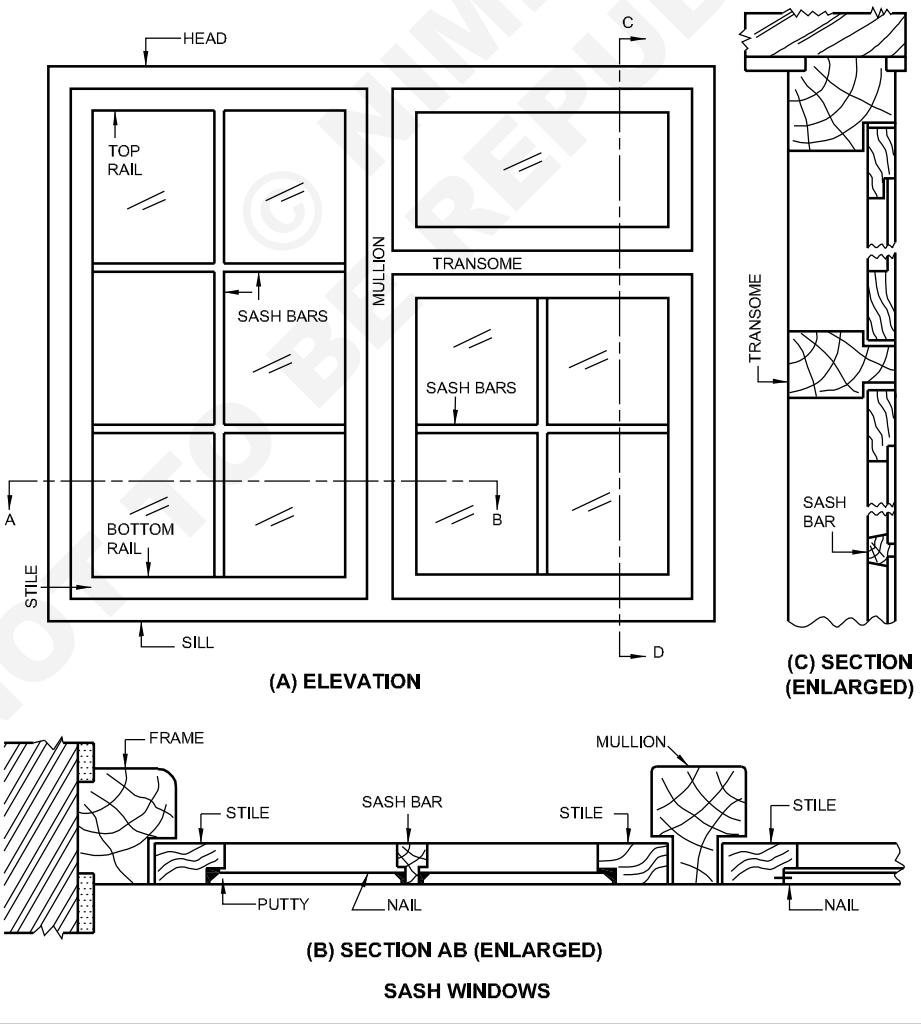
Glazed or sash window (Fig 4)

These windows are also similar type of casement window. In these windows the panel are fully glazed.

In between the top and bottom rails the spaces are divided into panel by means of horizontal and vertical members are called sash bars or glazing bars.

The sashes are rebated to receive the glass panels. The width and depth of the rebates are about 15 mm x 5 m respectively. The glass panels are fixed in position either by putty or by glazing beads by means of nails.

Fig 4



Louvered windows (Fig 5)

These types of windows are similar to the louvered doors. These windows allow free circulation of air when chased and they maintain sufficient privacy.

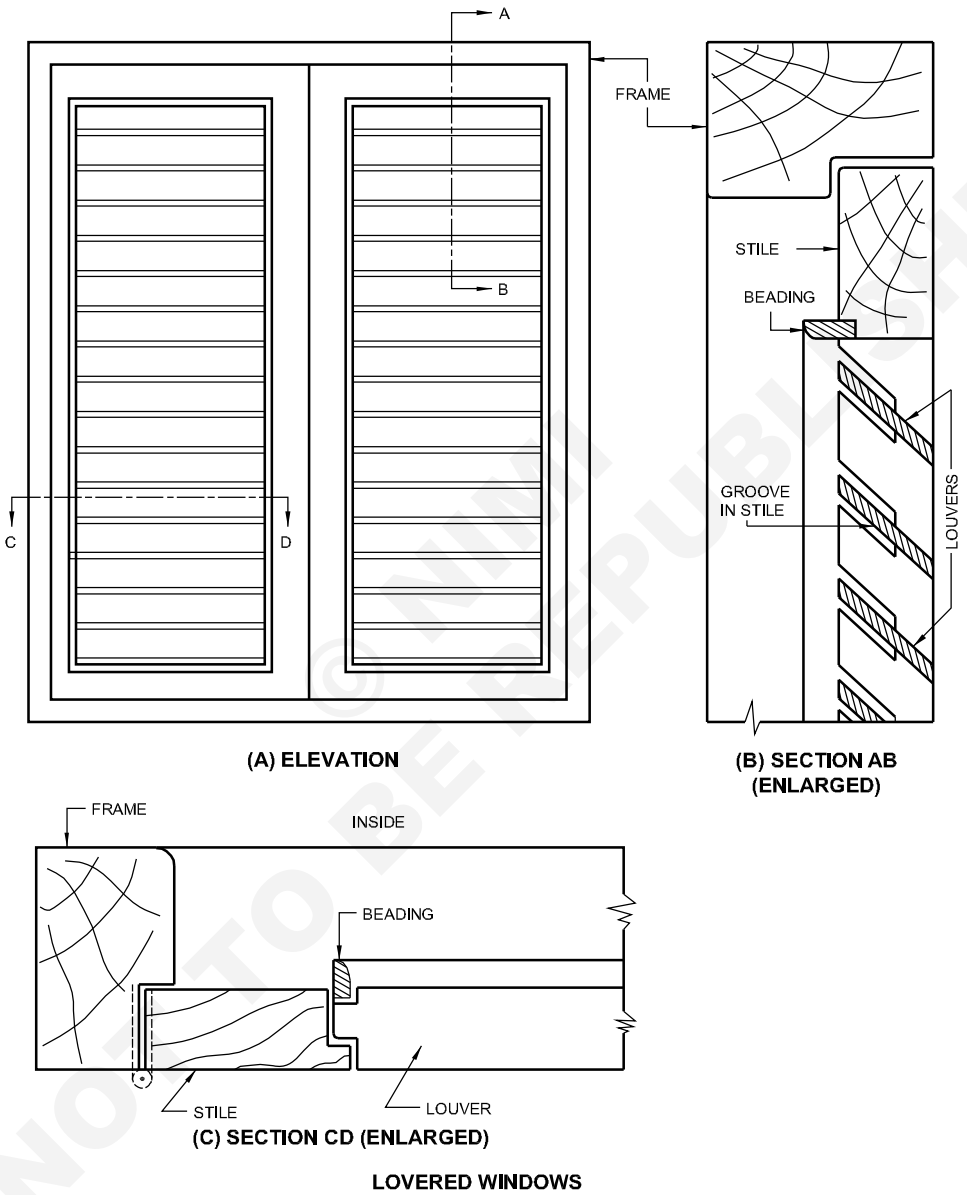
The shutter of these windows consist of top and bottom rails and two stiles and they are grooved to receive the louvers.

The inclination angle of louvers is 45° and they are generally fixed in position. The louvers should slope down ward to the outside of the shutter so that the rain water does not enter inside the construction.

The venetian shutters are provided in which the louvers can open or close. The louvers are made of wood, and slates pivoted at both the ends in the frame. All the blades are connected by small hinge to a vertical pattern.

Some mechanical operating device are provided to raise and lower the louvers. When the pattern is pulled up or down the gap between the blades are open or closed.

Fig 5



LOVERED WINDOWS

Bay windows (Fig 6)

These windows project outside the external walls of a room. These windows projection may be rectangular, square, circular, triangular, polygonal or of any shape.

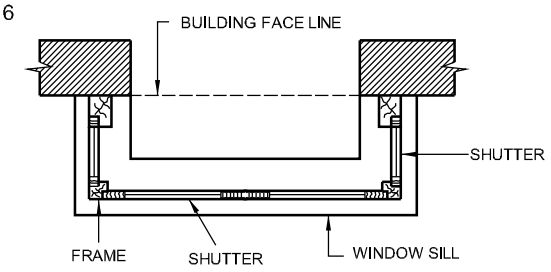
The projection of bay windows may start from floor level or sill level. These windows admit more light, increase opening or provide ventilation and improve the appearance of the building.

Corner windows (Fig 7)

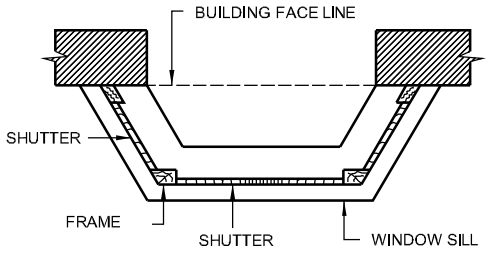
This is a special type of window to compare the other windows. These windows are provided at the corner of a room of the building.

They have two faces in two perpendicular directions. Out to this arrangements there is entry of light and air from two directions. A special lintels will have to be cast at the corner. The jam post of the window at the corner will have to be made of heavy sections.

Fig 6



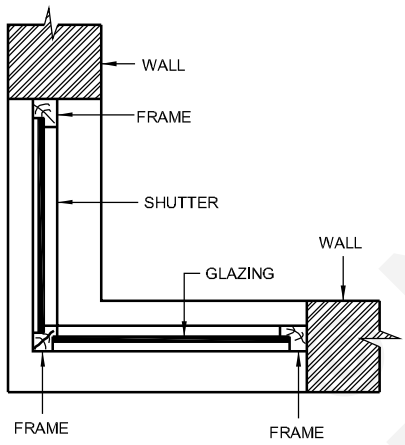
SQUARE BAY WINDOW



SPLAYED BAY WINDOW

CAN2516116

Fig 7



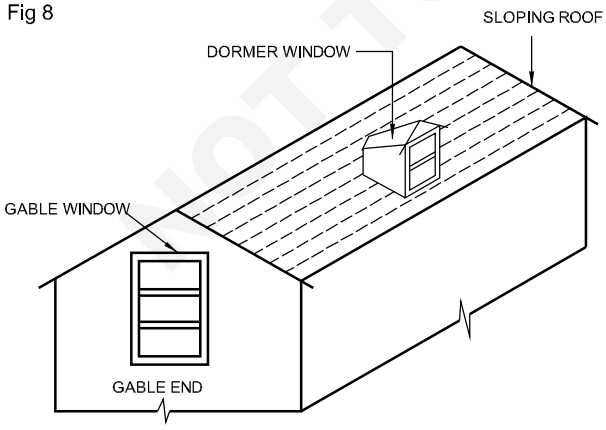
CORNER WINDOW

CAN2516117

Dormer windows (Fig 8)

These windows are vertical windows and they are provided on a sloping roof of the building.

Fig 8



CABLE WINDOW AND DORMER WINDOW

CAN2516118

The main purpose of providing the dormer window is to admit more light and air to the rooms which are constructed within or below the roof slope. These windows are gives very good appearance of the building.

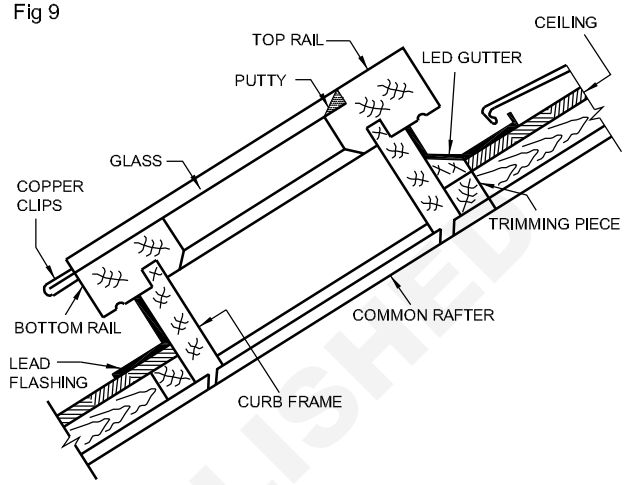
Gable window (Fig 8)

The gable windows are vertical windows which are provided in the cable end of the pitched roof.

Skylight windows (Fig 9)

These windows are provided on the sloping surface of a pitched roof. These windows are projects above the top sloping surface of a roof.

Fig 9



CAN2516119

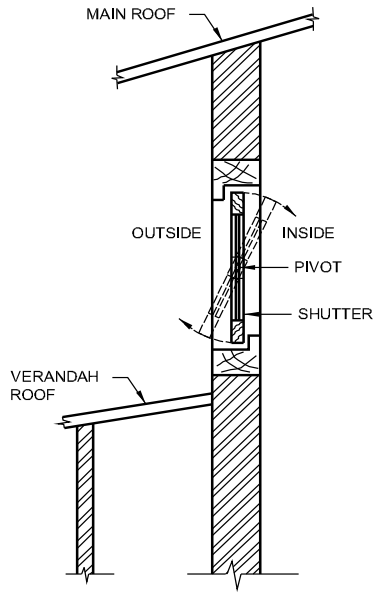
The common rafters are suitable trimmed and the skylights are erected on curb frame with the sky light windows are usually provided with the fixed glass panels.

The opening of sky light is properly treated by bead flashing to make water-proof the roof area surrounding the opening.

Clere-storey windows (Fig 10)

These windows are used if the room has greater ceiling height than the surrounding room of when a lean-to-roof of low height is there adjacent to the rooms. These windows are generally provided near the top of main roof and they open above the beam to roof.

Fig 10



CLERESTOREY WINDOW

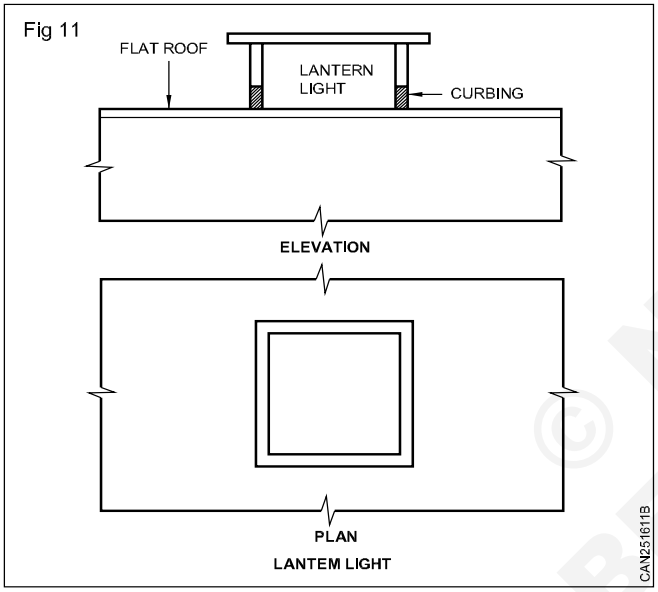
CAN2516111A

The window shutter swings on two horizontal shutters provided on side stiles. The window shutters can be open or close by means of two cords. On cord is attached to the top rail and the other open is attached to the bottom rail of the shutter. Care should be taken to see that the upper part opens inside and the lower part opens outside. Otherwise the rain water will accumulate inside the room. It is necessary to provide a suitable rainshed over the window. These windows are increase the appearance the building.

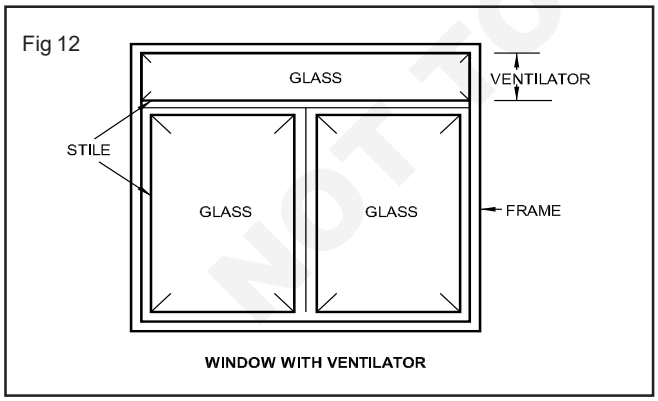
Lanterns windows (Fig 11)

These windows are fixed on the flat roof to provide more light and air to the inner part of the building where the light is coming from the window in the external wall is insufficient.

These windows are square, rectangular and circular in shape.These windows project above the roof level. The glass panels are generally fixed with the shutters. These windows admit the light either through faces or inclined faces.



Ventilators (Fig 12)

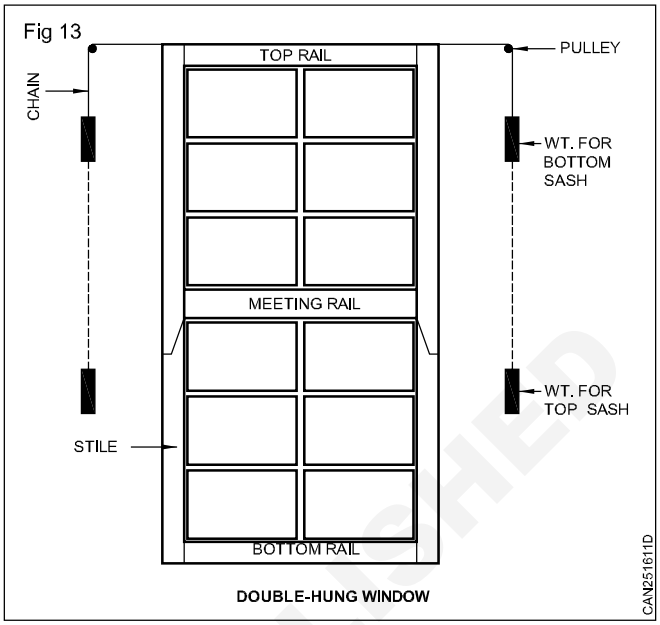


The ventilators are similar to the windows but smaller in size. The ventilators are fixed in more height than the window, generally about 25cm to 50cm below the roof level.

The ventilators has a frame and a shutter, generally the shutters are glazed which is horizontally pivoted. The shutters can be opened or closed by means of cords.

The top edge of the shutter open inside the room and the bottom edge of the shutter opens out side the building, so that the rain water is excluded.

Double hung windows (Fig 13)



These windows consist of a frame and a pair of shutters. The shutters are arranged one above the other. These shutters are slides vertically with in the grooves provided in the window frame.

The windows can be opened at top and bottoms to any desired extent. A pair of metal weight connected by a cord or chain over pulleys is provided for each sash.

The chain or the cord is fixed to the stile. The pulleys are fixed to the frame. When the weight is pulled the shutter opens to the required extent.

The upper sash moves in downward directions thus opening at the top. The lower sash moves in upward direction thus the opening at the bottom.

The ventilation can be controlled and cleaning of shutters can be carried out easily. A small parting bead is provided to separate the two shutters when they are opposite to each other.

Recommended dimensions for ventilators

No.	Designation	Size of opening (mm)	Size of ventilator frame (mm)
1	6 V 6	600 x 600	590 x 590
2	10 V 6	1000 x 600	990 x 590
3	12 V 6	1200 x 600	1190 x 590

Recommended designation for ventilators - Note :

a 10V6 Denotes a ventilator (V) opening with equal to 10 modules i.e., 1000 mm and height equal to 6 modules i.e., 600mm.

Roofs and trusses

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of a roof**
- **state the technical terms used in roof construction**
- **state the types and uses of roofs.**

The roof is the upper most part of a building which is constructed in the form of frame work to give protection to the building against rain, heat, wind and snow.

A roof consists of structural elements provided at the top of building for the support of roof covering

The roof and roof covering receives the rain, snow directly

It is essential to provide a positive barrier for the entry of moisture in the building.

Requirement of a roof

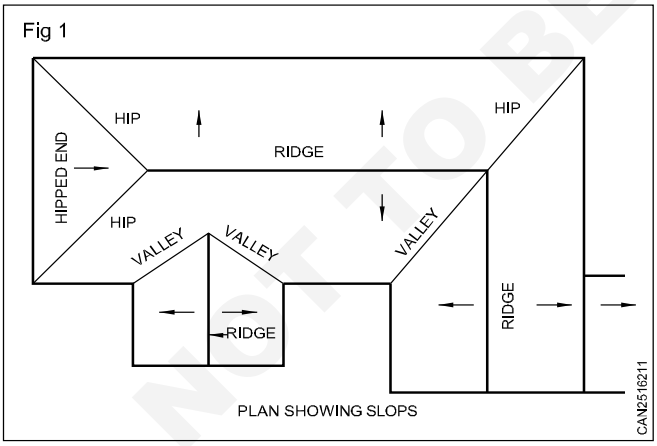
- A roof should have adequate strength and stability to carry the loads.
- A roof should be a effectively protect the building against rain wind and sun.
- It should be well drained and efficient water proof arrangement.
- It should be a fire resistant.
- It should grant a desirable insulation against sound and heat.

