MASON

1st Semester

TRADE THEORY

SECTOR: Construction, Construction Material & Real Estate

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 : Construction, Construction Material and Real Estate

Duration : 1 - Year

Trades : Mason 1st Semester - Trade Theory

Copyright © 2014 National Instructional Media Institute, Chennai

First Edition : August 2014, Copies : 1,000

Rs. 150 /-

All rights reserved.

No part of this publication can be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without permission in writing from the National Instructional Media Institute, Chennai.

Published by:

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE

P. B. No.3142, CTI Campus, Guindy Industrial Estate,

Guindy, Chennai - 600 032.

Phone : 044 - 2250 0248, 2250 0657, 2250 2421

Fax : 91 - 44 - 2250 0791

email : nimi_bsnl@dataone.in

Website: www.nimi.gov.in

FOREWORD

The National Instructional Media Institute (NIMI) is an autonomous body under the Directorate General of Employment and Training (DGE&T) Ministry of Labour and Employment has been developing, producing and disseminating Instructional Media Packages (IMPs are extensively used in the Industrial Training Institutes/Training centres in Industries to impart practical training and develop work-skills for the trainees and the trainers

The Ministry of Labour & Employment constituted Mentor Councils (MCs) to revampcourses run / to be run under National Council of Vocational Training (NCVT) in 25 sectors. The MCs have representatives from thought leaders among various stakeholders viz. one of the top ten industries in the sector innovative entrepreneurs who have proved to be game-changers, academic/professional institutions (IITs etc.), experts from field institutes of DGE &T, champion ITIs for each of the sectors and experts in delivering education and training through modern methods like through use of IT, distance education etc. The technical support to the MCs is provided by Central Staff Training and Research Institute (CSTARI), Kolkata and National Instructional Media Institute (NIMI), Chennai. Some of the MCs are also supported by sector-wise Core Groups which were created internally in the Ministry (in 11 sectors).

A Steering Committee to provide overall coordination and guidance to Mentor Councils has also been constituted and has representation from the MCs, Chair positions to be endowed by the Ministry, trade unions, and experts on distance education and training. The MCs are mandated to work towards revamping/ suggesting new courses, improving assessment systems, overall learning etc. for subjects under the purview of the NCVT.

Accordingly NIMI with the support and assistance of MC has developed **Mason trade Theory 1st Semester** in **Construction, Construction Material & Real Estate sector** to enhance the employability of ITI trainees across the country and also to meet the industry requirement.

I have no doubt that the trainees and trainers of ITIs & Training centres in industries will derive maximum benefit from these books and that NIMI's effort will go a long way in improvement of Vocational Training.

I complement Director, Mentor Council members, Media Development Committee (MDC) members and staff of NIMI for their dedicated and invaluable contribution in bringing out this publication.

ALOK KUMAR, I.A.S.,
Director General of Employment &
Training/ Joint Secretary
Ministry of Labour and Employment
Government of India

New Delhi - 110 001

PREFACE

This National Instructional Media Institute (NIMI) was set up at Chennai by the Directorate General of Employment and Training (DGE&T) Ministry of Labour and Employment, 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 disseminate instructional materials for various trades as per the prescribed syllabi under the Craftsmen and Apprenticeship Training Schemes.

The instructional materials are developed and produced in the form of Instructional Media Packages (IMPs). An IMP consists of Trade Theory book, Trade Practical book, Test and Assignment book, Instructor guide, Wall Charts and Transparencies.

Hon'ble Union Minister of Finance during the budget speech 2014-2015 mentioned about developing **Skill India** and made the following announcement

"A national multi-skill programme called Skill India is proposed to be launched. It would skill the youth with an emphasis on employability and entrepreneur skills. It will also provide training and support for traditional professions like welders, carpenters, cobblers, masons, blacksmiths, weavers etc. Convergence of various schemes to attain this objective is also proposed."

The Ministry of Labour & Employment constituted Mentor Councils (MCs) to revamp courses run / to be run under National Council of Vocational Training (NCVT) in 25 sectors which will give a sustained skill based employability to the ITI trainees as the main objective of Vocational training. The ultimate approach of NIMI is to prepare the validated IMPs based on the exercises to be done during the course of study. As the skill development is progressive the theoretical content on a particular topic is limited to the requirement in every stage. Hence the reader will find a topic spread over a number of units. The test and assignment will enable the instructor to give assignments and evaluate the performance of a trainee. If a trainee possesses the same it helps the trainee to do assignment on his own and also to evaluate himself. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also helps the trainees to grasp the technical topic quickly. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirement ,

Thus the availability of a complete Instructional Media Package in an institute helps the trainer and management to impart an effective training. Hence it is strongly recommended that the Training Institutes/Establishments should provide at least **one IMP** per unit. This will be small, one time investment but the benefits will be long lasting.

The **Mason trade Theory 1st semester in Construction, Construction Material & Real Estate sector** is one of the book develop by the core group members of the Mentor Councils (MCs). The 1st semester book includes **Module 1- Wood Working, Module 2 - Layout Marking and levelling, Module 3 - Masonry construction.**

The **Mason trade Theory 1st semester** is the outcome of the collective efforts of Members of Mentor Council which includes academic/professional institutions (IITs etc.) , experts from field institutes of DGE&T, champion ITIs for each of the sectors, and also Media Development Committee (MDC) members and staff of NIMI.