Technical terms used in roofing construction (Fig 1)

Span

The horizontal distance between the internal faces of walls

Fig 1



or supports

Rise

The vertical distance between the top of the ridge and the wall plate.

Ridge

A wooden piece provided at the ridge line of a sloping roof is called ridge.

Pitch

The inclination of sides of a roof to the horizontal plane. The pitch can be expressed either in terms of degree or as ratio of rise to span.

Eaves

The lower edges of the inclined roof surface is called eaves. A thin board of wood is provided at the eaves to cover the ends of the common rafts called eaves board. The rain water from the roof surface drops down.

Hip

The angle formed at the intersections of two roof slopes are called the hip.

Valley

It is a reverse of a hip. It is formed by the intersections of the roof surfaces, making an external angle less than 180°.

Hipped end

It is the sloped triangular surface formed at the end of the roof.

Verge

The edge of a gable, running between the eaves and ridge.

Ridge piece

It is the horizontal wooden member in the form of a beam or board. It is provided at the top of a roof truss. It is supporting the common rafter fixed to it.

Common Rafter

These are the inclined wooden members running from the ridge to the eaves.

They support the battens or boards to support the roof coverings. The common rafter are used at the centre distance of 30cm to 45cm.

Purlins

The wooden pieces which are placed horizontally on principal rafter to carry the common rafter are known as the purlins.

Hip rafter

These are the sloping rafters which form the hip of a sloped roof.

The rafter run diagonally from the ridge to the corner of the wall to support the roof covering. They receive the ends of the purlins and ends of the jack rafters.

Jack rafters

These are the rafter shorter in length than the common rafter.

Valley rafter

These are the sloping rafters which run diagonally from the ridge to the eaves for supporting valley gutters.

They receive the ends of jack rafters on both sides.

Eaves board

These boards are fixed to the feet of the common rafters at the eaves. The ends of the lower most roof covering material rest up on it.

It is usually 25 mm wide and 25 mm thick in size.

Barge board

These are the wooden boards or planks fixed on the gable end of a roof. These boards are connect the ends of ridge, purlin and wall plates.

Wall plates

These are the long wooden members which are embedded on top of wall to receive the common rafters.

The wall plates actually connect the walls to the roof.

Post plate

These posts are similar to the wall plate. These plates run continuous, parallel to the face of the wall over the top of the post and support the rafter at their feet.

Batten

Battens are thin wooden strips (some times called scantling).

The battens are nails to the rafter or ceiling. They support the roof ceiling

Template

Templates are square or rectangular blocks of stones or concrete plate.

They are placed under a beam or truss to spread the load over a large area of the wall.

Cleats

Cleats are small block of wood or angle iron and they are fixed on the principal rafters of the truss.

Cleats are used to support/prevent the sliding of purlins.

Truss

Actually a roof truss is a frame work, it is triangular in shape.

They designed to support the roof covering or ceiling over the rooms.

Dragon beam

The lower end of a hip rafter is generally supported on a diagonal piece of wood which is laid across the corner of the wall.

The diagonal wooden piece is known as dragon beam.

Types of roofs

- Pitched or sloping roof
- Flat or terraced roof
- Curved roof

Types of pitched roofs

- Single roofs
- Double or purlin roofs
- Trussed roofs

Types of single roofs

- Lean to roof

Types of double roofs

- Couple roof
- Couple closed roof
- Collar beam roof
- Collar and scissors roof

Types of trussed roof

- King post roof truss
- Queen post roof truss

Single roof

In these types of roofs the common rafters are placed on wall plates.

The common rafters are not provided of any intermediate supports

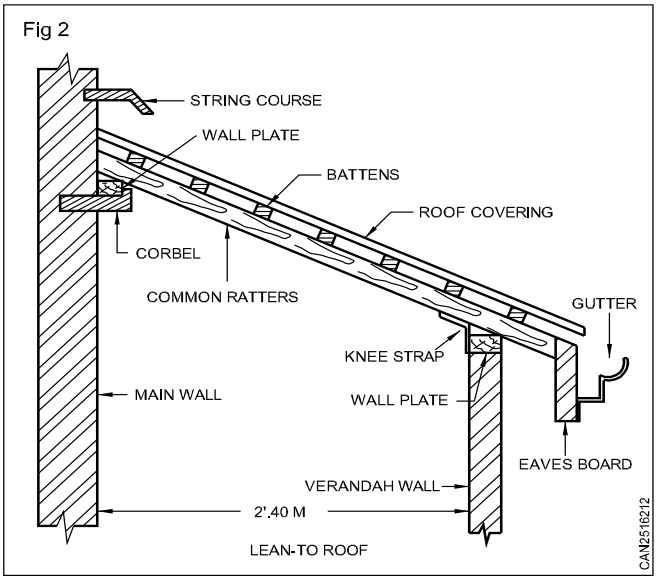
Single roofs are used where the span in not more than 2.5 meters.

Lean - to - roof (Fig 2)

This is the simplest form of pitched roof. These roofs are called pent roof or aisle roof. The slope of the roof in a building of one side only

In lean to roof one wall is carried up sufficiently higher than the other one to give the necessary slope to the roof.

Fig 2



The wooden wall plate is supported either on a steel corbel or a stone corbel which are provided at a centre distance of 1 meter.

The wall plate, are embedded on the other side to the wall or pillars

The common rafters are suitably secured on the wall plates. The eaves boards, batters and roof covering are provided on the common rafter.

The common rafters are nailed to the wooden wall plate at their upper ends. and notched and nailed to the wooden post plate at their lower end.

The roof are commonly used for sheds, out house of the building and varandha.

The roofs are very much suitable for the span distance not more than 5 meters.

Couple roof (Fig 3)

This type for roof is formed by a couple of common rafter.

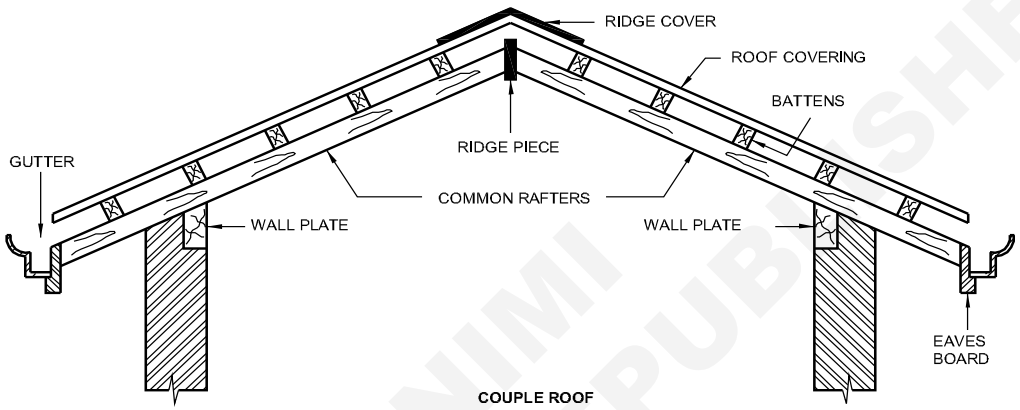
The common rafters slope upwards from the opposite walls and they meet on middle of the ridge piece.

The upper end of each common rafter begin firmly nailed on the ridge piece and the lower end being notched and nailed to the wooden wall plates.

These roofs has the tendency of spread out at the feet (wall plate level and push out with force the walls, supporting the wall plates.

A couple roof can be used where the span is up to 3.5 meters.

Fig 3



COUPLE ROOF

Couple-close roof (Fig 4)

This roof is similar to the couple roof except that the ends of the common rafter are connected by a horizontal beam called “tie beam”

The tie beam helps to prevents the common rafter from spreading and thrusting out of the wall. The tie beam may be a wooden structure or steel rod structure.

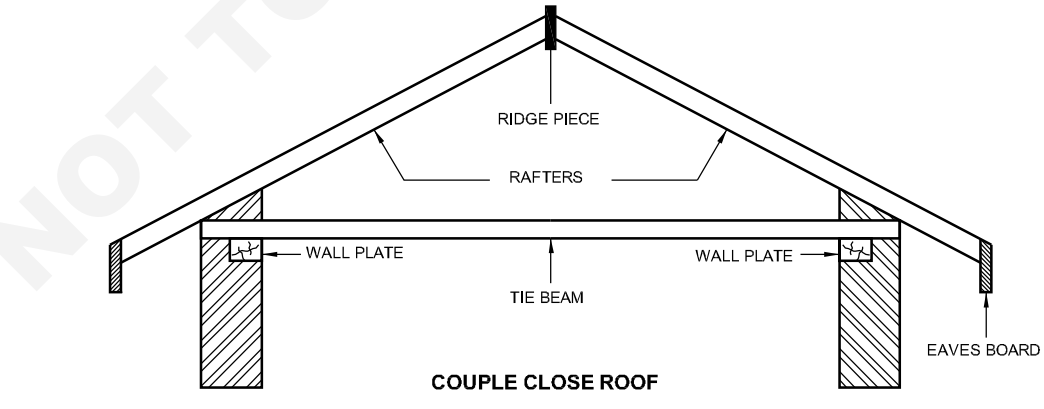
The tie beam can also be used as a ceiling joist where required.

For increased span or for the greater load the rafters may have the tendency to “Sag” in the middle.

This “Sag” can be prevented by providing a central rod connecting the ridge piece and tie beam.

A couple close roof can be used the span upto 4.25 meters.

Fig 4



COUPLE CLOSE ROOF

Collar beam roofs (Fig 5)

This roof differ from the couple close roof.

The tie called the collar beam is raised and placed at higher level in the roof construction.

When the span is increased or when the load become more the roof have the tendency to bend.

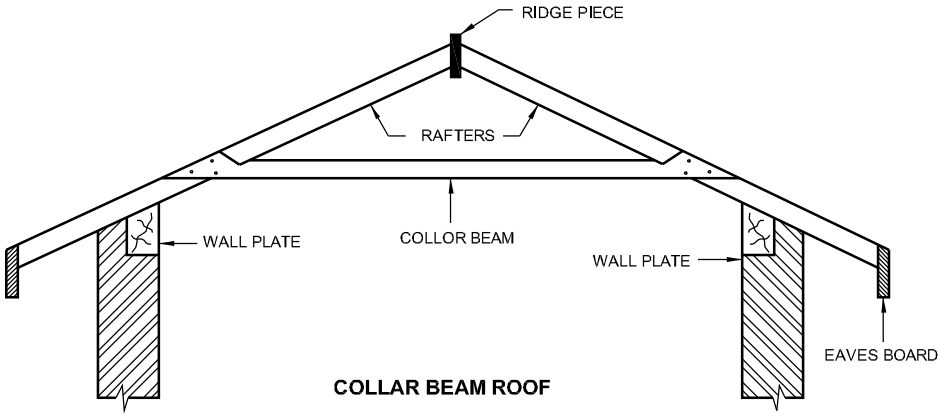
The collar beam is usually fixed at 1/3 rd to 1/2 the vertical height from the wall to the ridge.

The lower collar of the stronger is the roof.

The collar beam roof can be used up to a maximum span of 4.75 meter.

The collar beam provides roof greater height of the room.

Fig 5



COLLAR BEAM ROOF

Double or purlin roof (Fig 6)

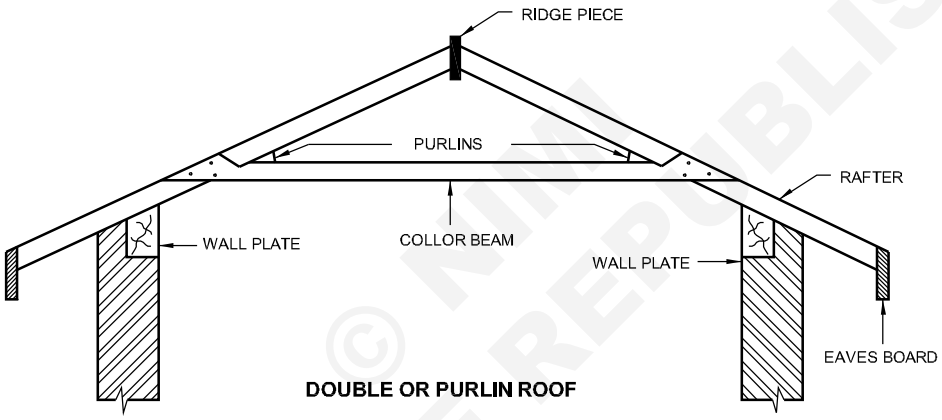
These roofs consist of the rafter and the purlin.

The purlins are giving the intermediate supports to the common rafter.

To reduce the size of common rafter to the economical range the intermediate supports are provided in the form of purlins.

The rafters are provided at a centre distance of 40cm to 60cm.

Fig 6



DOUBLE OR PURLIN ROOF

Each rafter are supported at three points.

- at the bottom on wall through wall plates
- at the top by the ridge beam
- at the centre by the purlin

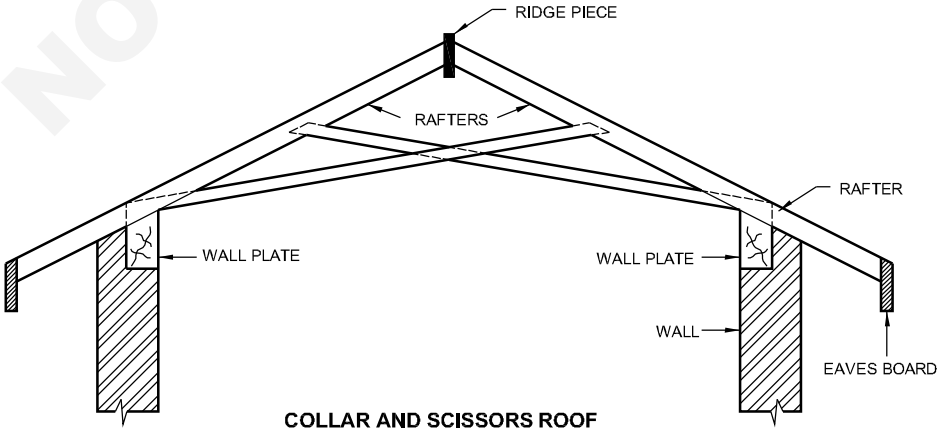
The effective span of the rafter is thus nearly halved and hence it becomes much lighter than it would be, if the spanned the whole length from eaves to the ridge.

For larger roofs two or more purlins can be provided to support the each after. The purlins can be adopted up to the span distance of 4.50 meters to 5.0 meters.

Collar and scissors roof (Fig 7)

This roof is similar to the collar beam roof except that two collar beams which are crossing each other to present an appearance of a scissors.

Fig 7



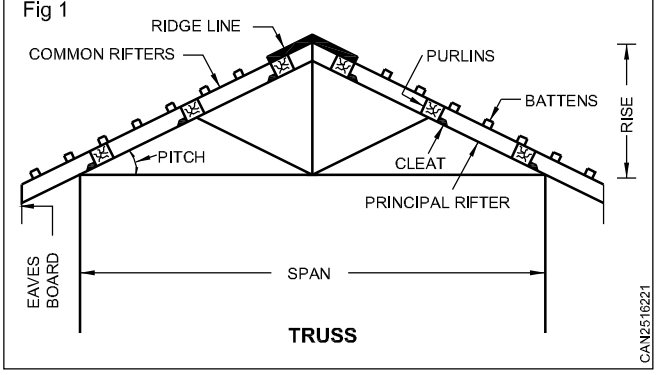
COLLAR AND SCISSORS ROOF

Trussed roofs

Objectives: At the end of this lesson you shall be able to
- **state the meanings of trussed roofs**

When the span exceeds 4.80 metres and when there are no inside supporting walls or partition for the purlin the framed structures are called the trusses.(Fig 1)

Fig 1



The centre to centre spacing of the truss depends upon the load of the roof, position of the cross walls, span and kind of materials of the truss.

The spacing is generally 3 metre for a wooden truss. The truss carry the ridge pieces and purlins on which the common rafter rest.

The trusses span in the same directions in which the common rafter runs.

The roof consist of the following three system.

- The purling to provide intermediate support to the rafter.
- The rafters to support the roofing materials.
- The trusses to support to the ends of the purlins.

The king post and queen post truss

Objectives: At the end of this lesson you shall be able to
- **identify the parts of an king post truss**
- **state the constructional details of king post truss.**

The king post truss (Fig 1)

A king post truss consist of the following parts.

- The lower tie beam.
- The two inclined principle rafter
- The two struts and
- The king post.

The centre post of this truss is known “KING POST”.

The king post forms a support for the tie beam.The principal rafters support the purlin. The purlins support the common rafter.

The common rafters have the same slope as the principal rafter and supports the roof covering the materials.

A king post roof truss is suitable for the span varying from 5m to 8m. The centre to centre spacing of the king post truss is up to 3 metres.

The tie beam receives the ends of the principal rafter and prevents the wall from spreading out due to thrust.

The king post prevents the tie beam from bending at its centre of span.

The struts connected to the tie beam and the principle rafter is in inclined direction to prevent the bending of principal rafter.

The ridge beam is provided at the top of the roof to provide end support to the common rafter.

The trusses are supported on the wooden blocks or stones or concrete, embedded in the supporting walls so that the load is distributed to a greater area.

Suitable joints are used in between the different parts of this king post truss and they further strengthen by straps and bolts. (Fig 2)

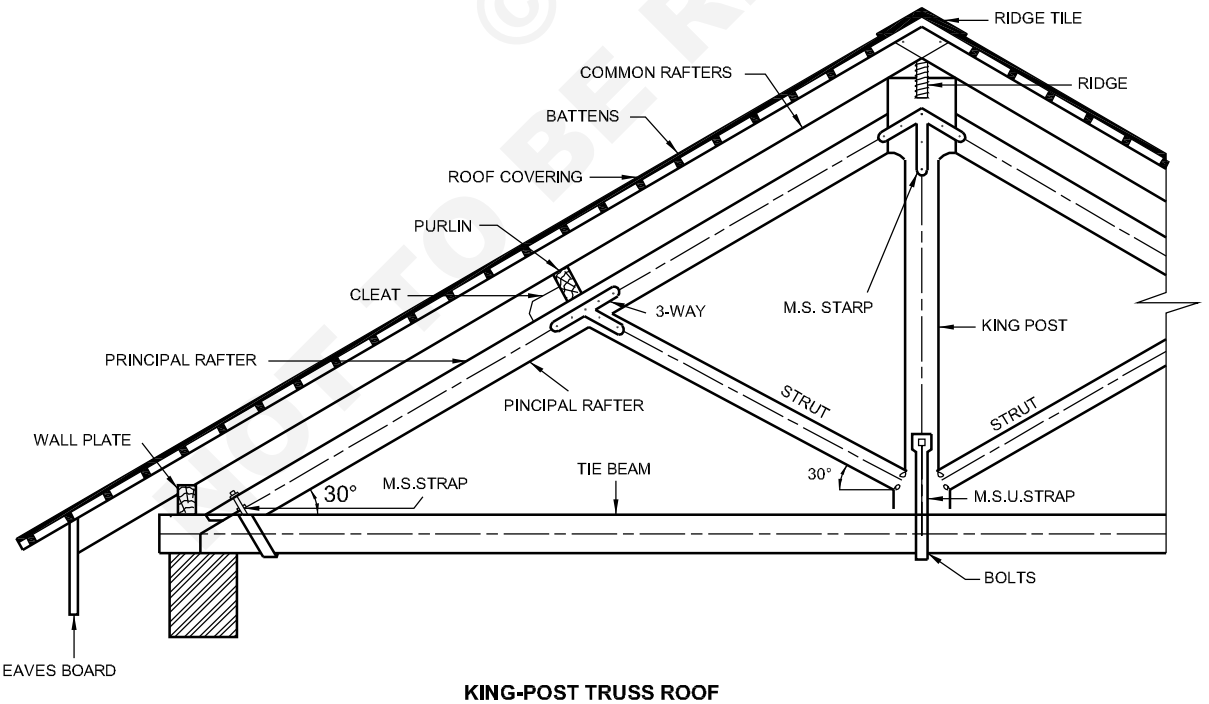
Tie beam - principal rafter = bridle joint

Strut - principal rafter = oblique mortice

King post - principal rafter = mortice & tenon

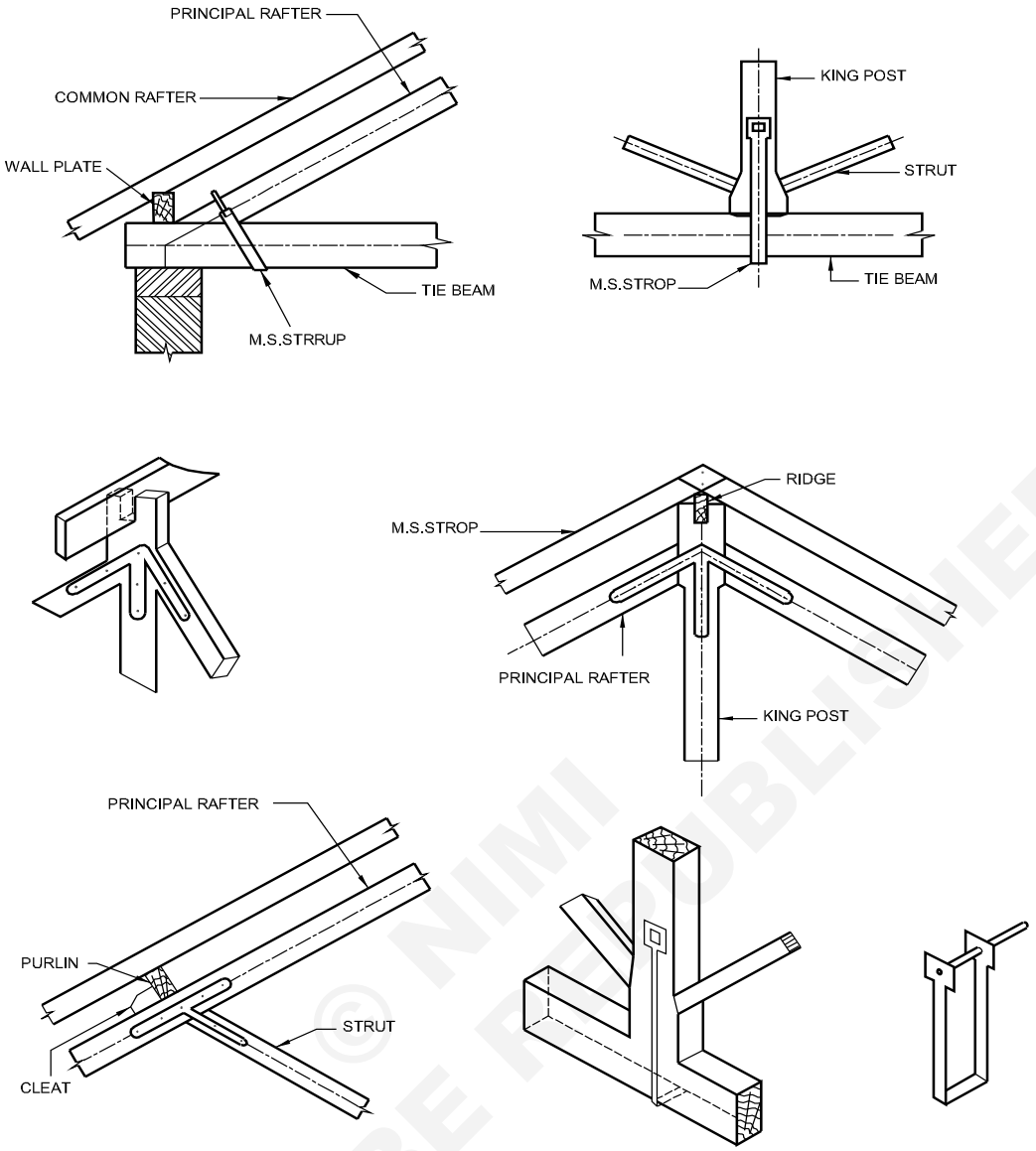
Principal rafter - tie beam = splayed shoulder tenon & mortice.

Fig 1



KING-POST TRUSS ROOF

Fig 2



DETAILS OF JOINTS AT THE ENDS OF A KING-POST

CAN2516312

Dimensions of members of King-post timber trusses

No.	Span (mm)	Members							
		King-post (mm)		Principals (mm)		Struts (mm)		Tie beam (mm)	
		D	B	D	B	D	B	D	B
1	3600	80 x 80		130 x 80		70 x 80		130 x 80	
2	4200	80 x 80		140 x 80		70 x 80		130 x 80	
3	4800	90 x 90		150 x 80		70 x 80		130 x 80	
4	5400	90 x 90		150 x 90		70 x 90		140 x 90	
5	6000	90 x 90		180 x 90		80 x 90		150 x 90	
6	6600	100 x 90		190 x 90		80 x 90		160 x 90	
7	7200	100 x 100		190 x 100		80 x 100		160 x 100	
8	7800	100 x 100		200 x 120		90 x 100		180 x 100	
9	8400	100 x 120		200 x 120		90 x 120		180 x 120	
10	9000	100 x 120		210 x 120		90 x 120		190 x 120	

Dimensions of members of Queen-post timber trusses

No.	Span (mm)	Members							
		Queenpost (mm)		Principals (mm)		Struts (mm)		Tie beam (mm)	
		D	B	D	B	D	B	D	B
1	7800	130 x 100		200 x 100		70 x 100		180 x 100	
2	8400	130 x 120		200 x 120		70 x 120		180 x 120	
3	9000	140 x 120		210 x 120		70 x 120		190 x 120	
4	9600	150 x 120		230 x 120		70 x 120		190 x 120	
5	10200	150 x 120		240 x 120		70 x 120		200 x 120	
6	10800	150 x 120		240 x 130		80 x 130		200 x 130	
7	11400	160 x 130		240 x 130		80 x 130		200 x 130	
8	12000	160 x 130		250 x 130		80 x 130		210 x 130	

The queen post truss

Objectives: At the end of this lesson you shall be able to
- **state the meanings of queen post truss**
- **identify the parts of an king post truss**
- **state the constructional details of king post truss.**

The queen post truss (Fig 1)

The queen post truss differs from the king post truss except that it is having two vertical members called queen posts.

The upper end of the queen post connected in position by means of a horizontal member is called a straining beam.

A string sill is introduced on the tie beam between the queen post to counter act the thrust of struts.

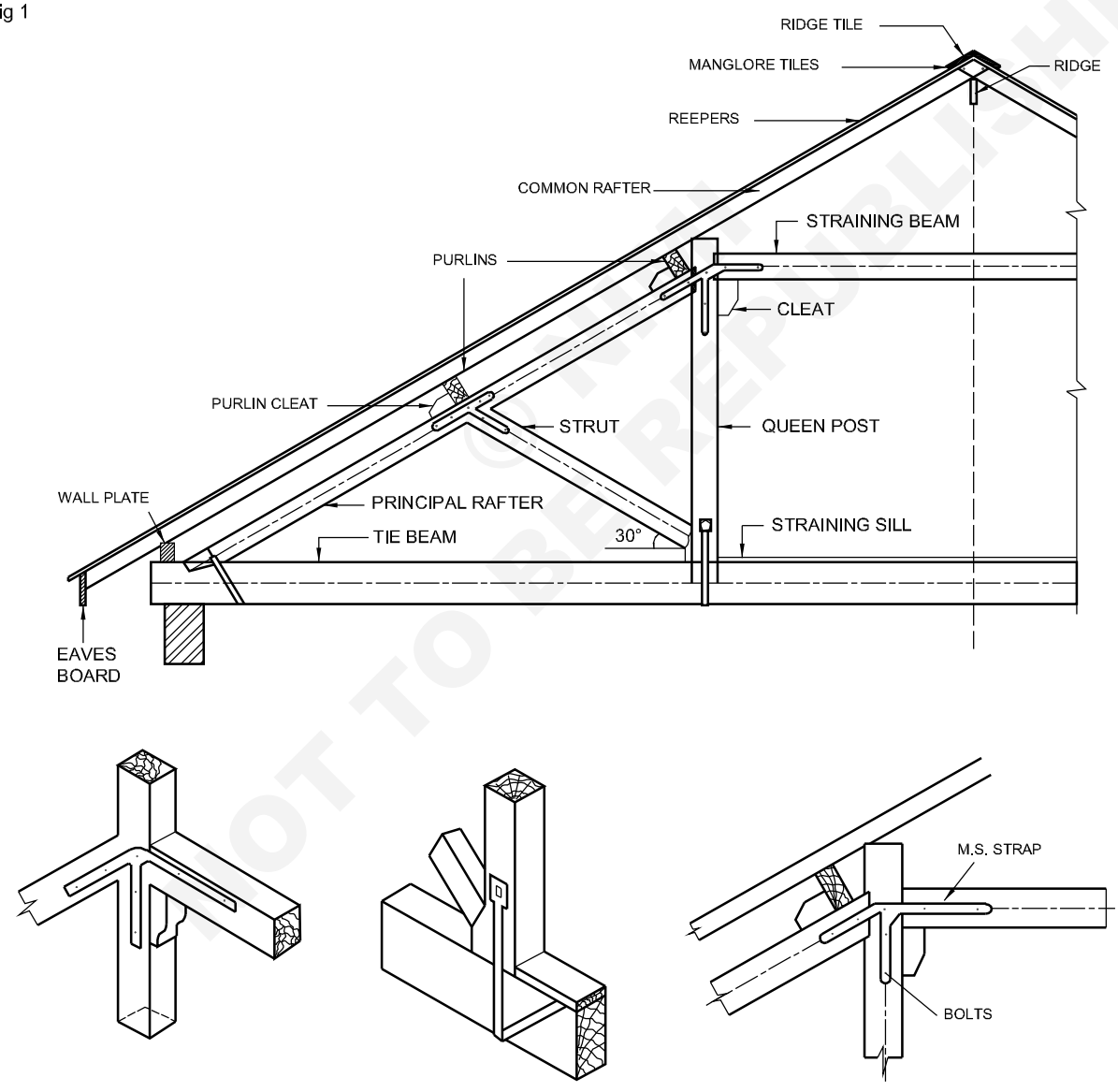
Two struts are used to join the feet of queen post to the principal rafter.

The additional purlins with cleats are provided to support on the queen post.

The queen post truss is suitable for the roof spans varying from 8 metre to 12 metres.

Suitable joints should be provided at all the connections as in case of a king post and further strengthen by stirrup straps and bolts.

Fig 1



QUEEN-POST TRUSS

Description of aluminium and anodising

Objectives: At the end of this lesson you shall be able to
- **description of aluminium**
- **state the properties and uses of aluminium.**

Description of aluminium

Aluminium is one of the most widely used metals in the world. It possesses an exciting range of properties. Moreover, aluminium combines with alloying elements like copper. Manganese, silicon, magnesium and zinc, and forms a very useful series of alloys.

The aluminium occurs in abundance on the surface of earth. It is available in various forms such as oxides, sulphates, silicates, phosphates, etc. But it is commercially produced mainly from bauxite ($Al_2O_3 2H_2O$) which is hydrated oxide of aluminium.

Manufacture: The aluminium is extracted from bauxite ores as follows:

1 The bauxite is ground and then it is purified.

2 It is then dissolved in fused cryolite which is a double fluoride of aluminium and sodium, AlF_3, 3NaF,

3 This solution is then taken to an electric furnace and the auminium is separated out by electrolysis.

Properties: Following are the properties of aluminium:

1 It is a very good conductor of heat and electricity.

2 It is a silvery white metal with bluish tinge and it exhibits bright lustre on a freshly broken surface.

3 It is a non-magnetic substance.

4 It is rarely attacked by nitric acid, organic acid or water. It is highly resistant to corrosion.

5 It is light in weight, malleable and ductile.

6 It is very soft.

7 It melts at 660^0C and its boiling point is 2056^0C

8 It possesses great toughness and tensile strength.

9 It readily dissolves in hydrochloric acid.

10 Its specific gravity is about 2.70

Uses of aluminium

This metal is chiefly used for making parts of aeroplane, cooking utensils, electric wires, window frames, glazing bars, corrugated sheets, structural members, foils, posts,panels, balustrades, bathroom fittings, precision surveying instruments, furniture, etc. Its other uses can be mentioned as follows:

1 It is used as a reducing agent in the manufacture of steel.

2 It is used for making aluminium alloys, automobile bodies, engine parts and surgical instruments.

3 It is used in the casting of steel.

4 It is used in the manufacture of electrical conductors.

5 It is used in the manufacture of paints in powder form.

Anodising of the aluminium

Objectives: At the end of this lesson you shall be able to
- **state the anodising of aluminium channel**
- **state the advantages of anodising.**

Anodising process is an electrochemical procedure which creates a protective aluminium oxide coating on aluminium sruface. Life time of such protective finish varies depending on how thick is the anodic coating.

Advantages of Anodising

1 Natural metallic sheet and aspect

2 Excellent corrosion resistance

3 No risk of fading

4 No risk of chalking

5 No risk of filifom corrosion

6 Preservation of the original surface texture and design

7 Optimal surface coverage

8 Anodic fim is totally impermeable

9 Exceptional abrasion resistance

10 On-site quality control possible without creating surface damage in testing

11 100% recyclable

12 Production process can be carried out in accordance with latest environmental standards.

13 Lifetime Guarantee is available.

Specification of different aluminium section

Objectives: At the end of this lesson you shall be able to
- **state different types of aluminium section**
- **state the application of aluminium section.**

Proportion

1 Corrosion resistance
2 Excellent mechanical properties
3 Dimensional tolerance
4 High durability
5 Resistance against corrosion
6 Excellent finish
7 High strength

Aluminium sheet & Plate aluminium in its various forms is stocked in a range of strengths varying utility sheet, is used for all general sheet metal work such as flashings, ductwork, lining walls, etc. Also primarily for spinning and deep drawing operations such as utensils, ornaments, etc.

Thickness : 0.15 - 150 mm

Width : 20 - 2000 mm

Length : 1000 - 6000 mm.

Good plasticity and conductivity.

Generally used in individual and construction applications.

Aluminum strips

Available in varied standard sizes and grades, these strips are widely used to make engine sheets.

Properties

1 Rustproof
2 Dimensionally stable
3 Fine finish

Aluminium tubes

Wide and remarkable range of aluminium tubes are available, as per standards of industry laid norms and guidelines.

Properties

1 Resistance to abrasion
2 Ability to withstand high temperature
3 Highly durable

Aluminium angle

Aluminium angles that have wide usage in different industries like Pharmaceutical, Chemical, Food, Agriculture and many more. The salient features like durable finish standards, withstand high temperature and abrasion resistant are available in standard sizes.

Widely used in the following sectors:

1 Aircraft fittings
2 Fuse parts
3 Missile parts
4 Worm gears and keys
5 Aircraft
6 Aeroscope
7 Defense applicaions

Aluminium channels

Aluminium channel is manufactured using high grade of aluminium. These are extensively used in various industry applications, owing to features like elegant design, study construction and durable performance.

Properties

1 Easy installation
2 Dimensionally accurate
3 Corrosion resistant
4 Sturdy

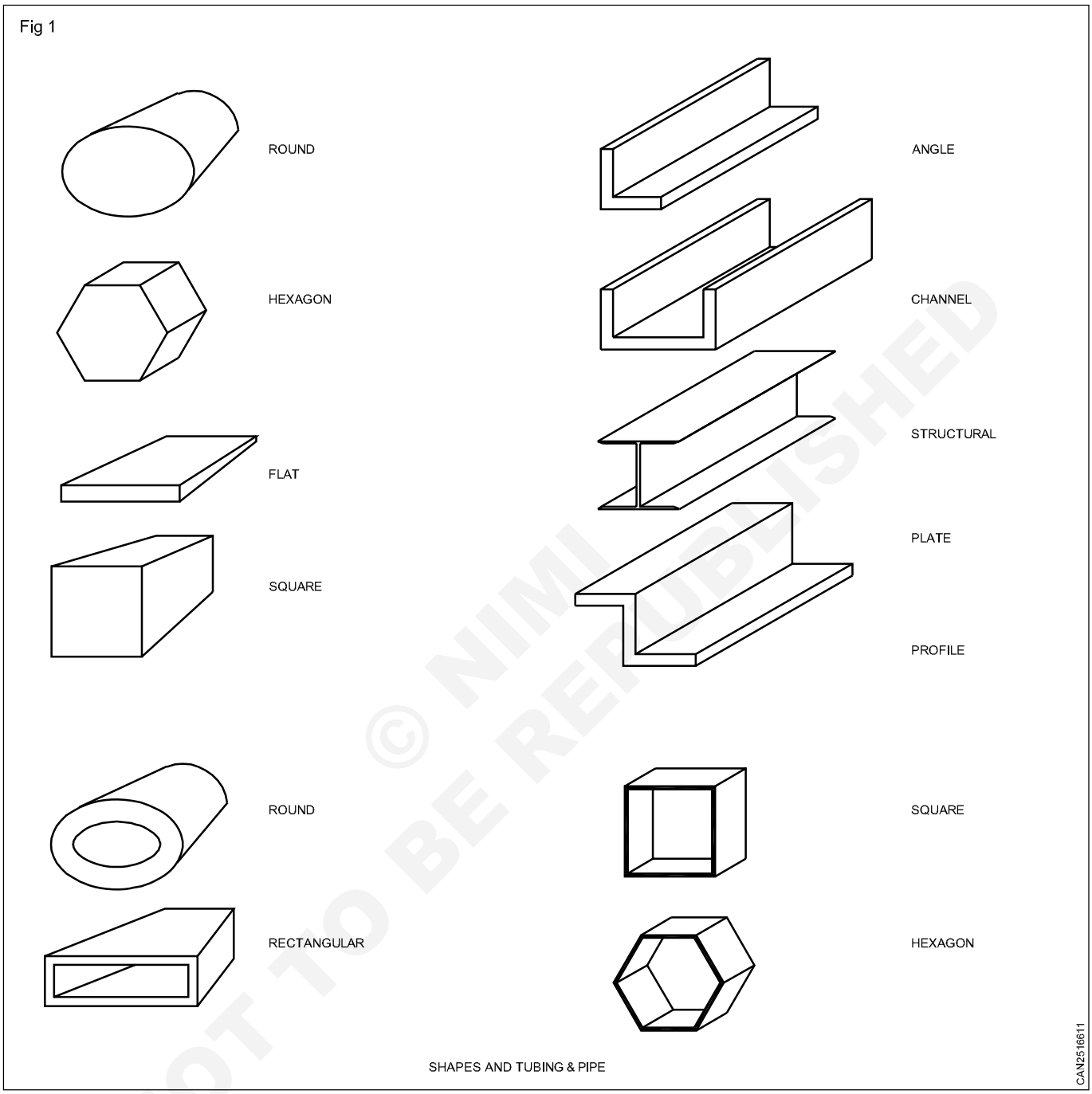
Aluminium channels are constructed using a vertical web with top and bottom flanges at a 90 degree angle to the web. Inside radius corners provide additional strength to the structure, further increasing the strength of the material. The high strength and high heat properties of aluminium make it a good material for use in electronic, electrical and machinery enclosures. Due to its corrosion resistance it is used for housings exposed to weather and channels in window and door frames for buildings and vehicles.

Channels are one of the most widely used extruded aluminium profile shapes because the aluminium alloy's malleability permits the extrusion of a wide array of different channel profile shapes and sizes suitable for many industrial, manufacturing and construction applications. Extruded aluminium channels is widely used in railroad car windows and other components inside the train itself, in addition to the construction of the outer bodies of heavy vehicles such as trucks, since both require strength and less weight to maximize fuel efficiency. Many different metal profile shapes are referred to as "Channels"; however it is generally accepted that they fit into several widely-used categories. These shapes include U-Channel, J-Channel, C-Channel, both square and rectangular open seam tubing, hat channel and almost any other unusually shaped aluminium extrusion profile for which there isn't another name, such as Z-channel.

Aluminium channels excellent joining characteristics and ability to accept applied coatings also make this product an excellent choice in aircraft and marine fittings and hardware.

Sharp, defined edges, is an excellent choice for lightweight cosmetic and structural applications and is also usually available in smaller profile sizes than other types of aluminium channel.Aluminium Work Terminology.

Fig 1



Aluminium partition section's

Objectives: At the end of this lesson you shall be able to
- **identify aluminium partition sections used for making aluminium partitions**
- **state the application of aluminium partition sections**
- **explain the advantages of aluminium partitions.**

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.