NIMI wishes that the above material (Trade Practical & Trade Theory) will fulfil to satisfy the long needs of the Trainees and Instructor and helps the trainees for their employability in vocational training.

NIMI would like to take this opportunity to convey sincere thanks to all the Mentor Council members and Media Development Committee (MDC) members.

Director , NIMI

Chennai - 600 032

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 organisation to bring out this IMP **(Trade Theory)** for the trade of **Mason** under the **Construction, Construction Material & Real Estate** Sector Sector for Craftsman Training Scheme. This Book is prepared as per Revised Syllabus.

MEDIA DEVELOPMENT COMMITTEE

Dr.N. Dhang	-	Professor D/O Civil Engineering, Indian Institute of Technology, Kharagur, Chairman, Mentor Council.
Shri. M.C. Sharma	-	Joint Director (TTC) DGE & T, New Delhi, Mentor, Mentor council.
Smt. Arpana Singh	-	Training Officer NVT (W), Noida, Team leader, Mentor Council.
Shri. K.N. Babu	-	Training Officer RVTI, Bangalore, Member, Mentor Council.
Shri.G. Jayaraman	-	Retd. Assistant Training Officer MDC Member, NIMI. Member, Mentor Council.
Shri. M.N. Venkatraman	-	Retd. Assistant Director of Training MDC Member, NIMI, Member, Mentor Council.
Shri.R.N. Manna	-	Training Officer CSTARI, Kolkatta, Co-ordinator, Mentor Council.
Shri. V. Gopalakrishnan	-	Training Officer, NIMI, Chennai-32, Co-ordinator, NIMI, Chennai.

NIMI records its appreciation of 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 staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

INTRODUCTION

TRADE THEORY

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

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

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

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

TRADE PRACTICAL

The trade practical manual is intented to be used in workshop. It consists of a series of practical exercises to be completed by the trainees during the Second Semester course of the Machinist trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered.

The manual is divided into three modules. The distribution of exercises in the four modules are given below.

Module 1 -	Wood Working	13 Exercises
Module 2 -	Layout Marking and Levelling	07 Exercises
Module 3 -	Masonry Construction	20 Exercises
		40 Exercises

The skill training in the shop floor is planned through a series of practical exercises centered around some practical project. However, there are few instance 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 traninee. 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.

CONTENTS

THEORY

Lesson No.	Title of the Lesson	Page No.
	Module 1: Wood Working	
1.1.01	Role of mason, description of mason trade, General precautions and safety measures	1
1.1.02	Generate precautions and safety measures in workshop	8
1.1.03	General classification of joints	32
1.1.04	Hinges	42
1.1.05	Bolts	47
1.1.06	Drill (parts and functions)	52
1.1.07	Timber	78
1.1.08	Door Frame	82
1.1.09	Roofs	91
1.1.10	Wooden floors	99
1.1.11	Nails	101
1.1.12	Screws used in wood	104
1.1.13	Scaffolding	107
	Module 2: Layout marking and levelling	
1.2.01	Investigation and site clearance	113
1.2.02- 1.2.04	Setting out and fixing levels	114
1.2.05 -1.2.07	Setting out of building foundation	116

Lesson No.	Title of the Lesson	Page No.
	Module: 3 Masonry construction	
1.3.01-1.3.02	Building materials - bricks	119
1.3.03	Masonry tools Method of cutting bricks by using bolster and hammer	125
1.3.04	Brick masonry technical terms used Building materials - mortar	131
1.3.05 -1.3.13	Types of bond	136
1.3.14	Building materials, Cement, lime	147
1.3.15	Lintel	149
1.3.16-1.3.17	Requirement of food cement Proportion of mixing P.C.C	151
1.3.18	Types of walls	156

Role of mason

Objectives : At the end of this lesson you shall be able to
- **the role of mason.**

- Any designing and construction project such as residential building, public, Industrial building, construction of canals, bridges, dams, drainage, water supply etc. are constructed by the mason.

The role of mason

Excavation of sail

The mason excavate the soil foundation.

Mixing of concrete

The mason mix the concrete according to prescribed ratio for P.C.C and R.C.C work.

Mixing of mortar

The mason mix the cement mortar according to the prescribed ratio of cement mortar for mason work, plastering

Laying of bricks and block

The mason lay the brick or concrete block according to the bond such as English bond, Flemish bond etc.

Laying of types of walls

The mason lay the corner wall, cross wall, T-Junction, straight wall, obtuse wall, acute wall, pillars etc.

Plastering the surface of wall

The mason prepare the surface wall for plastering and also plastering the surface.

Laying D.P.C and rain water pipe

The mason laying different D.P.C materials and fix rain water pipe and also weathering course in building.

Temporary structure: The mason fix the temporary structure of scaffolding, Racking shore, dead shore etc.

Set out and lay house drainage. Construct a rubble masonry wall. Construct a R.C.C. stair construct types of flooring.