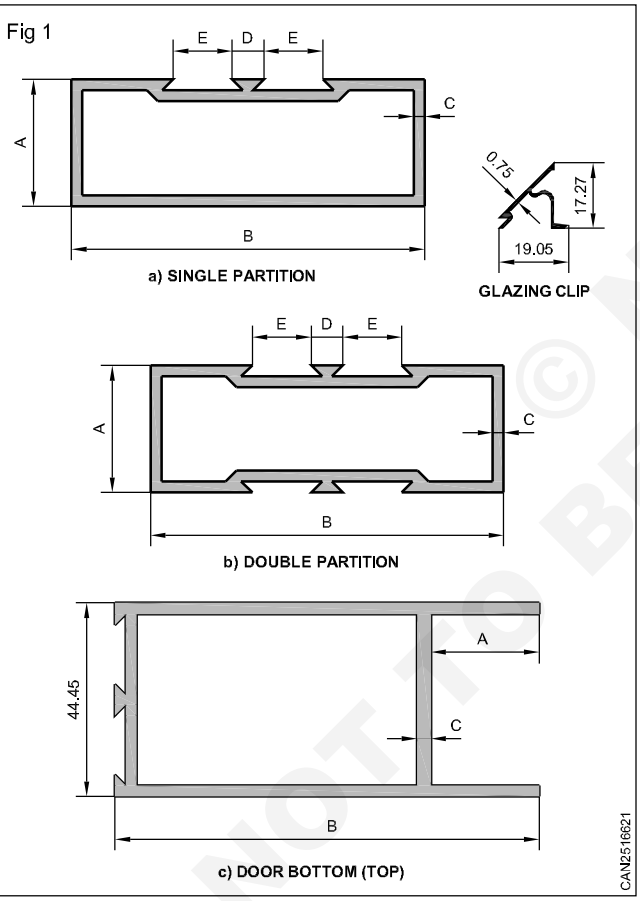
The aluminium partitions are slim and attractive, elegant and functional in design, enabling optimum utilisation of available space. They are very durable and easy to maintain.

Frames should be wiped with a soft piece of cloth only.

Aluminium Partition Sections

(Fig 1) shows different partition sections, used to construct partitions. Single partition, double partition, rectangular tubes, partition split, glazing clips are different partition sections.

Fig 1

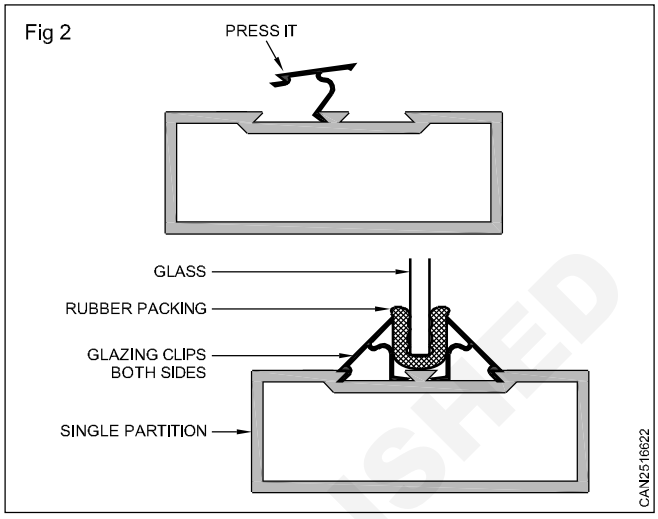


Single partition is used when prelaminated particle boards or glasses are to be fitted on one side only. Double partitions are used where glasses or prelaminated particle boards are fitted on both sides of it.

Glazing clips are engaged in the grooves of the single or double partition from side facing each other and glasses along with 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 2) 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.

Fig 2



Partition sections are fitted to each other at right angles, using aluminium angle piece and metal screws. (Fig 3) 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 4)

Fig 3

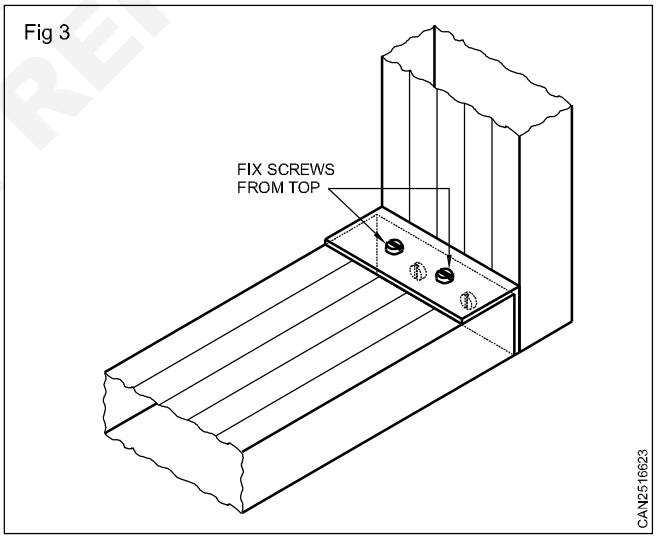
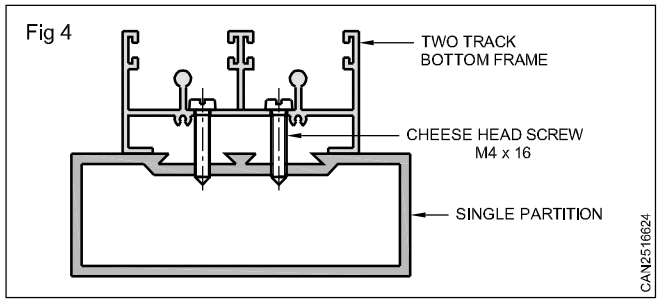


Fig 4



Partition frames are fixed to the walls and grout with metal screws and rowl plugs in holes.

Aluminium window sections

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

- **identify different aluminium sections to make sliding window outer frame**
- **identify different aluminium sections to make sliding window**
- **state application of different window sections for outer frame and sliding widows**
- **explain the fitment of rubber packing in window frames**
- **explain the fitment of glass along with rubber packing in sliding window shutters.**

(Fig 1) shows different aluminium sections used for making sliding window outer frame.

These sections are available in 2,3 or 4 tracks. Bottom frames are having their vertical ribs with round shapes at top to serve as tracks.

Side and top frames are similar, but differ from bottom frame for not having ribs for tracks.

Aluminium windows with bearings at their bottom, slides on tracks of the bottom frame. One window is mounted on each track of the bottom frame. Top and side frames have slots which locate and guide the windows in their tracks.

Top, side and bottom frames are fitted with rubber packings to avoid contact. (Fig 2)

Fig 1

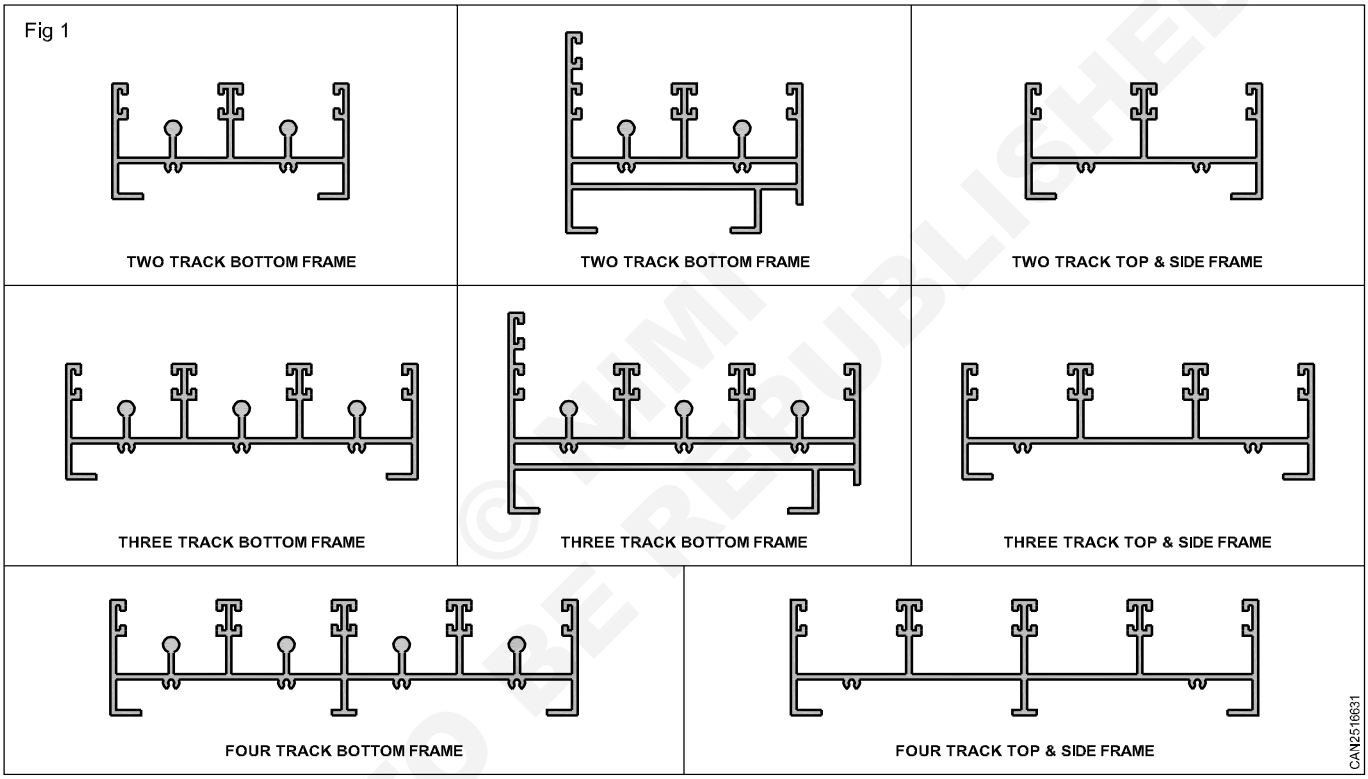
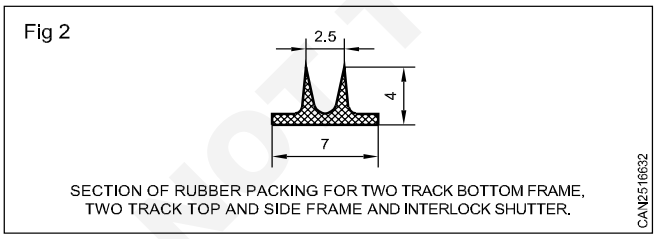


Fig 2



These frames are fitted on aluminium partitions using metal screws. (Fig 3)

Fig 3

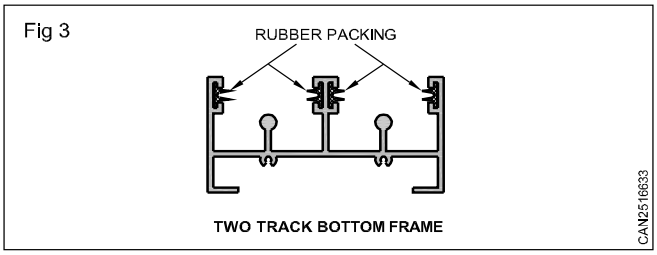
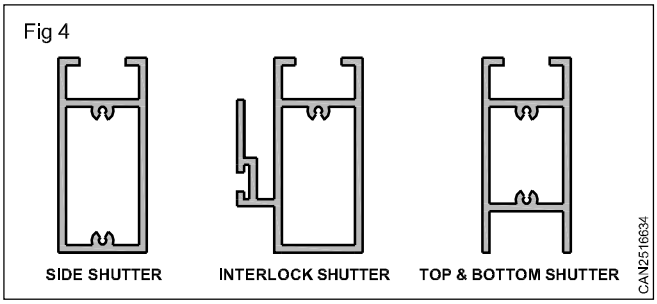


Fig 4 shows different aluminium sections used for making sliding windows.

Fig 4



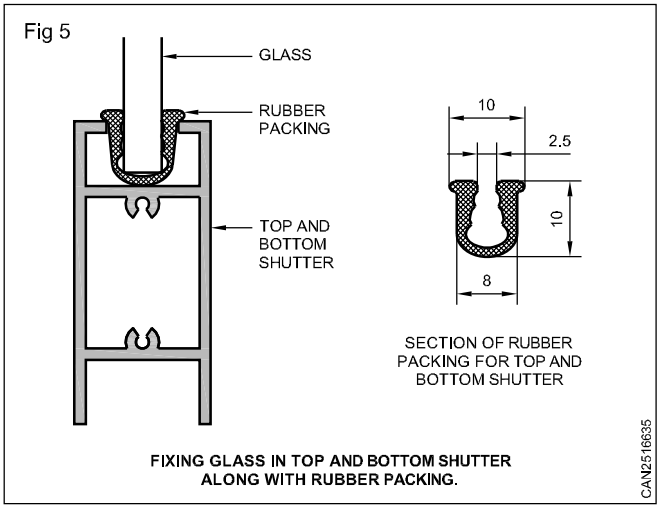
Bottom and top shutters are similar, having slots on both sides. One slot is shaped like C and other slot is shaped like U.

Side shutters are having slot on their one side only. This slot is shaped like C.

Interlock shutters are used on the inner side of the frame having special shaped rib to facilitate interlocking. They are having 'C' shaped slots on one side only.

In 'C' shaped slot, glass is fitted with rubber packing.

(Fig 5) shows fitment of glass along with rubber packing in shutters.



FIXING GLASS IN TOP AND BOTTOM SHUTTER ALONG WITH RUBBER PACKING.

Interlock shutters are fixed opposite in direction for adjustment windows to facilitate interlocking. Rubber packings are inserted on it to avoid metal to metal contact.

Bearings are mounted on the bottom shutter from bottom. Each window have two bearings at their ends. The bearings are provided with grooves on the centre. These grooves are engaged on round shape of rib (track) of bottom frame. (Fig 6)

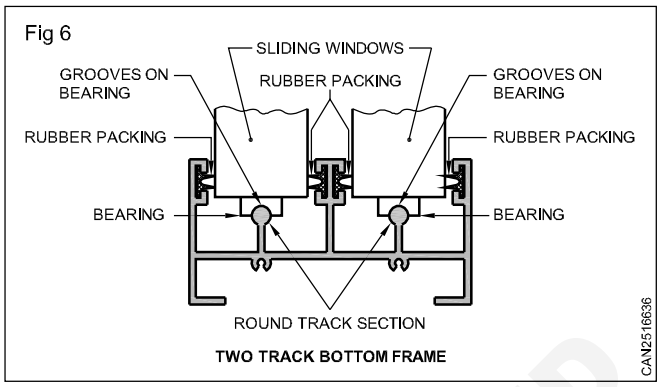
The top and bottom shutters are provided with two round grooves throughout its length in their central packet.

The side shutters and interlock shutters are joined to bottom and top shutters by metal screws sideway through side and interlock shutters such that the screws are inserted in round grooves provided in bottom and top shutters.

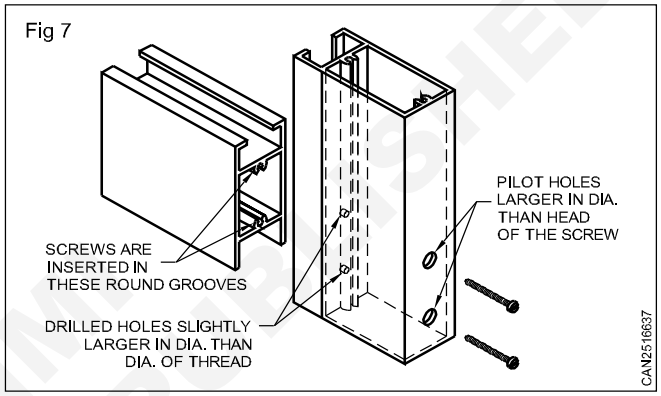
As the material is aluminium and the section is thin, the screws makes threading on grooves, when they are rotated.

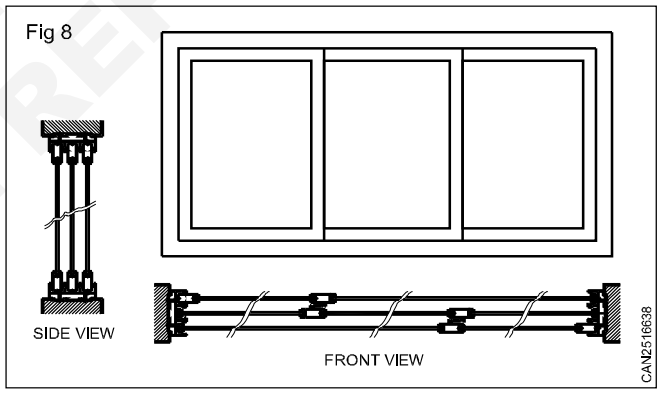
The screws are selected so that the root diameter of threads is equal to the diameter of round groove. (Fig 7) shows, the fitment of side and bottom shutters.

(Fig 8) shows typical sliding window frame.



TWO TRACK BOTTOM FRAME





Aluminium door sections

Objectives: At the end of this lesson you shall be able to
- **identify different aluminium sections used for making doors**
- **state the application of different aluminium door sections.**

(Fig 1) shows different aluminium door sections.

Door verticals are used as vertical members of the door frame. They are two types of door verticals. One is having groove for rubber packing and other is not having groove.

For Air conditioned cabins or rooms, door vertical with groove is used. Rubber packing is inserted in it and made air proof.

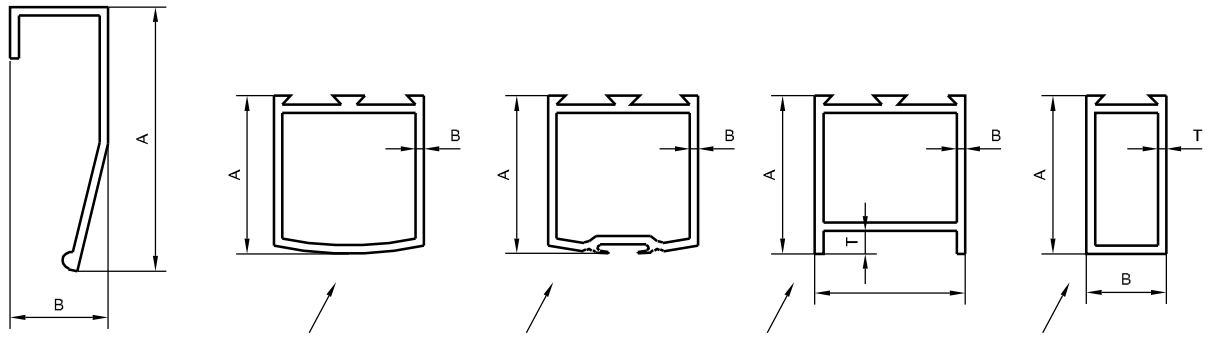
Door top and bottom are used as top and bottom members of door frame. They are having grooves like single/double partition on one side.

This facilitates fixing of glass or prelaminated particle board using glazing clips.

Door mullions are used as central member of door frame. Grooves for glazing clips are provided on both sides of them, to fix glass or prelaminated particle boards.

Door handle is fixed on door mullion by screws.

Fig 1



DOOR HANDLE

A	B	Kg/m
100.00	30.00	0.988

DOOR VERTICAL

A	B	Kg/m
50.00	2.50	1.319
85.00	2.00	1.365

DOOR VERTICAL

A	B	Kg/m
50.00	1.80	0.901
50.00	2.50	1.202
85.00	2.00	1.418

DOOR TOP & BOTTOM

A	B	T	Kg/m
50.00	1.50	9.50	0.759
50.00	2.50	9.50	1.299
100.00	2.50	25.00	1.974
109.00	1.85	25.00	1.505

DOOR MULLIONS

A	B	T	Kg/m
50.00	45.00	1.80	0.900
50.00	45.00	2.50	1.292
100.00	44.45	2.00	1.594

CAN2516641

Use of screws in aluminium section types of adhesives

Objectives: At the end of this lesson you shall be able to
- **state the types of screws in aluminium section**
- **state the use of screws in aluminium section.**

In the aluminium window and door manufactured industrial field much depends on the prodder choice of screw fasteners to be used in each job.

Various types of screws

- Slotted screws
- Cross recessed head screws
- Self tapping screws
- Common wood screws.

Slotted Screws

A screw fastener with a single groove across the diameter of the head.

Slotted screw is commonly found in existing, products and in salvations and is still used in, some simple carpentry and applications where little torque is needed, mostly used for decorative purpose and less in pack.