Description of mason trade

Objectives : At the end of this lesson you shall be able to
- **state the masons tools and its uses and safety**
- **state the building materials and its uses**
- **state the construction of corner wall and 'T' jucntion walls with brick and concrete block**
- **state construction of piers and plaster**
- **state fixing of doors and windows**
- **state construction of foundation upto DPC level and floors**
- **state construction of man hole and estimate.**

Identify the masons tools uses and its safety

- Mason should be able to identify, select and practically use of the following masonry tools.
- Trowel - jointing board - steel square - spirit level-boat level - plumb rule - straight edge - gauge rule - line and pins - bolster - club hammer - square and bevel - axe - masons saw - carborundom stone - pointing trowel - steel or wooden Hawk - wooden float - internal angle tool - external angle tool.
- Mason should be able to know safety precaution of the following.
- Safety for personal -safety for college and others safety for tools and equipments - safety for materials - general safety precautions.

Identify and selection of the building materials also uses of the materials.

Brick: Qualities of good bricks -clamp brick, kiln bricks - sizes of bricks.

Stone: Good qualities of building stone - classification of stone - uses of stones - natural bed of stone.

Sand: Pit sand - river sand - sea sand - qualities of good sand - classification of sand such as - fine sand - coarse sand - gravelly sand - bulking of sand.

Cement: Composition of ordinary cement and its function - storage of cement - types of cement uses of cement.

Lime : Types of lime - high calcium lime

Magnesia lime: Hydraulic lime.

Classification of lime: good qualities of lime.

Timber: Classification of trees - method of cutting and felling of timber - defects in timber - good qualities of timber - uses of timber - plywood - uses and advantages of plywood.

Concrete: Types of concrete mixture - grade of concrete -slumps of concrete - method of mixing concrete - curing the concrete.

Construction of corner wall and 'T' - junction wall with brick and concrete block

- Mason should be able to construct the concrete wall in English and Flemish bond in various thickness (one brick and one and half brick thick)
- Mason should be able to construct one and half brick and one brick 'T' junction in English and Flemish bond to a height of 3 feet or twelve courses.

Construction of piers and plaster

- Mason should be able to construct attached pier and detached pier in English and Flemish bond.
- Mason should be able to plastering work with cement mortar.

Fixing of door and windows

- Mason should be able to the method of fixing doors and window frames.

Construction of foundation upto D.P.C level and floor

- Mason should be able to construct a foundation up to the D.P.C level
- Mason should be able to lay IPS, mosaic floor and tiled floor.

Construction of man hole

Mason should be able to construction of man hole.

Estimate

Mason should be able to calculate or estimate the quantity of materials required for specific work.

General Precautions and Safety Measures

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

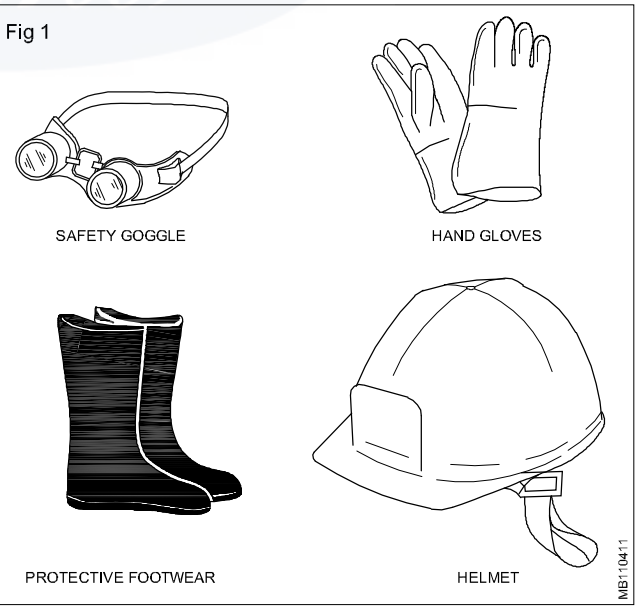
• describe the general precautions to be observed in a masonry (Building Constructor) yard.

- The general precautions to be observed in a masonry Yard or workshop.
- Accidents are quite frequent in the building industry.
- These accidents often result in lost time or the job, partial or total disability or even loss of life.
- Accidents can be reduced if each person works safely and uses the precautions that the nature work requires.
- Safety precautions can be classified
- 1. Safety for self
- 2. Safety for college and others
- 3. Safety for tools and equipments
- 4. Safety for materials.

1. Safety for Personal

- Always avoid loose clothing.
- Wear goggles while grinding the tools.
- Wear the safety shoes. (Fig.1)

Fig 1



- Do not through any sharp instruments.
- Do not through brick or brick bats from top.
- Check the scaffolding before you clamb up

2. Safety for college and others

- Give caution before lifting heavy units.

- Lifting heavy units by crow bar put some lever underneath the crow bar.
- Combined job is carried out give caution time to time and do safe work.

3. Safety for Tools and equipment

- Use proper tools for proper work.
- Do not throw any tools either from top or at bottom.
- All the tools should be washed and oiled after use.
- All the tools should be cleaned and washed and kept in a safe place.

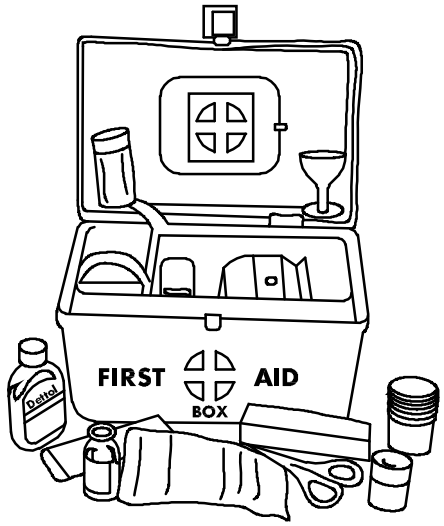
4. Safety for Materials

- Bricks should be stacked properly and bricks should not be allowed to be scattered on the work place.
- Cement bags are staked properly on the wooden planks placed on the floor.
- Provide sufficient space say 0.5 meter away from wall and place cement bags.
- Cement godown should be free from air tight, otherwise cement may get spoiled.

General safety measures

- Electric wire / cables
- High tension / Low tension electric line passing near by the slab, care should be taken while placing reinforcement by working persons.
- While placing concrete it may affect working persons.
- Throwing of waste materials bricks bats, broken blocks may lead to injury to persons working below.
- Scaffolding should be erected firmly and properly braced.
- Walking on parapet wall may fall down due to in balance condition.
- Take more care while using the ladders because it may slip and fall down.
- The lift pit is left unguarded the children of workers may fall in the resulting in fatal accident.
- Bar bending work helpers of bar benders to follow short cut method throw surplus steel pieces form top floor to ground and may cause fatal injuries.
- Do not use faulty tools and equipment. Repair or replace these tools.
- Keep the working area clean, many accidents are caused by litter underfoot.
- Personal safety protective kit (Fig.2)

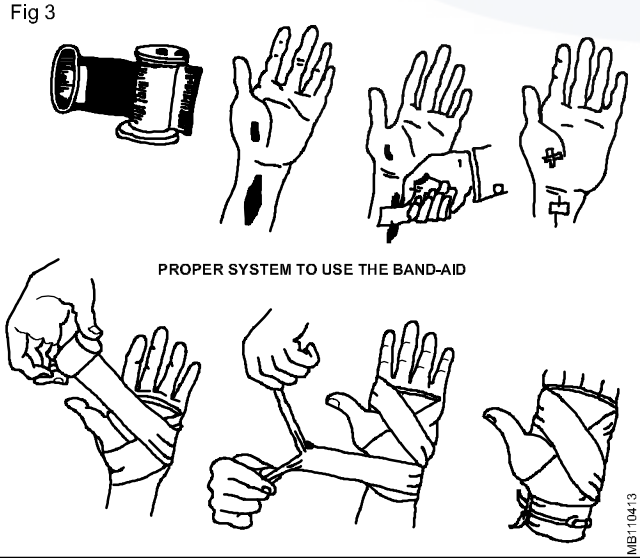
Fig 2



- Protecting workmen from injury during the execution job, safety precautions play a vital role.
- Safety gloves :- Used for material handling welding machine, gas cutter etc. (Fig.1)
- Safety Helmets :- Use where sitework is going on at different levels.(Fig.1)
- Gumboots :- For cutting hard rock, concreting works, Asphalting etc. (Fig.1)
- Safety Belt :- Used for workmen working on height, on outer sides of the building.
- Safety Goggles :- Used for while grinding for gas welding, breaking of pavements etc as shown in figure.
- Site or work spot should have a list of following emergency telephone numbers.
- Fire 101
- Ambulance 101
- Police 100
- Nearest doctor xxxxx
- First Aid
- First aid is an immediate and temporary care given to the victim of an accident, or sudden illness till the treatment from the doctor is made available.
- First aid kit (Fig.2)
- Cotton dressing
- General medicine

- Triangular bandage
- Potassium permanganate
- Pocket of cotton wool
- Roller bandage 25 mm
- Roller bandage 75 mm
- Iodine bottle
- Dettol
- Safety pins
- Scissors
- Knife
- Blade.
- Major possible injuries at site
- In construction work major injuries may causes in the following
- Bleeding
- Sudden stopage of respiration
- Fracture.
- Bleeding
- Usually bleeding can be controlled by direct pressure applied to the wound with a sterile dressing or any cloth. As shown in (Fig. 3).

Fig 3



PROPER SYSTEM TO USE THE BAND-AID

MB110413

- Sudden Respiratory Blockage
- In the case of electric shock, gas poisoning, suffocation etc, where breathing is stopped immediate action is necessary. As shown in (Fig. 4).

Fig 4



RESCUE OPERATION TO RELEASE FROM ELECTRICAL SHOCK

MB110414

- Mouth to mouth respiration should be started as quickly as possible without any time loss. As shown in (Fig.5).