Cross recessed head screws

A screw fastener with a cross or double slot screw. Cross recessed head screws are used general assembly work. It is manufactured in both coarse and fine series fitted with either a slotted or recessed head.

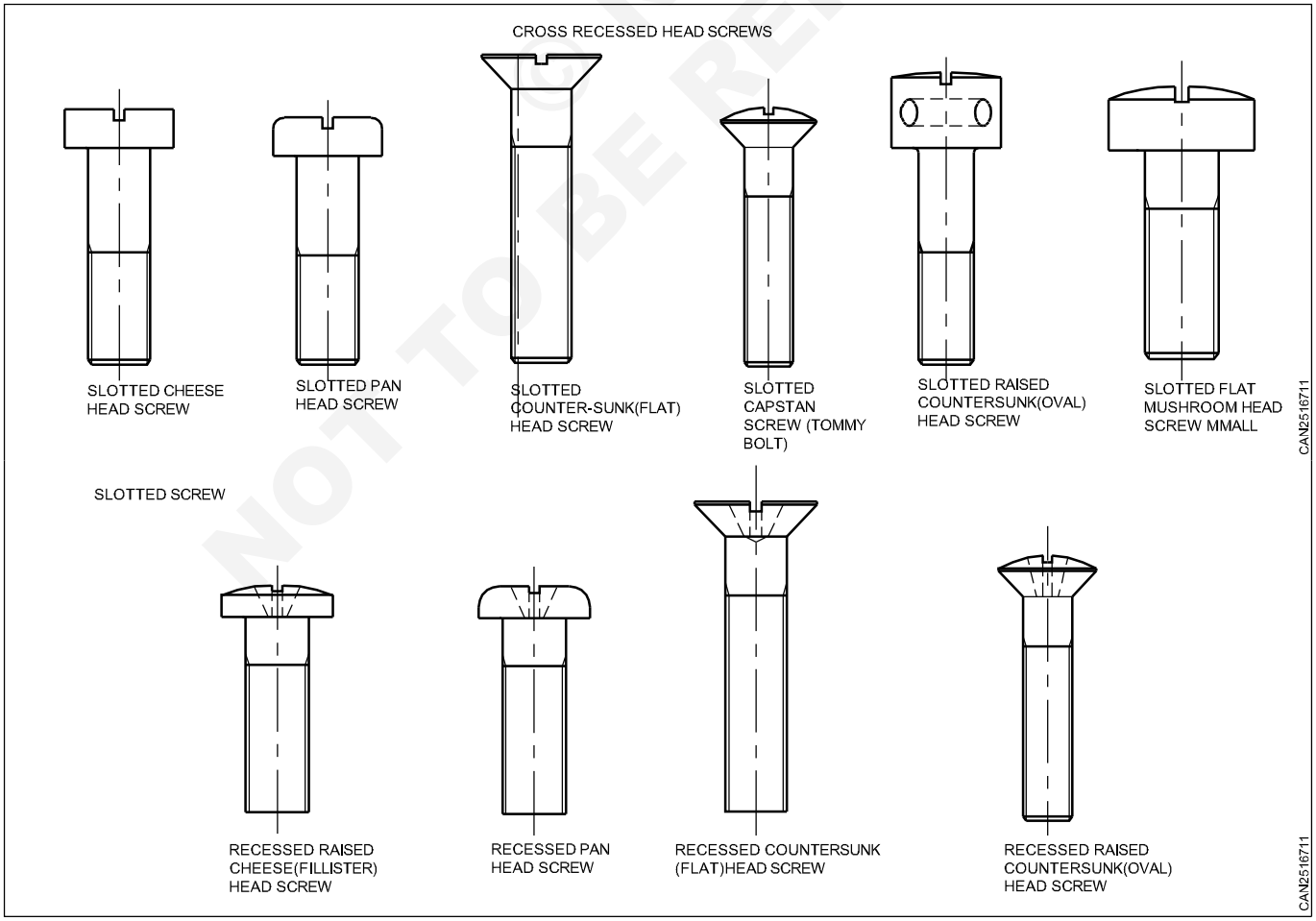
Self tapping screws

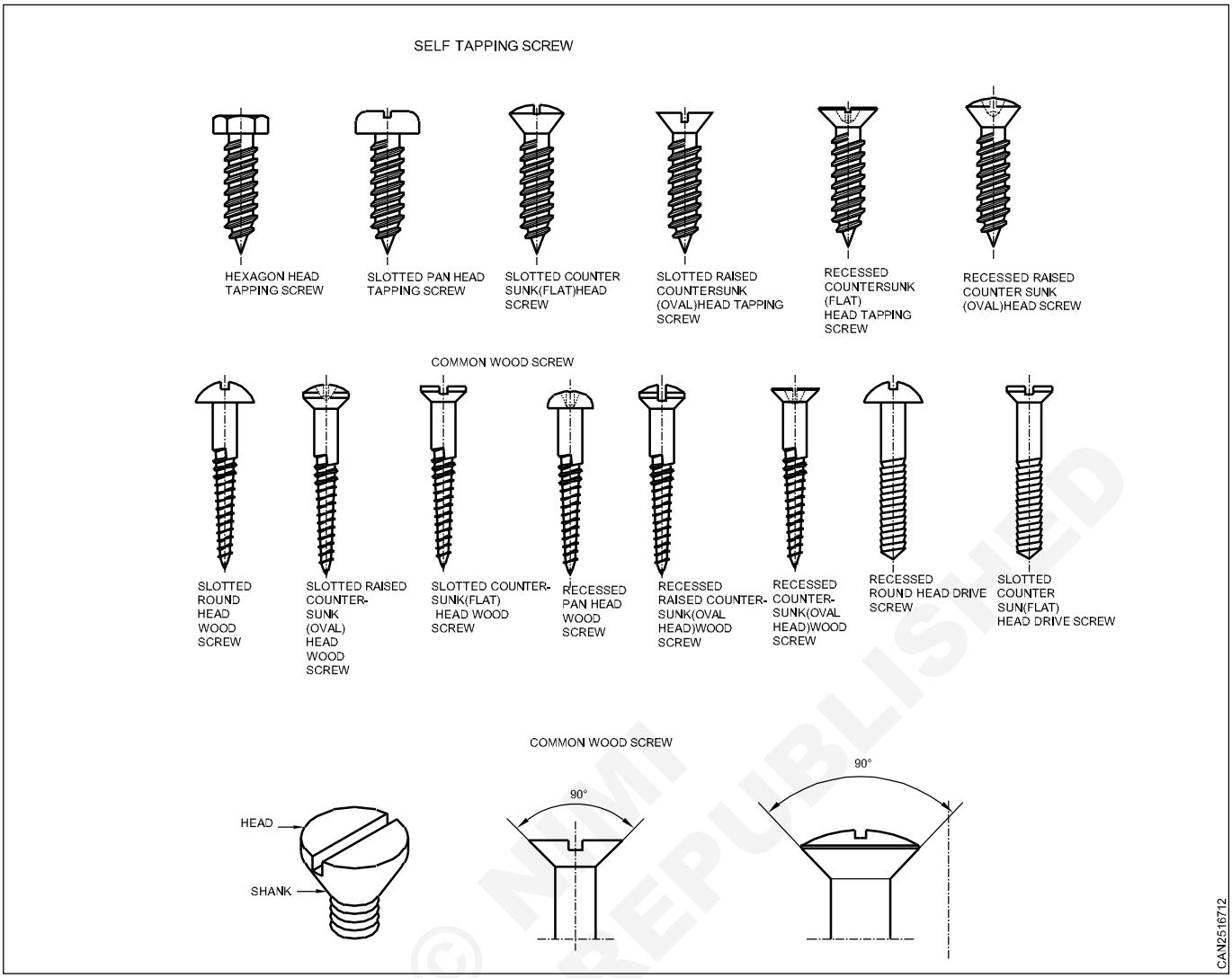
Self tapping screws, also called sheet metal screws, are very versatile. They can be used to securely fasten metals together, including aluminium. They are also be used to efficiently fasten metal to other materials such as wood or plastic by creating a mush stronger bond than a regular nail.

Common wood screws

Wood screws have a single spiral of thread running from the point. This types of screws is used for sewing pieces of timber together, strengthing joints, and fixing metal fittings such as hinges, catches locks to wood.

Types of Screws and Screw Heads





Types of adhesive used in aluminium bar joining

Objectives: At the end of this lesson you shall be able to
- **state the types of adhesive and used in aluminium bar joining.**

Aluminium adhesives, aluminium glue, aluminium bonding adhesive technologies such as acrylies, epoxies and cyanoacry lates bond with this light weight, versatile and corresion resistant metal. Due to aluminium's chemical properties, adhesives will obtion 100% their strength when bonded to aluminium.

When looking to bond aluminium, it is important to keep in mind that aluminium surfaces often have a weak, invisible oxide layer just wiping with a solvent cleaner is not unusually sufficient if a high bond strength is sought. Adhesives bond well to the oxide layer-however-the oxide layer isn't bonded well to the aluminium. It often looks as if the adhesive bond has failed, but on close inspection, it is clear that the oxide layer has just come off the aluminium.

Aluminium is a soft, lightweight, light-grey metal. Most aluminium is made into an alloy to enhance properties. The type of aluminium will affect the bond strength and adhesive selection.

Types of adhesives and uses

Anaerobic adhesives - Suitable for close-fitting concentric parts or threaded components.

Cyanoacrylate - also known as instant adhesives, super glue, crazy glue, ca glue, etc. All grades will bond aluminium well.

Single component epoxies - are ideal for bonding aluminium.

Two component epoxies - also from strong bonds to aluminium.

Structural acrylics - such as TA4246 are very strong aluminium bonders.

UV Curable adhesives - are a good choice providing light can reach the entire bond site. If there are shadowed areas.

Fibre glass rubber padding gasket type of channel window

Objectives: At the end of this lesson you shall be able to
- **explain the fibre glass**
- **state the used for fibre glass in aluminium sections.**

Fibre glass: Fibre glass is a type of fibre reinforced plastic where the reinforcement fiber is specifically glass fibre. The glass fibre may be randomly arranged, flattened into a sheet (called a chopped strand mat), or woven into a fabric. The plastic matrix may be a thermosetting plastic most often epoxy, polyester resin or vinylester, or a thermoplastic.

The glass fibres are made of various types of glass depending upon the fibreglass use. These glasses all contain silica or silicate, with varying amounts of oxides of calcium, magnesium, and sometimes boron. To be used in fibreglass, glass fibres have to be made with very low levels of defects.

Fibre glass is a strong lightweight material and is used for many products. Although it is not as strong and stiff as composites based on carbon fibre, it is less brittle, and its raw materials are much cheaper. Its bulk strength and weight are also better than many metals, and it can be more readily moulded into complex shapes. Applications of fibreglass include aircraft, boats, automobiles, bath tubs ad enclosures, swimming pools, hot tubs, septic tanks, water tank, roofing, pipes, cladding, casts, surfboards, and external door skins.

Properties

An individual structural glass fibre is both stiff and strong in tension and compression

A fibre glass component is typically of a thin “shell” construction.

Fibre glass is an immensely versatile material due to its light weight, inherent strength, weather, resistant finish and variety of surface textures.

Advantages

- High dimensional stability / strength
- Low thermal conductivity / energy efficient
- Environmentally friendly
- Structural integrity
- Low maintenance and excellent in sulator

Rubber padding / Gasket

Objectives: At the end of this lesson you shall be able to
- **state the use of rubber padding in aluminium section.**

The rubber beading generally is a strip of rubber used along the edges of glasses to provide them support such that the glasses could withstand the jerks and shocks.They are fastened to the windows of automobiles like cars, buses, trucks etc.

Types of rubber padding / gasket

Door gaskets (Fig 1)

Rubber gaskets and door gaskets include the packing indispensable for air tight doors.

Fig 1

Rubber padding (Fig 2)

Rubber packings are in serted on it to avoid metal to metal contact.

Fig 2

Rubber packing

Many different types of rubber packing are sued between hatch covers and coaming to achieved weather tightness. Traditionally sponge rubber packing was used pressing it against the compression bar. Over the years ships became much larger and so having bigger movement.

Between the coaming and the hatch covers. To solve this issue sliding rubber packing was used. By pressing sliding rubber packing against a flat surface the hatch cover sealing system was able to adapt to bigger hull deformations.

Hatch cover rubber packing supplied by Cargo care solutions is made of high quality material to guarantee a long life time. Our sliding rubber offers low friction for better sliding together with a minimum wear. Further, more it is UV radiation resistant and applicable in a big temperature range. Our spong rubber has a strong solid skin to reduce damage on the packing. The sponge core is fabricated from a strong natural rubber offering the best compression and a minimum wear.

Sponge rubber (Fig 3)

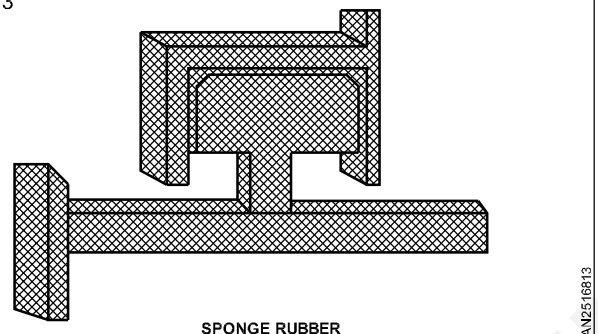
1 Mostly used on side rolling and folding hatch covers

2 Consists of a solid skin with a sponge rubber core

3 Standard compression: 12 mm

4 Produced to guarantee long life time.

Fig 3



Sliding rubber (Fig 4)

1 Mostly used on pontoon hatch covers or large vessels with folding hatch covers.

2 Consists of EPMD material.

3 Standard compression:12 mm

4 Produced to guarantee long life time

Aluminium wheel

Are fitted to bottom of window and door to provide ease movement. Available in a wide range of designs and sizes (diameter of wheel) using any of the methods for fitting illustrated (Fig 5).

Fig 4

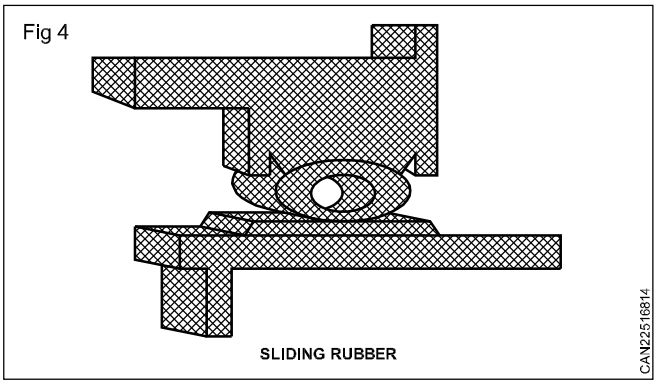
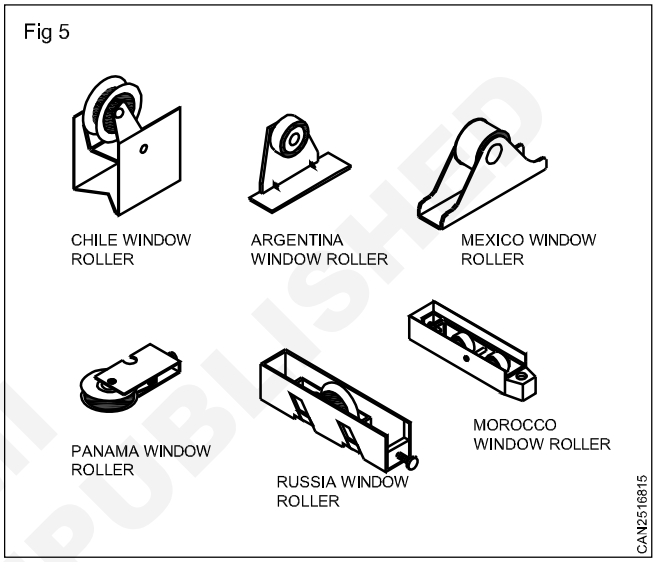


Fig 5



Applications

It is used to partitioning, paneling, cupboard shutters, false sealings, furniture, panel doors, insets, etc. It is available in standard thickness(MM) 6,9,12,18,25,etc.

Standard size (Feet) are 8x4, 4x6, 9x6, 9x3, 6x4, 6x3, 8x3 combination size 9x4 and 9x2 etc.

Type of channel window and uses

Objectives: At the end of this lesson you shall be able to
- **state the types of channel window and use.**

Aluminium Channel

Windows (frames and sashes) have the advantage over the timber of having low maintenance costs, and becauses of their narrow frames they provide maximum light and ventilation, but they must be treated with baked anti-corrosice paint, galvanized, sheradized or constructed of aluminium.

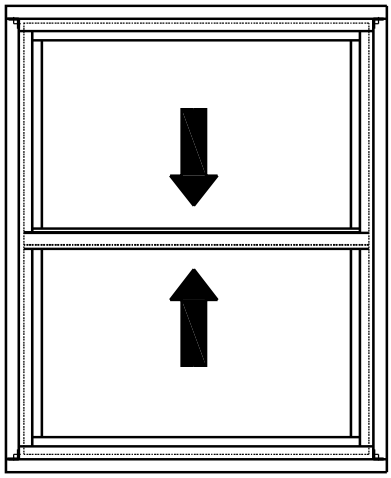
Types of windows is involved building construction named according to the type of frame (solid or box) or the way the ashes are hung.

Any type of window can be fitted into any types of wall, either into the outer skin or into the inner skin or cavity walls

Vertical Sliding Sash Windows: Usually consist of pairs of sashes or double hung sashes, both of which open by sliding vertically in the channels of a box frame. The sashes are separated by a parting bead. (Fig 1)

Horizontal Sliding Sach Windows: Solid window frames are used. The sashes slide horizontally on metal tracks fixed to the sill and guided by tracks secured to the head. Ball bearing sach roller sheaves are mortised into the bottom rails (Fig 2).

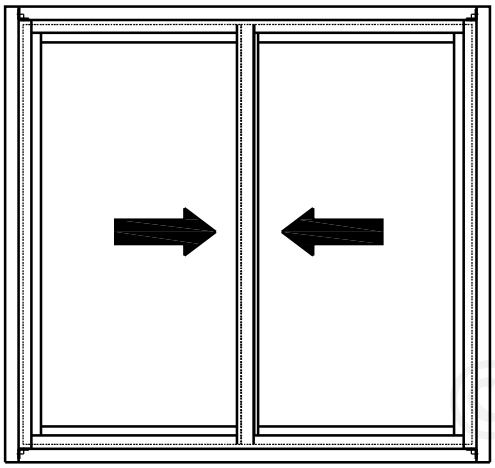
Fig 1



VERTICAL SLIDING SASH WINDOWS

CAN2516821

Fig 2

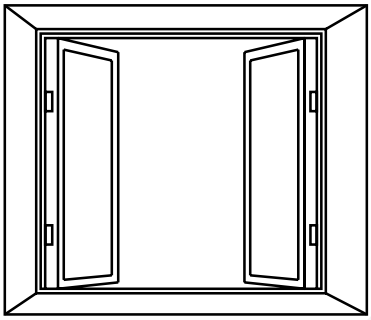


HORIZONTAL SLIDING SASH WINDOWS

CAN2516822

Casement Windows: The Sashes are hinged along one of their vertical edges to the stiles of solid window frames. They generally open outwards and any be held open with a casement stay or telescopic stay arms operated manually or by a hand winder. (Fig 3)

Fig 3

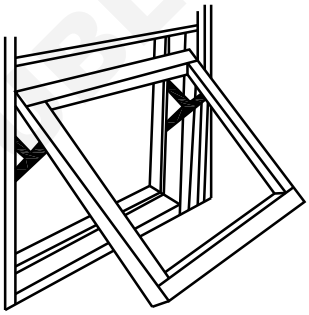


CASEMENT WINDOWS

CAN2516823

Awing or Hopper Windows: These are usually multiple sashers arranged in vertical tiers (some may be fixed) in a solid casement frame with mullions. Friction casement stays are attached to the sash stiles and jambs and mullions so that each sash opens outwards from the bottom. The sashes may be separated. (Fig 4)

Fig 4



AWNING OR HOPPER WINDOWS

CAN2516824

PVC doors

Objectives: At the end of this lesson you shall be able to
- **description the PVC door**
- **state use of PVC as substitute of wood**

Description

Polyvinyl chloride (PVC), a synthetic resin made from the polymerization of vinyl chloride. Polyethylene among the plastics in production and consumption, PVC is used in a enormous range of domestic and industrial products, from raincoats and shower curtains to window frames and door frame and doors, vinyl flooring, cable coatings, medical devices, pluming and Automotive parts.