Fig 5

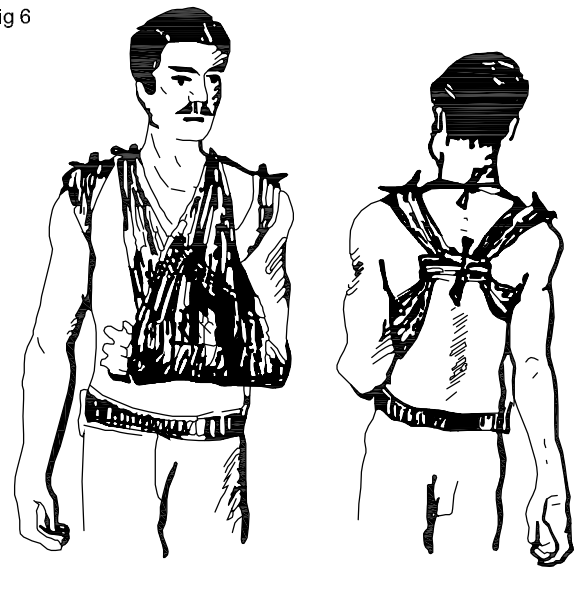


MB110415

Fractures

- In the case of visible fractures and even a fracture is suspected, the adjacent joints should be immobilized.
- If the fracture is with bleeding it should be controlled.
- Care should be taken not to disturb the fractured bone. As shown in (Fig. 6).

Fig 6



TEMPORARY BANDAGE FOR FRACTURE

MB110416

- Excavation of soil for coloumn footings and for deep trenches.
- Sliding of earth or soil from sides of coloumn pits or deep trenches. As shown in (Fig. 7).

Fig 7



WE HAVE TAKEN ALL THE SAFETY PRECAUTIONS ON THIS SITE SIR !

MB110417

- Snake bite Precautions and First aid
- Snake bite is the most common accident observed on construction site.
- One should know whether bitten snake was poisonous or non - poisonous. As shown in (Fig. 8).

Fig 8



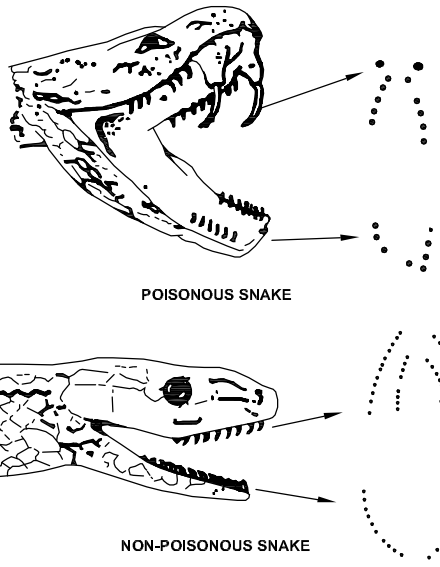
DANGER OF SNAKES WHILE EXCAVATION

MB110418

- Poisonous Snake
- Only two prominent.
- Marks of the fangs can be seen after the bite.
- Non - Poisonous Snake

Two rows of marking of small teeth can be seen after biting. As shown in (Fig 9).

Fig 9



POISONOUS SNAKE

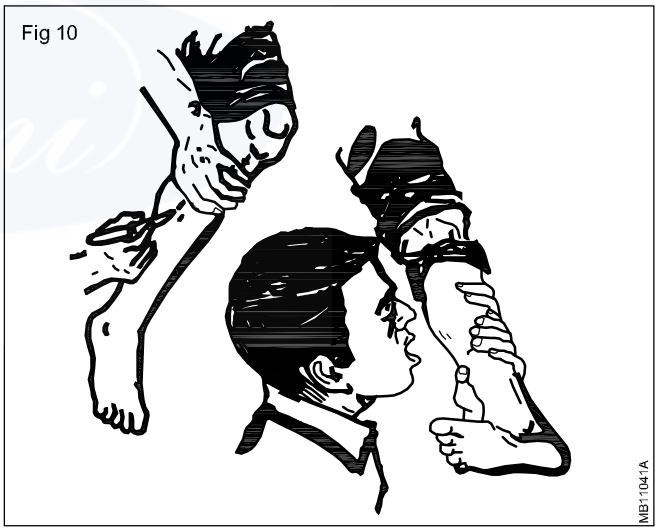
NON-POISONOUS SNAKE

IDENTIFICATION TEETH MARKS FOR POISONOUS SNAKES

MB110419

- First Aid treatment on snake bite
- Tie a cloth immediately around the patient in resting position.
- Do not allow the affected portion of the body to move.
- Wash the wound with clear water.

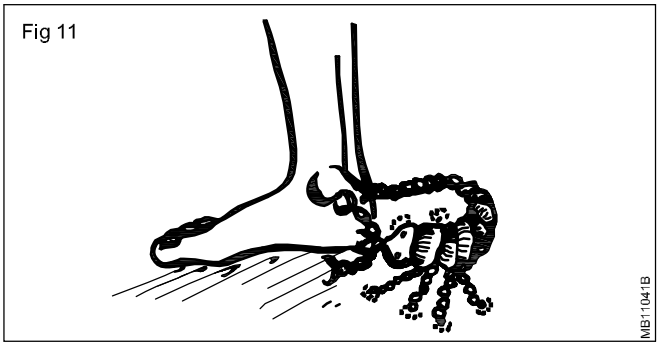
Fig 10



MB11041A

- Take for medical treatment. As shown in (Fig. 10).
- Scorpion stings
- Usually two types of scorpions red and black.

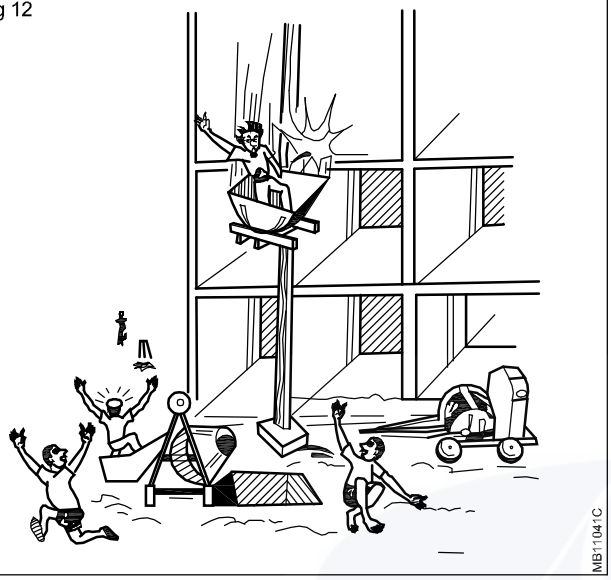
Fig 11



MB11041B

- Tie the cloth immediately upper portion.
- Take for medical treatment nearest doctor.
- Accidents during slab concreting
- Column reinforcement cage may collapse.
- Lift scaffolding means vertical probs not fixed well may collapse while concreting.
- Wrong signal to lift operator and mis operation of lift may lead to accident. As shown in (Fig.11).

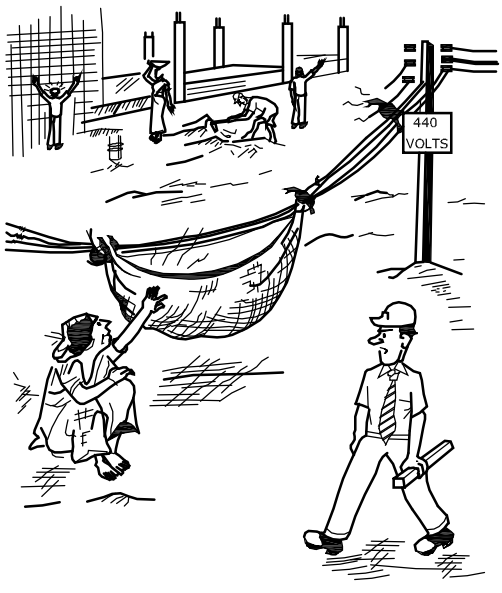
Fig 12



MB11041C

- Accidents due to Electric cables
- Careful working near cable area. All the necessary precaution to be taken. Otherwise accidents may happens as shown in (Fig. 12).

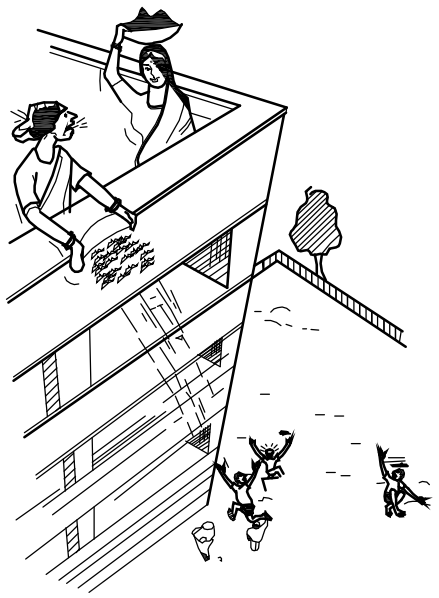
Fig 13



MB11041D

- In construction site the waste materials such as broken brick bats, waste concrete or other debris should not be thrown from top to the bottom of the ground. Otherwise accidents may cause as shown in (Fig. 13).

Fig 14



MB11041E

- Careless way of curing may cause accidents as shown in (Fig.14)