Uses of PVC as substitute of wood

- PVC is a very durable material. It is strong and resilient to any conditions. The tough material can withstand any kind of weather and climate.
- They are very light weight. Hence they are very easy to install and handle.
- PCV doors are resistant to rotting, rusting, flaking, fading and peeling. It is also not a corrosive material. All you have to do to clean PVC is slight soap washing.
- PVC is a very low maintenance material that is time saving for buys people.
- PVC is very stable to pollution, salt water and chemicals. Wood often swells and rots if it comes in contact with water or chemicals. It is not the case with PVC.
- PVC is resistant to fire and flames. If there are any fire accidents, you will not have to worry about the safety of your doors.
- Unlike aluminium, PVC prevents condensation.
- It also keeps your home warm in winter and cool in summer. They promote cost efficient thermal insulation.
- They are sturdy and unbreakable.
- PVC is much cheaper than the wooden and aluminium doors.
- It is not just a good thermal insulator, but also a sound insulator. The rooms will remain sound proof once you cover them with PVC doors.
- They also need minimal maintenance in terms of cost. Wooden doors need to be polished every two to five years unlike PVC doors.
- They come in practically all colours. They can also be designed in the way you want and to suit the interiors of your home.
- PVC has more performance ratings than other materials used to make doors. This is because recent innovations have enhanced the structural performance of PVC changing the perception of people who neglected it until now.
- It is also an environmental friendly material as it is completely recyclable. Thus, it is a resource saving material that causes less pollution.
- They consume less energy even while manufacturing, thus it is an eco friendly material.
- They are pleasing to the eye and have an aesthetic appearance. It is the beast choice for modern homes that are designed in nice patterns.

Qualities of cheapest PVC door

Objectives: At the end of this lesson you shall be able to
- **state the qualities of PVC door.**

PVC door with cheapest price having the following qualities.

- Available of the required sizes.
- Attractive with different designs.
- Neat and tidy to look.
- Can be made into different sizes and shapes.
- If will not absorb wetness.
- Transportation is very easy
- Easy to work on it.
- To join and assembling is quickly.
- Strong and sturdy for use
- Suit all climates
- Cast is chap comparatively for the similar size
- Weight is less for the similar size.
- Give good appearance
- Minimum wastages in working
- Fitting the different parts is easy.

PVC doors properties

Mechanical properties

PVC has high hardness and mechanical properties.

The mechanical properties enhance with the molecular weight increasing but decrease with the temperature increasing.

Thermal and fire properties

The heat stability of raw PVC is very poor, so the addition of a heat stabilizer during the process is necessary in order to ensure the product's properties. PVC starts to decompose when the temperature reaches 140^0C.

Electrical properties

PVC is a polymer with good insulation properties, but because of its higher polar nature the electrical insulating property is inferior to non polar polymers such as polyethylene and polypropylene.

Since the dielectric constant, dielectric loss tangent value, and volume resistivity are high, the corona resistance is not very good, and it is generally suitable for frequency insulation materials.

Chemical properties

PVC is chemically resistant to acids, salts, bases, fats, and alcohols; therefore, it is used in sewerage piping.

It is also resistant to some solvents, mainly. Plasticized PVC, also known as PVC-P, is in some cases less resistant to solvents.

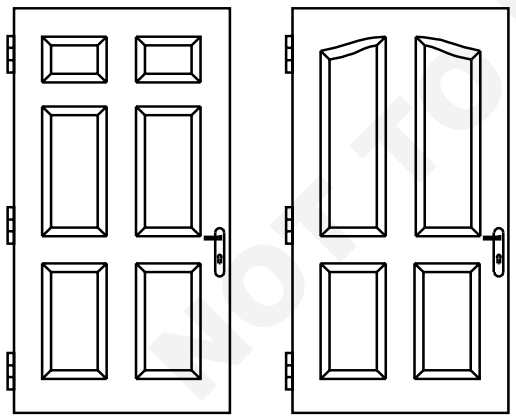
For example, PVC is resistant to fuel and some paint thinners.

Types of PVC door

Moulded PVC door (Fig 1)

All the surface of moulded PVC door should be uniform smooth finish and free from crack and seam. Passing joints shall be finished ensuring that no gages are visible.

Fig 1



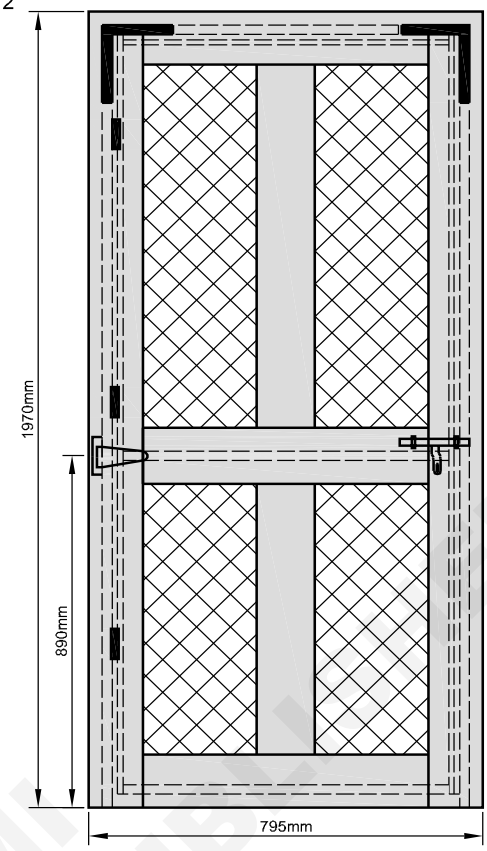
MOULDED PVC DOOR (WOOD FREE)

CAN2516921

Wire mesh solid PVC door (Fig 2)

All the surface of wire mesh solid PVC door should be uniform smooth finish and free from. Crack and seam positing shall be finished ensuring that no gaps are visible size: Length: 1970 mm width: 795MM.

Fig 2



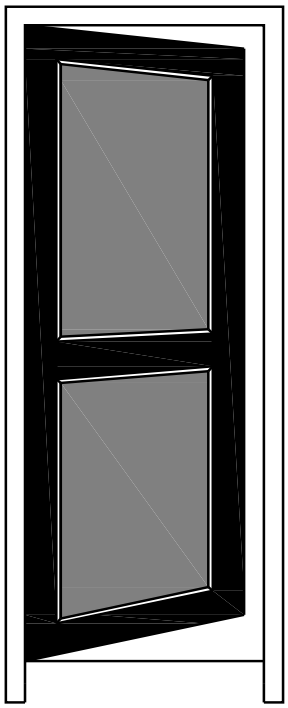
WIREMESH SOLID PVC DOOR

CAN2516922

Kitchen and W.C bath PVC door (Fig 3)

All the surface of module PVC door should be uniform smooth finish size 28mm with solitaire pan, 'A' section 'H' section, plastic bracket, galvanized 'T' bar and galvanized tube.

Fig 3



KITCHED AND W.C BATH PVC DOOR

CAN2516923

New style PVC door

Objectives: At the end of this lesson you shall be able to
- **state the type of PVC door.**

When you begin creating the interiors of your house, you will discover that there countless door types to pick to impart that space with the ideal appearance and still permit it to deal with its function.

If it is a vacation home you will need to know how to protect a vacant property and strong door would be good idea.

Fig 1

PVC doors application

- Used in different types of building such as residential, commercial, institutional and many more.
- Used in interiors as it is available in many designs and colors.
- Used in interiors as it is light weight doors.
- Used commonly because it is cheap.
- Used commonly because of no maintenance required making it time saving.

Comparison of moulded PVC door and wooden door

Properties	Moulded PVC Door	Wooden Door
Environment friendlines	PVC Sheet is environment friendly. No wood is cut/ used in manufacturing of PVC Sheet	Non-Environment friendly as this door is fabricated with wood.
Screw Holding Strength	This door has goot good screw holding strength as inside material is solid core Flush door/Block Board.	Door are heavy. This causes excessive stress on hinges and the door tends to sag in due course of time. This further causes extra stress on screws.
Proneness to Warping/ Damage	No warpage since moulded door is solid & waterproof.	When the door comes in contact with water, wraping takes place.
Finish	PVC Moulded door has smooth surface.	Unfinished surface requires further expenses and labour for finishing.
Availability of designs & colors	PVC Moulded doors are available in wide range of colors and designs	Required color is obtained by painting or polishing.
Effect of Water/ Termite	Edges of door are lipped with PVC sheet by using solvent cement adhesive. No effect of water and termite is there.	Borer and termites make the wood hollow. The door stars sagging absorbing moisture from air, if, not seasoned properly.
Fire Retardant	Fire retardant & self extinguishing in nature.	Catches fire & burns.
Weight	Heavy	Heavy

Properties	Moulded PVC Door	Wooden Door
Dimensional Stability	Good quality Flush door is used as inner core & 10mm thick PVC sheet lipping is provided on four sides. This gives strong dimensional stability.	Panel joints get open in due course of time due to moisture retention.
Maintenance	100% maintenance Free.	Requires maintenance i.e. Painting and termite.

Plastics

Objectives : At the end of this lesson you shall be able to
- **determine the machining parameters for the following operations**
- **list the types of plastics**
- **differentiate between thermoplastics and thermosetting plastics**
- **state the properties and uses of the different types of thermoplastics, thermo-setting plastics and elastomers.**

The dictionary meaning of plastic is 'capable of being easily formed or moulded'.

There are a number of synthetic materials available under the name of plastics.

Plastics have their origin in the chemical synthesis of materials from different sources like:

- agriculture
- agriculture and petroleum
- petroleum and coal
- petroleum and mineral
- minerals.

Of these, coal and petroleum are mostly used in making plastics.

Plastics are divided into three major catagories.

- Thermoplastics
- Thermo-setting plastics
- Elastomers

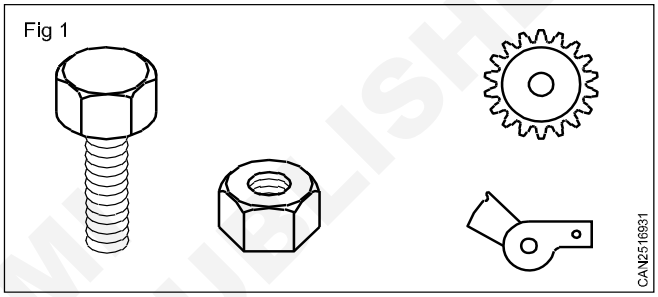
Thermoplastics: These are formed into shape by the application of heat and pressure. They soften when heated, and become solid again when cooled. There is no chemical change in the moulding operation.

Thermoplastics are:

- nylon (polymide)
- polythene
- polypropylene
- polystyrene
- poly vinyl chloride (PVC)
- acrylic resin
- cellulosic's.

Nylon (Polymide) (Fig 1) : It is strong, tough and of light weight. It has a good abrasion resistance, and resistance to chemicals, fuels and oils.

Fig 1

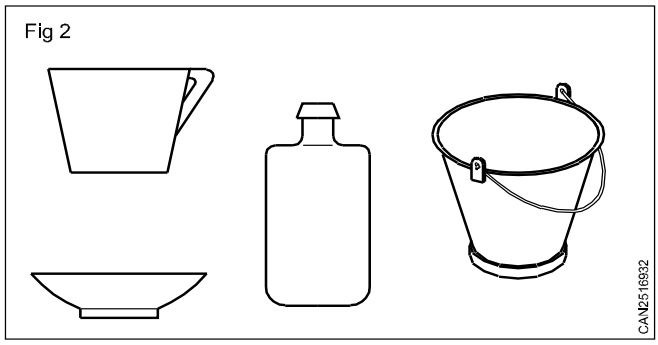


It is used for making light engineering components such as gears, bushes, bearings, machine slides, rollers, brush bristles etc.

Polythene (Polythylene) (Fig 2): There are two types.

- Low density polythene (LDPE)
- High density polythene (HDPE)

Fig 2



Polythene is cheap. It has high resistance to water, oils and chemicals. It can also withstand sizable temperature changes.

Low density polythene is used for making bags, sacks for package, dust bins, toys, and house-wares etc.

High density polythene is used for large moulded containers, bottles, milk crates, pipes and better quality house wares.

Polypropylene (PP): It is the lightest among plastics. It is tough and has high resistance to heat and chemicals.

It is used for making automobile accelerator pedals, suitcases, hospital equipment, ropes and twines etc.

Polystyrene (PS): It is cheapest, has good resistance to water, oils and alkalis. But it disolves in solvents.

It is used for making thin-walled containers for dairy products and foodstuffs. It is also used for fridge liners, spools, cassettes and cartridges for tapes and photographic films. It is also used in vaccum cleaners.

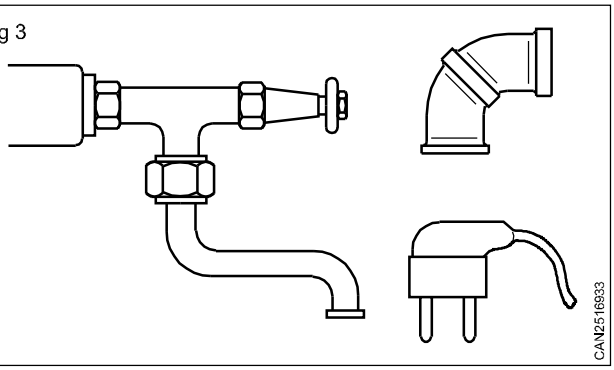
Poly vinyl chloride (PVC) (Fig 3): It possesses good physical strength, and has good resistance to water and chemicals. It is also a good electrical insulator.

PVC may be flexible or rigid.

Rigid PVC is used for pipes and fittings, doors, windows, wall cladding, electrical conduits, gramaphone records, bottles for edible oils etc.

Flexible PVC is used for cable and wire insulation, floor and wall coverings, tents and hose-pipes etc.

Fig 3



Acrylic resin (Polymethyl methacrylate): It is popularly known as perspex. It possesses exceptional stability in outdoor weather, resulting in wide use in signs and displays and lights fittings. At room temperature, it is rigid. It is transparent, and is avaliable in a wide range of colours.

It is used for sanitary wares, furnitures, record player lids, radio and speedometer scales etc.

Plastic processing methods

Objectives : At the end of this lesson you shall be able to
- **describe blow moulding process**
- **describe thermoforming**
- **describe rotational moulding**
- **describe extrusion.**

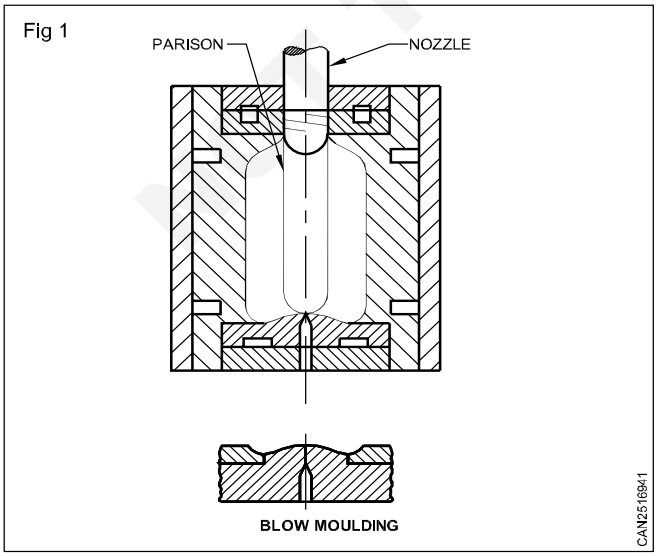
INTRODUCTION

A variety of special procedures are widely used in the processing of plastics. This is in addition to basic procedures like injection moulding, compression moulding and transfer moulding.

Blow moulding

Blow moulding is a process of forming hollow articles from a softened plastic tube. The process consists of forming a tube of the melt (called parison) and introducing air into the parison to expand it. It can be either a free blown object or blown against a mould (Fig 1) to form into a definite size and shape.

Fig 1



The equipment consists of

- an extruder to plasticize the resin
- a cross head with die and core to create parison
- an air source to inflate the parison
- a press to open and close the mould.

Theoretically any thermoplastic resin can be used for a blow moulding operation. However, only those materials which show high hat strength, good stretch properties at the extrusion temperature, suitable for formation of a parison and subsequent blowing can be used.

Thermoforming (Figs 2 to 4)

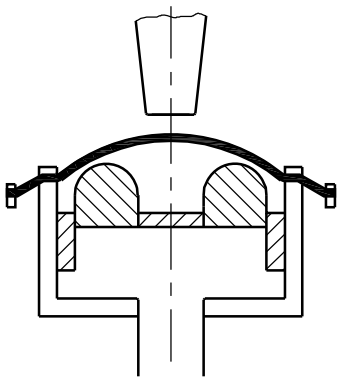
Flat sheet material is converted to a three dimensional shape. The sheet material is brought to a thermoplastic state by the addition of heat. It is then forced into a mould pneumatically or mechanically. This process is also called vacuum forming. This is because much of the early work was done using vacuum to provide the forming pressure.

Advantages of thermoforming process are:

- in comparison to other plastics processing methods tooling is relatively inexpensive.
- the cost saving will be very impressive in the production of large parts.
- many parts with very thin wall thickness can be made only by this method.

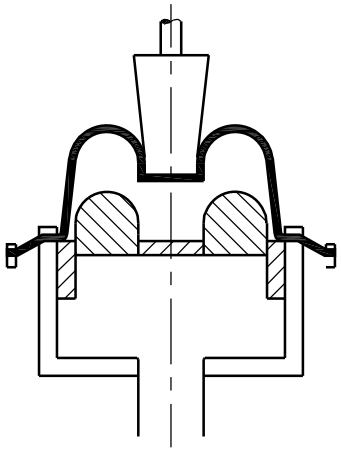
- the process is ideal for production of small number of parts, samples, prototypes etc. This process is used in the production of refrigerat or doorliners, automobile dash board panels, cheese containers, soft drink cups etc.

Fig 2



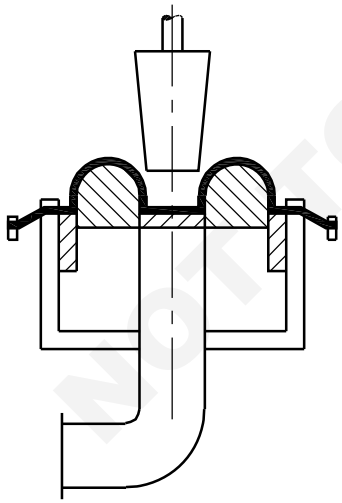
CAN2516942

Fig 3



CAN2516943

Fig 4



CAN2516944

Rotational moulding

Rotational moulding is also known as rotoforming or roto moulding. A predetermined mass of thermoplastic powder is charged in a closed mould. The mould rotated simultaneously in two perpendicular planes in a hot oven. The temperature will be from 260 - 485°C depending on material and product.

This causes the powder to melt and deposit uniformly on the mould surface. When the melting phase is completed, the moulds are moved while still rotating from the oven. The moulds are placed in a cooling chamber where they are cooled by air circulation or water spray. Internal cooling to speed the cycle by means of nitrogen or water fog is adopted to lower the cost. After the cooling cycle the moulds are opened and the moulded parts are removed. Gasoline tanks, toys, plastic balls etc are produced bythis methods.

Advantages of rotational mouldings are:

- tooling is simple and in expensive
- parts produced are stain free
- parts are usually made with uniform wall thickness
- no weld lines, sprue marks, gate marks or ejection marks on the parts
- hollow parts are produce with simple tooling
- usually no secondary operations are required
- wall thickness change can be easily made without new tooling or tool modification.

Disadvantages of rotational mouldings are:

- not suited generally for large production run of small parts.
- not suitable for production of parts with wall thickness less than 0.5mm.

Extrusion

Extrusion moulding is used to make continuous shapes such as tubes, rods, pipes, wires, etc., out of thermoplastic material. The extrusion machine is similar to an injection moulding machine. The material is fed into the machine through a hopper. The screw compresses and plasticises the material until a liquid melt is obtained. The melt is then pumped through the die which shapes the extrusion.

On leaving the die the extrusion is cooled, solidified and drawn off by some type of take off equipment. The final product is then cut to length, reeled up or coiled.

Removing old painting and repainting

Objectives: At the end of this lesson you shall be able to
- **describe the method of removing old paint**
- **state the repainting on furniture.**

Introduction

Removing paint and applying a fresh coat of finish can help you restore any piece of furniture to its original splendor. But why should you remove the old finish when you can just slap some paint on top of it. In a nutshell, stripping off old paint is the only way to achieve perfect results.