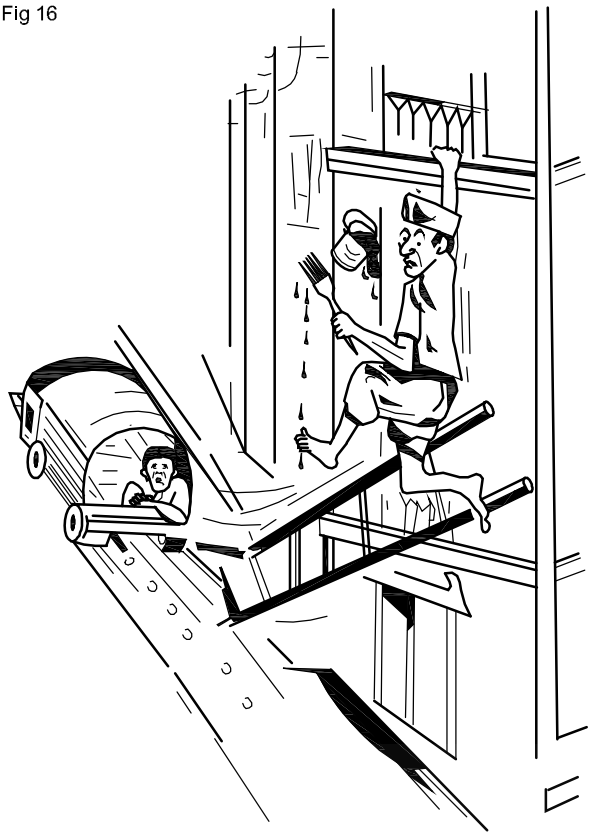
Fig 15



MB11041F

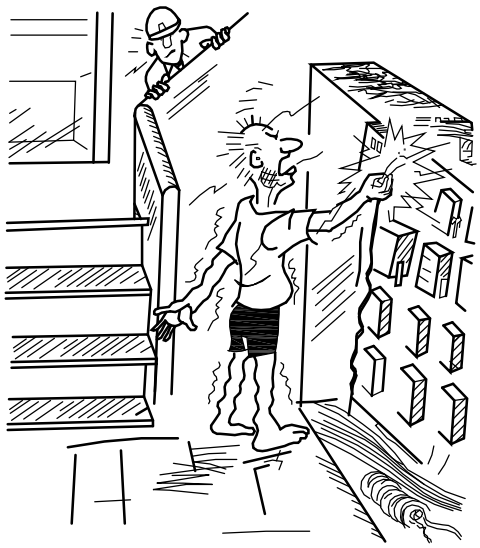
- Working on ladder may slip and painter may fall.
- Use safety belt anchored to hooks.
- Co-worker to hold the ladder firmly.
- Ladder should be anchored properly as shown in (Fig.15)
- Causes of Electrical accidents

Fig 16



MB110410

Fig 17



CAUSES OF ELECTRICAL ACCIDENTS

MB110411H

- The common causes of Electrical accidents at site.
- Insertion of the loose wires in sockets without a plug pin.
- This is the most common practice, and the cause of most of the electrical accidents at construction site.
- Insertion of loose wires is mostly done by the unskilled workers, helpers, etc. As shown in (Fig.16).

General precautions and safety measures in Workshop

Objectives : At the end of this lesson you shall be able to
- **know the general precautions to be observed in a carpentry shop.**

The general precautions to be observed in a carpentry shop are as follows.

- Always avoid loose clothing.
- While using cutting tools such as chisels and care should be taken to see that the cutting action is performed in the direction away from your body.
- 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 on the floor, since it may cause any bodily injury 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 utilised.
- No machine should be operated with out the permission of the shop-in-change.
- The shop floor are around machineries and it 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.

_ _ _ _ _ _ _ _ _ _

Carpenter's pencil & marking instruments (Tools)

Objectives: At the end of this lesson you shall be able to
- **state the meaning of marking**
- **state the uses of pencil**
- **state constructional features and uses of steel rule**
- **state constructional features and uses of collapsible rule and folding rule**
- **state the uses of measuring tape.**

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

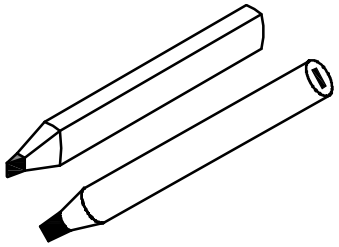
– Marking out is done with pencil or scriber.

– Carpenter's pencil usually is an oval cross-section. (Fig 1)

– It is sharpened with a chisel.

– The pencil is not used for an accurate work.

Fig 1



CARPENTER'S PENCIL

MB170111

– Suitable pencil hardness for marking out on 'H.B' 'H' and 'F'

The Rule (Steel) (Fig 2)

– 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" Fig 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.

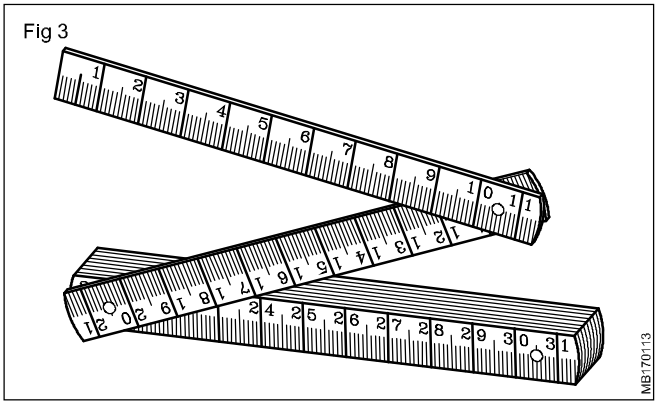
1/16"	=			1.6 mm
2/16"	=	1/8"	=	3.2 mm
3/16"	=			4.8 mm
4/16"	=	1/4"	=	6.35mm
5/16"	=			8.0mm
6/16"	=	3/8"		9.5mm
7/16"	=			11.1mm
8/16"	=	1/2"	=	12.7mm
9/16"	=			14.3mm
10/16"	=	5/8"	=	15.9mm
11/16"	=		=	17.5mm
12/16"	=	3/4"	=	19.05mm
13/16"	=		=	20.6mm
14/16"	=	7/8"	=	22.2mm
15/16"	=		=	23.8mm
16/16"	=	1"	=	25.4mm

Collapsible Carpenter's rule (Zig-Zag) (Fig 3)

It is also called Zig-Zag rule. It consists of 10 pieces each loosely rivetted 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.