Necessary of remove old paint from furniture

Hiring a professional to repair, strip, and finish your furniture may seem like a good idea.

However, you can save a few hundreds of dollars by doing the work yourself. Below are five tips to help you do the job right the first time.

Method of removing old painting

Prepare the furniture: The first thing you need to do is to remove the knobs, handles, and hinges from your furniture. If a piece of furniture is damaged, repair it before you start stripping. Once slits have been repaired and joints reinforced or re-glued, its time to decide on the appropriate method to get rid of old paint or finish.

Test the finish: Before using any paint remover, test the finish. Apply lacquer thinner, denatured alcohol paint remover to a small section of the furniture and allow it to work for 10 to 20 seconds. Wipe it off with a rough cloth; if the finish comes off easily, you can use the same product to remove the entire finish. It's essential to know that lacquer can be removed with lacquer thinner; shellac with denatured alcohol; shellac-lacquer combinations with a mixture containing 50% lacquer thinner and 50% denatured alcohol; and paint with special removers.

Use the paint remover: Paint removers are used to soften old finishes so that they can be washed, scraped, or sanded off easily. Most removers contain waxes, such as paraffin, to prolong the evaporation process. Since wax prevents paint and finishes from adhering a properly to wood, mineral spirits or turpentine can be used to remove wax before applying the new finish. If the remover doesn't contain wax, aluminium foil can help slow the evaporation process. After applying the chemical, cover it with aluminium foil, wait atleast 30 minutes, and then check the result. The paint should be soft enough to be removed with a scrapper. Some of the best products for removing paint from furniture are the water-away removers, which don't require scrapping or sanding. However, the problem with these products is that the finish must be washed off with water, which can cause the wood to swell.

Note: Opt for non-chemical removal methods: A power sander can help you remove old paint faster than chemicals. If you choose to use a power sander, The straight-line and orbital sanders are the best tools for removing any wood finish. However, You must take great care, or you may end up damaging your furniture.

Process of Repainting on Furniture

Surface Preparation-Surface preparations is important because it directly affects the surface finish of the paint.

Sanding: After removing paint from your furniture, use a scraper, steel wool, or sandpaper to get rid of remaining traces. Be careful not to dig into the wood too deep. Then, select the right type of sandpaper to sand away imperfections and achieve a smooth surface. As an example, 100-grit sandpaper for finish sanding.

Primer helps give uniform colour and texture to the finished paint, and provide better adhesion to the top coats. The types of primer used is also dependent on the kind of wood surface to be painted,

Putty Coat: Putties are generally used in minor cracks and surface imperfections.

Repainting: While the paint is still wet, take a brush and run it over the surface of the furniture; using long, even strokes allow the coat to dry.

Finish Coat: Generally two coats of finish coat are required to get the desired finish and color. It is important that each must be completely dry before the application of next one.

New painting on furniture

Objectives: At the end of this lesson you shall be able to
- **describe the method of new painting on furniture.**

Introduction

Painting wooden furniture is a way to give new life to the piece of furniture. The process itself is relatively simple, requiring just a few basic tools and supplies. Carefully sand the furniture and repair any blemishes in it then take your time applying several thin coats of primer and paint. You 'll soon have a beautifully renewed piece of furniture.

Method of new painting

Prepare the area for painting surface: Place drop cloths on the floor, and open any windows and doors to allow plenty of ventilation into the area. Position the furniture on the cloths put on a face mask and gloves before beginning the project to protect your skin and lungs.

Remove any necessary hardware from the furniture: Most of the time, any knobs, pulls, or other hardware can simply be unscrewed. Removing the hardware before you paint allows you to evenly paint the whole wooden surface, and protects the hardware from drips of paint.

Patch any chipped, holed, or pitted surfaces with wood filler: Apply most of the wood filler to the damaged part of the wood. Use the putty knife to scrape away excess wood filler and allow it to dry.

Sand the surface of the furniture: If you have a large piece of furniture, save yourself time and effort by using an orbital sander. Edges, grooves, and any other nooks and crannies can be finished off with a small sanding block, or just sanded by hand.

Remove any dust sanding the furniture surface: Wipe gently with a clean tack cloth to remove the sand dust from furniture surface.

Priming

Primer

Primer is also good it you have a musty or stinky place of furniture. Also, it you're painting row wood that's never been painted or stained before, giving it a coat of primer before painting it helps to reduce your number of coats of paint otherwise the wood will soak up a lot of your paint color.

First coat of primer

Use a paint roller to hit wide-spaced, even areas of wood surface that aren't contoured, and a paint brush along corners, edges, and a paint brush along corners, edges, and harder-to-reach areas allow the primer to dry before moving.

Sand the primed surface after it has dried: Go over every area of primed surface with a fine-grit sandpaper. This will help your paint bond to the primer even better. Be sure to wipe away any sawdust or residue with a tack cloth after sanding.

Apply final coats of primer: Apply atleast one more coat of primer after the first one has dried, and a third if needed to completely cover the furniture. Lightly sand between the coats.

Painting and finishing

First Coat the Wooden Furniture in a thin layer of latex paint: Go over even surfaces of the furniture with a foam roller. Work fairly quickly, but don't apply too much paint at once. Your furniture will look much better if you use several light coats rather than a single heavy one.

Go back over the paint with a brush: While the paint is still wet, take a brush and run it over the surface of the furniture, using long, even strokes. Pay special attention to the places where rollers cannot apply paint such as edges and corners. Allow the coat to dry.

Use the highest quality brush you can afford. The bristles of poor quality brushes will come loose and get stuck in the paint, or the coverage just won't look uniform.

Apply a second coat of paint after atleast six hours: Most people will find that a single coat of paint won't give the furniture that professional look that they're seeking. Wait for the first coat of paint to dry (overnight is best, but atleast six hours), and then hit it with another coat of the same paint.

Sand between coats of paint: After each coat has dried, go over it lightly with fine grade sandpaper. Make sure to wipe away any dust or residue with a tack cloth. This will make sure that each coat adheres smoothly and evenly.

Add new hardware or replace the old: If you want to replace the old hardware, just fit it back into the original holes and screw into place. If you are installing new hardware.

Let the furniture cure for a few days: Your freshly painted furniture will need to sit for a little while after you're finished so that everything will set. Using the furniture too early can leave scratches or dings in the finish, so let the finished piece sit two to three days first.

Wooden floors

Objectives: At the end of this lesson you shall be able to
- **state the construction details of wooden floor**
- **state the types and uses of wooden floor.**

In wooden flooring construction the timber only is used as a flooring material.

To sub divide the portion in between the basements and roof level the solid construction is called floor.

The purpose of flooring is to provide a flat level surface to support the building, furniture and partition etc.

The wooden floors are not much used in residential buildings

The flooring consists of the floor joist timber which are nailed to the wall plates at their ends.

The wooden floors are used for dancing hall, where the temperature drop is very low, and in hill areas where the timber is cheaply and readily available.

Wooden flooring is one of the costlier flooring.

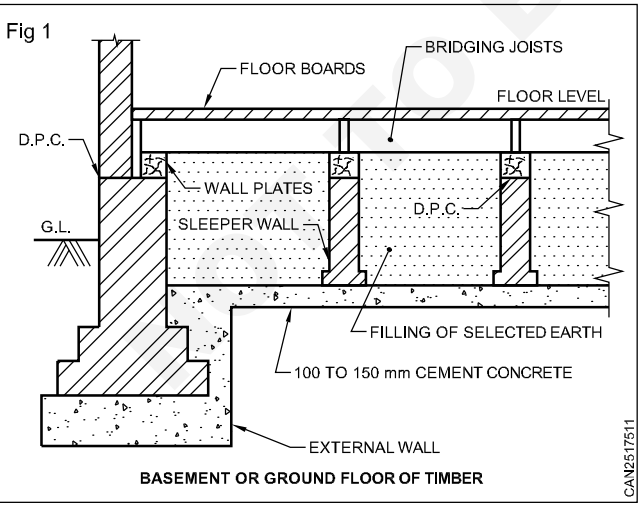
The wooden floors are lighter in weight, poor fire resistance, sound insulations properties and damp resistance.

Types of wooden floors

- Basement or ground floor
- Single joist wooden floor
- Double joist wooden floor
- Framed joist wooden floor

Basement or ground floor (Fig 1)

Fig 1



BASEMENT OR GROUND FLOOR OF TIMBER

This flooring is used in an auditorium to perform the dance and drama programmes.

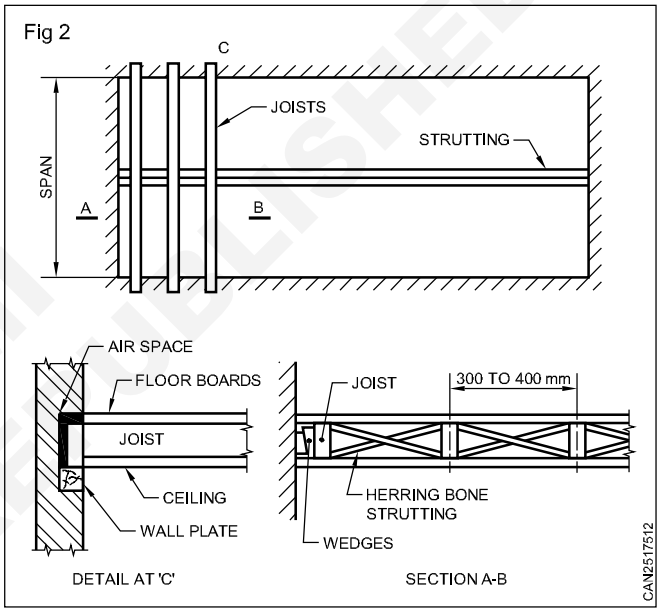
The sleep walls (75 mm x 100 mm as a brick thickness) are constructed at a centre distance of 1.00 meter to 1.75 meter. The wall plates are provided along the walls and along the sleeper walls.

The sleeper walls reduce the span of the bridging joist. The sleeper walls serve as an end support for the bridging joist.

The ends of the bridging joist are usually provided at a centre distance of 30cm. The flooring boards are provided to finish the floor work.

Single joist floor (Fig 2)

Fig 2



This is one of the simplest type of wooden floor. The floors consist of single joist. The width of the joist from 5 cm to 8 cm are placed below the floor boards

The joist are placed at a centre distance of 30 cm to 45 cm. The joists are supported on wall plates at their ends.

A space about 5 cm is kept at the ends for air circulation

The span distance is approximately 4 meters.

When the span distance is become more than 2.50 meters it is necessary to strengthen the joint by providing the HERRING BONE STRUTTING at the mid-span.

The size of the herring bone studding is 50 mm x 30 mm to 50 mm x 50 mm.

At the end the wedges are provided between the walls and the joist.

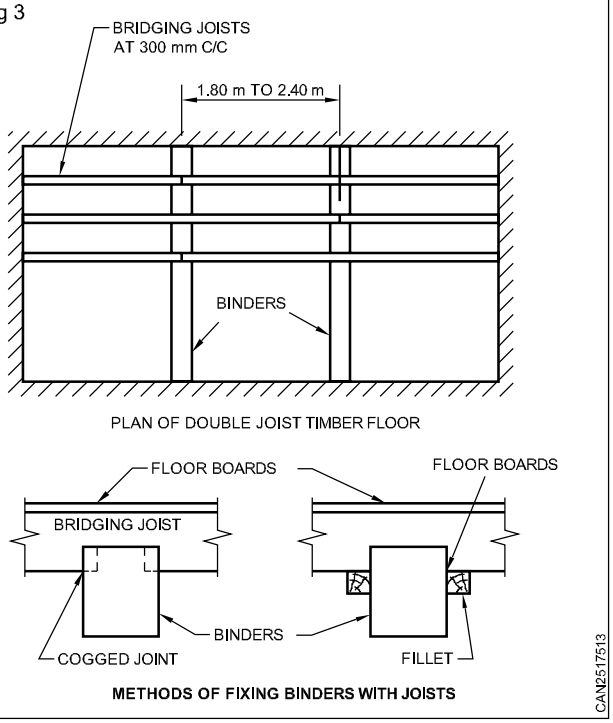
The end of the joist are nailed or notched to the wall plate.

The floors are used where the spans are short and the loads are lighter.

Double joist wooden floors (Fig 3)

This type of flooring is stronger than single joist wooden floor.

Fig 3



The flooring commonly is used for the span between 4m to 8m.

The intermediate supports called binder are provided for the bridging joist.

The binders are usually placed at a centre distance of 1.75m to 2.50m.

The ends of the binders rest on wooden or stone blocks.

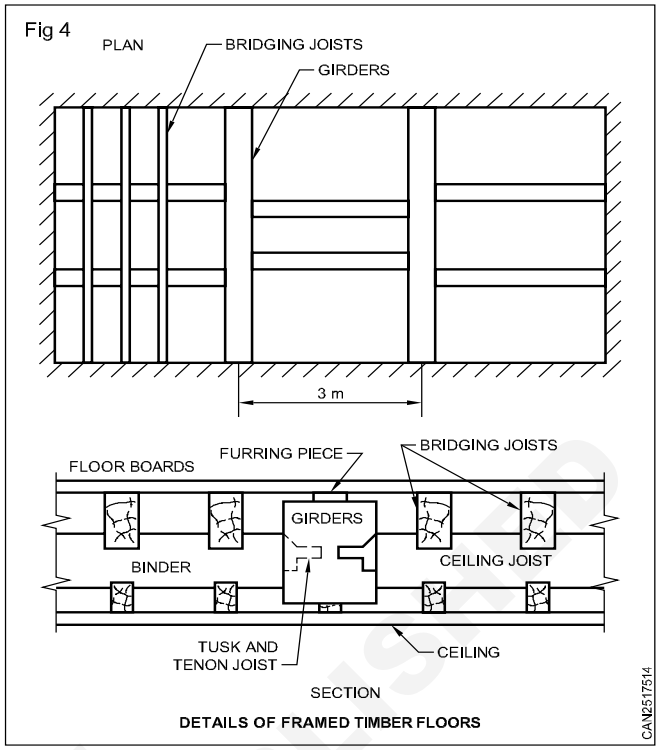
This type of flooring prevents the passage of sound in a better way. The loads of the bringing joist is thrown in a wall.

The depth of floor is increased by the use of binder and the height of the room is decreased.

The fillets are placed along the binders to support the bridging joist.

Framed or triple joist wooden floor (Fig 4)

Fig 4



This type of wooden floors are suitable for the span more than 7.5 meter. This type of wooden floors consist of floor boards, binders, girders and bridging joist.

The intermediate supports called girders are provided for the binder. The girders are usually placed at a centre distance of 2.5 meter to 3.00 metre.

The bridging joists support the flooring boards.

The binder are staggered and connected to the girders using by tusk and tenon joint.

The ends of the binders support iron stirrups which are fixed to the girders.

The ends of the girders rest in walls on stones or concrete templates.

Wooden partition wall

Objectives: At the end of this lesson you shall be able to
- **state the construction and types of wooden partition**
- **state the requirements of partitions**
- **state the advantage and disadvantages of wooden partition.**

Refer Exercise: 1.3.57

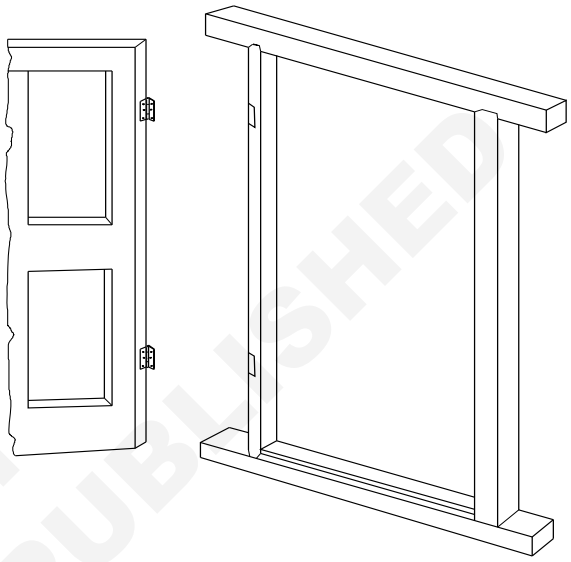
Basic principle of repairing work, illustrate of nail, screw and bracket, material estimates and hilti laser tools

Objectives: At the end of this lesson you shall be able to
- **state the basic principle of repairing work for door, window, staircase and rack.**

Principle of repairing work

Buildings constructed from wood are indeed affected by its agent and serious defects and damages can reduce values to a building. In repair works, it is important to identify the causes and repair techniques that best suites with the condition. This paper reviews the conservation of traditional timber mosque comprises the concept, principles and approaches of mosque conservation in general. As in conservation practice, wood in historic building can be conserved by using various restoration and conservation techniques which this can be grouped as fully and Partial Reinforcement, Removing Paint and also Preservation of Wood and control insect invasion, as to prolong and extended the function of a timber in a building. It resulted that the common techniques adopted in timber mosque conservation are from the conventional ways and the understanding of the repair technique requires the use of only preserve wood to prevent the future immature defects.

Fig 1



Repairing work for door, window, staircase and rack

Repairs to timber doors and windows must be based on the principle of doing as little as possible and only as much as necessary to retain and protect the element.

Repairs must match existing in material form dimensions and profile and there must be no damage to significant fabric.

Repairs must not involve in high proportion of the structure of the door or window repair work include.

Refluxing loose architraves, decorative trims and mouldings

Cutting out decay and parching damaged door and window.

Strapping loose joints with steel or brass angles.

Careful hand sanding of the elements in windows binding because of excessive or soft paint layers.

Replacing deteriorated door hinges (Fig 1)

Replacing deteriorated window sill fronts. (Fig 2)

Keep records of all repairs, replacements and additions to timber doors, windows. wooden staircase and rack.

Replacing the wooden staircase handle with the pressure to be applied when holding and lowering the conventional handle too much. (Fig 3)

Fitting of baluster steel angles of loose wooden staircase.

Polishing handle of highly desolved wooden staircase.

Removing and repolishing termite and mushroom eroded legs in a carcles rack. (Fig 4)

Re-polishing a office rack that has been use for a long time.

Fig 2

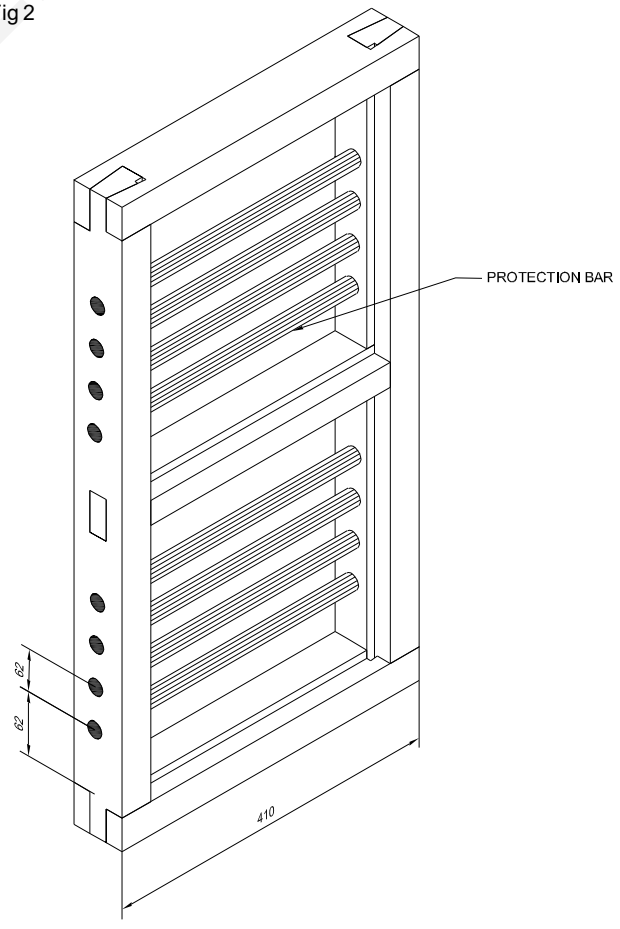
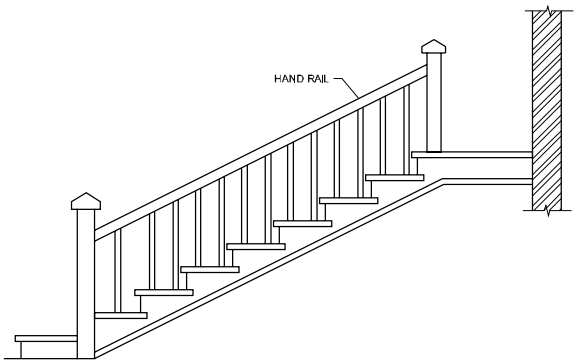
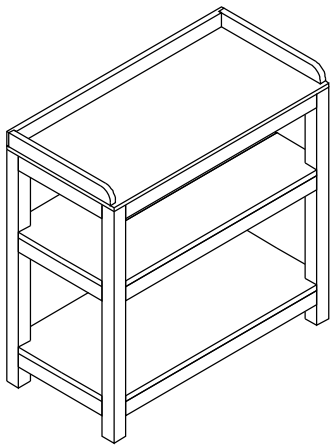


Fig 3



CAN25179Y2

Fig 4



Use of nails, screws, bracket, angle plates, anchors and bolts

Objectives: At the end of this lesson you shall be able to
- **name the use of various types of fasteners**
- **explain the rural building nails and screws**
- **brief the bracket and angle plate**
- **state the use of anchors and bolts.**

Nailing

Nailing is fairly strong cheap and quick method of fastening wood. Nails have a head, shank and point and are usually made from steel wire, Galvanized, copper plated or aluminium nails are used for work which will be in contact with water.

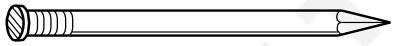
In rural building two classes of nails are used namely,

1 nails of large flat heads and

2 wire nails of very small heads.

Wirenails with flat heads (Fig 1)

Fig 1

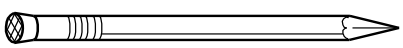


CAN2517711

These are nails with large flat heads. The head prevents the fastened member from being pulled off over the head of the nails. These nails are available in sizes of 7mm to 310 mm long.

Wire nails with small heads or lost head nails (Fig 2)

Fig 2



CAN2517712

These are wirenails with very small heads which can be punched or set below the surface of the wood, and covered with putty. The disadvantage is that the nail head can be easily pulled through the wood and so it cannot be used for very heavy construction. These nails are available in sizes from 7 to 50 mm long. Small lost head nails are called panel pins.

Concrete nails (Fig 3)

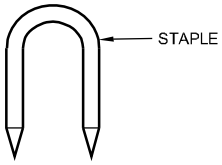
These are hardened steel nails available in different shapes and sizes. They are used to fix things in masonry concrete.

Fig 3

CAN2517713

Staples (Fig 4)

Fig 4



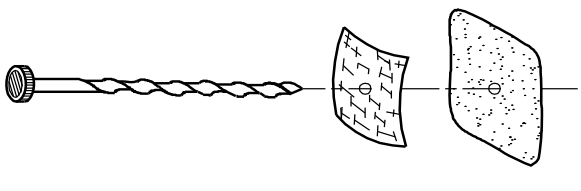
CAN2517714

These are U-shaped nails with points. They are used to fasten wire and screens to walls or timber.

Roofing nails (Figs 5,6 & 7)

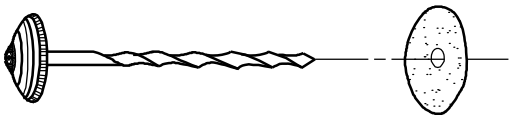
Special roofing nails are used for fixing corrugated sheet materials. They should be aluminium or galvanized metal to prevent rust which could cause the nail head to break off.

Fig 5



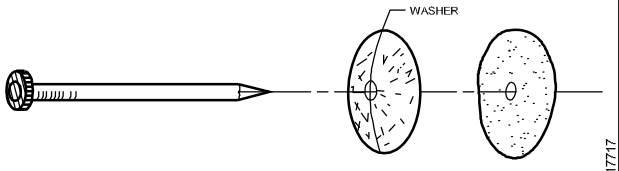
CAN2517715

Fig 6



CAN2517716

Fig 7



CAN2517717

Roofing nails are short nails of firmly heavy gauge with wide round heads. They are used for fastening roofing material and soft board wall sheathing. Some roofing nails are coated to prevent rusting

Box nails

Box nails are similar to common nails except they are thinner, because of their small gauge. They can be used close to the edges and ends with less danger splitting the wood.

Finish nails

Finish nails are of light gauge with a very small head. They are used mostly to fasten interior trim. The small head is sunk into the wood a nail set and covered with a filler.

Casing nails

Many carpenters prefer them to fasten exterior finish.

Duplex nails

On temporary structures such as wood scaffolding and concrete forms the duplex nail is used.

Brads

Brads are small finishing nails they are sized according to length and gauge. The higher the gauge number, the thinner the brad. Brads are used for fastening thin material such as small moulding.

Masonry nails

Masonry nails are cutnails or wirenails. These nails are made from hardened steel to prevent them from bending.

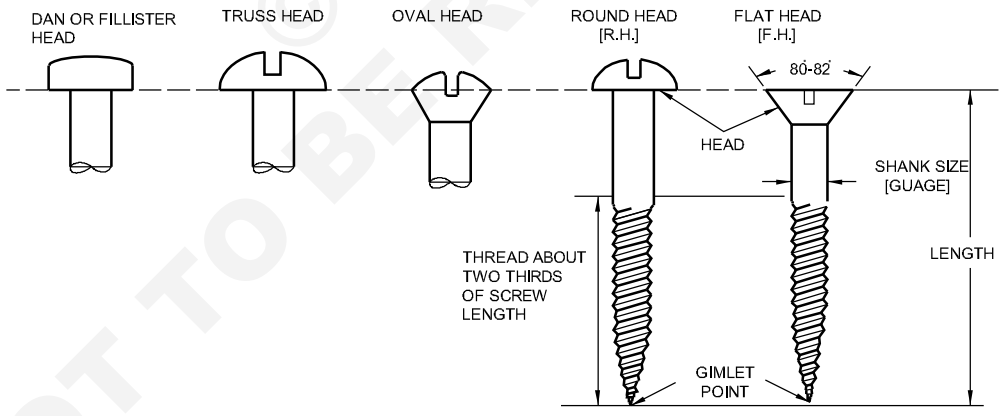
Screws

wood screws are used when greater holding power is needed and when the work begin fastened must at times be removed.

A wood screw is identified by the shape of the screw head. For example a screw may be called a flat head Phillips or a round head common screw. Three of the most common shapes of screw heads are flat head, round head and oval head. (Fig 8).

The pointed end of screw is called gimlet point. The threaded section is called the thread. The smooth section between head and thread is called shank. Screw lengths are measured from the point to that part of the head that sets flush with the wood.

Fig 8



SCREWS

CAN2517718

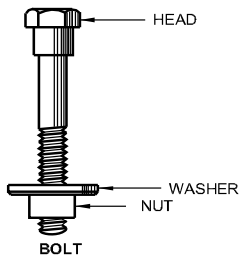
A screw head that is made with a straight single slot is called common screw. A Phillips head screw has a crossed slot.

Lag screws

Lag screws are similar to wood screws except that they are larger and have square or hexagon head designed to be turned with a wrench instead of screw driver. When great holding power is needed and where ordinary screws cannot be used this fastener is used.

Bolts (Fig 9)

Fig 9



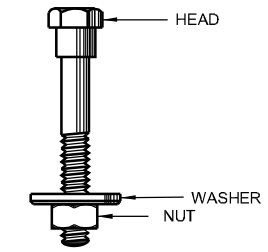
BOLT

CAN2517719

Most bolts are made of steel. To prevent rusting galvanished bolts are used. Commonly used bolts are carriage, machine and stove bolts.

Carriage blots (Fig 10)

Fig 10



CARRIAGE BOLT

CAN251771A

The carriage bolt has a square section under its oval head. The square section is embedded in wood and prevents the bolt from turning as nut is tightened.

Machine bolts

The machine bolts has a square or hexagonal head. This is held with a wrench to keep the bolt from turning as the nut is tightened.

Stove bolts

Stove bolts have either round or flat heads with a screw driver slot. They are threaded all the way upto the head. Machine screws are very similar to stove bolts.

Anchors

Special kinds of fastener used to attach parts to solid masonry, hollow walls and ceilings are called anchors. There are hundreds of types available but a few are mentioned here.

Split fast anchor

These are one piece steel with two sheared expanded halves at the base

Single and double expansion anchors

They are used with machine screws or bolts.

Light duty anchors (Fig 11)

Three kinds of drive anchors are commonly used for quick and easy fastening. The hammer drive anchor has a body of zinc alloy containing steel expander pin.

In the aluminium drive anchor both the body and pin are aluminium to avoid the corroding action of electrolysis. The nylon nail anchor utilizes a nylon body and a threaded steel expander pin.

lead and plastic anchor also called inserts are commonly used for fixing light weight fixtures to walls.

Wall Brackets

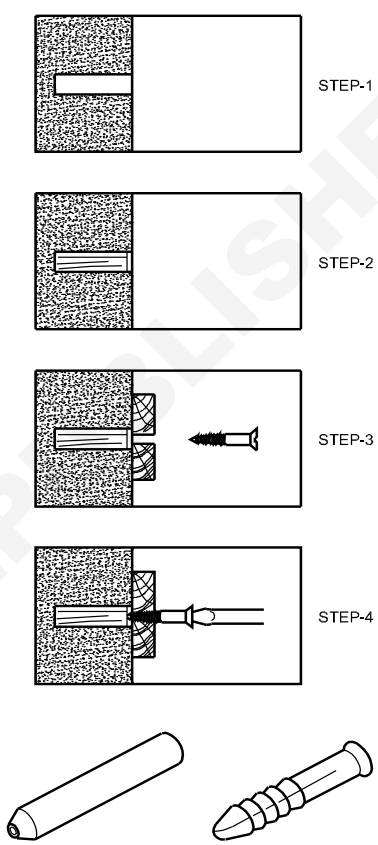
Metal wall brackets are used in residential construction because they can be

- Quickly attached to wall
- Easily moved from one place to the other
- Installed above overhangs

Great care is needed when fastening the brackets to a wall. For light work at low level the type that is attached with nails may provide sufficient safety. Nails should be of 16 or 20 mm dia. Carpenters prefer the greater safety provided by brackets that hook around studding.

Some metal wall brackets have post for holding guard rails and toe boards. A guardrail protects worker on the scaffold and a toe board protects people beneath from falling tools.

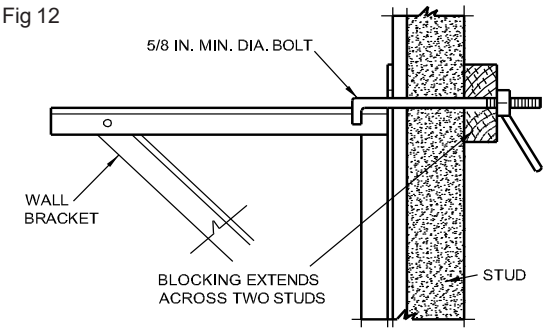
Fig 11



LIGHT DUTY ANCHORS

CAN251771C

Fig 12



WALL BRACKET

CAN251771D

Estimate of carpentry product

Objectives: At the end of this lesson you shall be able to
- **state the classification of cost accounting**
- **explain the cost elements of total cost of the product**
- **identify direct and indirect cost elements.**

Outline of cost accounting: The cost price means the expenses incurred for the manufacture of a product and cost accounting is to calculate the expenditure for a definite unit of product. So cost accounting is the basis of the selling price of a product and also the numerical data for improving the management.

Classification of cost accounting: It is classified into advance accounting and after accounting according to the performed time.

Advance accounting or estimated the accounting is the calculation before the manufacture, of a product and it is mere budget or estimate.

After accounting or actual expense accounting is done on the basis of the actual expenses after the product is finished. It is applied to every kind of business to furnish the foundation of advance accounting.

Elements of cost

The elements consisting the total cost of a product are listed hereunder:

Material costs	Direct material cost	(Raw materials, materials).
	Indirect material costs	(Auxiliary materials,consumable tools,utensils, office appliances).
	Direct labour costs	(Wage of direct workers) .
Manufacturing cost	Labour costs	
	Special costs	Painting, Polishing.
	Expenditures	
	Direct expenditures	(Designing cost directly burdened on products, wooden patterns and others).
	Indirect expenditures	(Depreciation expense of machines, welfare expense, land rent, house rent,premium, power rate, travelling expenses,tax, other sundry expenses).
Total cost (Selling cost)	Selling expenses General (administrative expenses)	Expenses required for the administration of the whole enterprise (The expenses related to the Head office, for example)
Selling price = Total cost + Profit		

Inspection and cost estimate

Objectives: At the end of this lesson you shall be able to
- **state the different types of inspection that should be carried out for satisfactory production**
- **explain inspection parameters for different inspection types.**

Introduction

It is essential to have a through knowledge of a product, the purpose of use and the place of use, to inspect it for a satisfactory production.

Inspection consists of three parts:

1 Inspection of materials.

2 Intermediary inspection in the course of manufacturing process.

3 Inspection of finished products.

Inspection of materials: It is important to select good materials to improve the performance of a product. It sometimes happen that a wood during the working operation or much trouble comes for a working process due to bad selection of woods. The inspection of carpentry working materials consists of four aspects. i.e appearance inspection, quality inspection, dimensional inspection and the inspection of mechanical intensity.

Appearance inspection

The strength, durability and stability of the article depends on the type of material, the sectional size of the materials and members, and the joinery methods used relative to the particular uses of the article.

Quality inspection: Quality inspection is done by utility, the strength and durability depending on the size of members and honesty of construction; using joints and shapes best suited to the materials.

Inspection of mechanical intensity: Mechanical intensity means, tensile strength, elasticity, hardness of material.

Intermediary inspection: Although one inspection of finished goods will be enough for a product made by one process, an inspection after every process is needed for a finished product after many processes. It is called and intermediary inspection to find a faulty point in any product before it is finished, without wasting time and labour carpentry working consists of such operation as sawing (planing), (press, handwork) joint and assembling and finishing.

Planning: Having developed the design and completed the working drawing it is necessary to plan for its construction. This means giving careful thought to such items as the amount and type of materials and fittings required, their cost, tools necessary for its construction, assembling and finishing.

In industry further planning is necessary to cut labour costs and co-ordinate hand and machine techniques for construction, assembling, finishing, packing and transport.

The working rod or rod: This is a special full size working drawing used in industry or large workshops (joinery works, cabinet works or factories) where the design may have to be repeated several times. E.g., production of chairs, tables, wardrobes, cabinets, built-in cupboards, doors and window sashes.

The rod is a sheet of plywood or a wide smooth board on which full size drawings are set out from details supplied by the designer's scale drawings and specifications (descriptions of the materials and fittings, etc.,). The rod can be stored for future use.

Selection of Materials: For the design can greatly affect its utility, appearance and cost. The materials selected should suit the purpose of the article taking into consideration sizes of materials, strength, durability, structure, ornamentation and finish. Refer to notes on "Design Fundamentals" Efficiency.

Cutting List: This is a summary of the materials required for the job. It is compiled by "taking off" the sizes of individual members from the working drawing or rod. Generally the individual members of the various units (carcases, doors, drawers) are grouped together and listed in tabular form under the headings.

Preparation: Consists of planning the pieces ready for setting out. A study of the design (Working drawings) will determine the amount of preparation required for each member. Check sizes with Cutting list and drawing or rod.

Setting Out: Place identification marks on members and joints, e.g., letters or numbers.

Set out positions and shapes of joints. Mark waste with crosses. Check sizes from scale drawings or mark directly from rod.

Assembling: The assembling of large jobs has to be carefully planned and often consists of three stages.

Finishing: Prepare surfaces and edges by fine sanding, damping and when dry sand again.

Apply the finish required according to its particular finishing schedule.

Note: Sometimes members, such as door panels, planted mouldings, shelves and partitions, are finished or polished before assembling.

Laser measuring tools

Objectives: At the end of this lesson you shall be able to
- **explain the laser measuring tools**
- **state the different types of laser measuring tools**
- **state the applications of laser measuring tools.**

Introduction of laser measuring tools

Introducing the new age laser measuring devices and distance measuring instruments ideal for both indoor as well as outdoor applications Hilti's laser measuring instruments offer near-perfect precision and accuaracy in distance measurement that is infallible for state agents, building surveyours, and architects. Hilti offters the best laser measuring tools that allow the user to certain the exact distances of the site and arrive at informed conclusions. These laser measurement tools facilitate accurate mapping of parking lots, square design, and, accurately examine construction sites and other countless areas to as certain the distance between pumps, assess the gap between pump lines and piping runs.

Hilti laser measuring instruments help in measuring heights where alternative measuring methods fail to deliver exact results. They out perform in weighting heights from floors to ceillings in a one-person operation, measuring quickly and safety in difficult to access places, volume calculations for adequate planning of ventilation and heating systems, determining the surface area of walls, ceillings, and floors etc.

Types of laser measuring tools

Laser range meters (Fig 1)

Fig 1

The choicest exemplary distance measuring instruments and devices including laser measuring tools, laser range meters that enable easy calculation of area, volume, and other document measurement directly onto digital photos. Simple, robust, single-button laser range meter for quick and accurate distance measurement up to 100m

The best laser measuring tools for measuring distance from 0.25m - 100m quickly and accurately

Measuring heights where alternative measuring methods fail.

Measuring heights from floors to ceilings in one man operation.

Water-resistant and dust-tight distance measuring instrument.

Quick, reliable measurements with this laze distance measuring device

This laser range meter facilitates measuring functions aided by the graphic display. (Fig 2)

Fig 2

The best laser measuring tool with and extremely rugged built to withstand hard jobsite use.

Built-in 360^0 tilt sensor for various application possibilities in one laser measuring instrument.

LEDs provide clear identification of the measuring reference and thus help avoid errors.

Ideal laser range meter for measuring the lengths of cables and pipes.

The best laser measuring device for determining the surface area of walls, ceilings, and floors for painting etc.

Ideal laser measuring tool for measuring heights from floor to ceilings in a one man operation.

Laser range meter PD-E (Fig 3)

Fig 3

This distance measuring device measures up to 200m even under the toughest outdoor conditions.

The outdoor display can be read even in very bright sunlight.

The laser range meter comes with LEDs to provide clear identification of the measuring reference and thus help avoid errors.

Laser measuring device with built-in optical view finder for outdoor measurements.

This laser measuring instrument comes with a built-in 360^0 tilt sensor for various application possibilities.

Best laser measuring tools for easy measurement of roof lengths using the trapezoid function.

Ideal laser measuring device for measuring long distance using outdoor mode.

Rotating lasers

Our rotating laser level machines are designed to be robust and easy to use helping to simplify all kinds of leveling, aligning, squaring and slope applications on your job.

Rotating lasers pr 30 HVS (Fig 4)

Fig 4

Teamed up with the all in one PRA 30 remote control/laser receiver, the Hilti PR 30-HVS rotating laser measuring tool forms a complete, reliable solution for virtually any leveling, aligning and squaring tasks.

Built to last engineered to US military standards (MIL-STD-810G) with head mounted bumpers, four shock absorbing handles and IP66 protected housing; best laser measuring tool to maintain laser accuracy in reach jobsite conditions.

Lithium-battery, featuring cordless power care (CPC) for longer-lasting power output, charges within 35 minutes.

Laser range meter with digital slope entry and E-targeting simplify grading tasks.

Fast, automatic laser alignment at up to 150m auto alignment system makes this a one person task.

P.S 250 Ferro's can system (Fig 5)

Fig 5

Ideal laser measuring tool that scans large areas of concrete quickly easily.

The best laser measuring device that provides accurate depth of cover measurement for reinforcement at depth of up **mm.

This laser range meter displays a clear 2D images of the reinforcement on the monitor for on the spot structural analysis and depth of cover assessment.

Records scan data automatically over lengths of up 30 meters and up to 9 image scans.

Ideal distance measuring instrument for the generation of structural assessment reports including statistics and visual presentation in 2D/3D views of areas of up to 45 x 45 m.

Helps avoid costly rebar hits and damage caused by cutting through structurally significant reinforcement when coring and hammer drilling.

P.C 1000 x scan system (Fig 6)

Fig 6

This laser measuring device provides a real time inside view of concrete structures and generates true images automatically for direct on site evaluation of scan data by the user no expert skills required.

The laser measuring instrument features three scan modes for specific applications: Quick scan detection, Quick scan recording and images can (2-D and 3-D data visualization with top view and cross sectional view).

Compact all in one, handled design offers easy, user friendly operation, quick start up for the speed of use plus unmatched data visualization.

The laser range meter displays a top view of the scan for easy object mapping plus cross sections in both directions for easy identification of multiple layers in concrete structures.

The best laser measuring tool with a powerful monitor unit for an in depth, on site scan analysis plus PC software for subsequent data evaluation and documentation.