Fig 3



Folding Rule (Fig 4)

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.

Fig 4

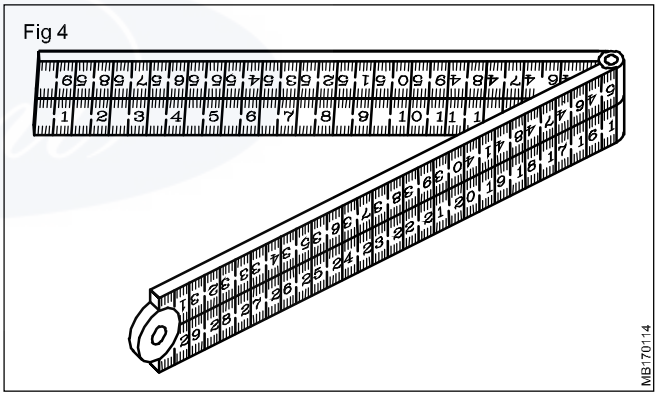
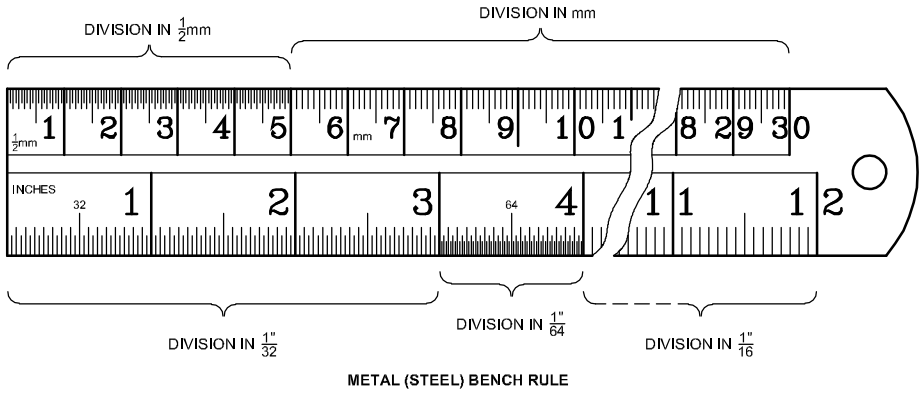


Fig 2

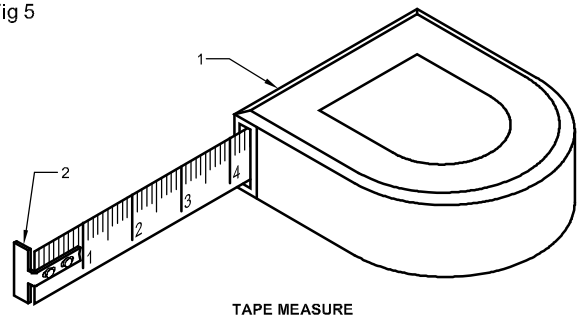


METAL (STEEL) BENCH RULE

Tape measurement Fig (5)

- 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.

Fig 5



TAPE MEASURE

MB170115

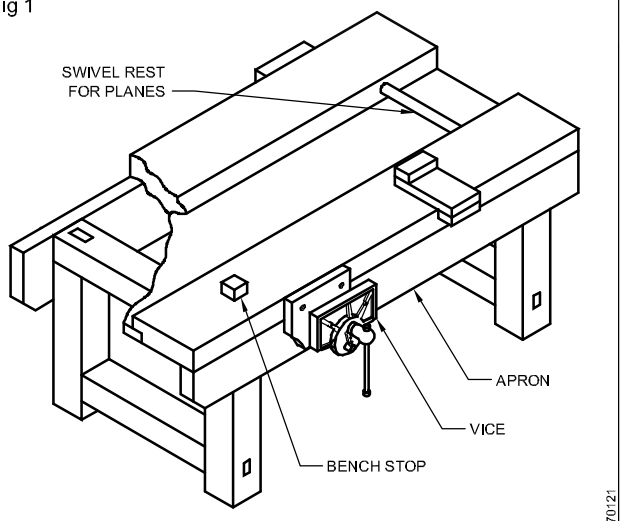
Carpenter's work bench

Objectives: At the end of this lesson you shall be able to
- **state constructional feature of work bench**
- **state the uses of work bench**
- **state the specification of work bench for single and double man working.**

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.
- Shelves or racks can also be provided on the table.
- The length is 120cm to 180 cm and width 90 cm 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.
- To avoid slipping while planing operation s 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)
- 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.

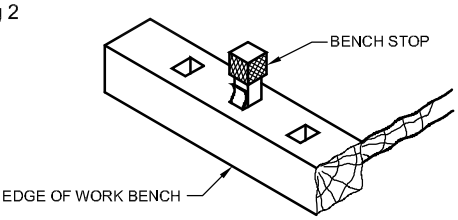
Fig 1



WORK BENCH

MB170121

Fig 2



MB170122

Carpenters' vice

At the end of this lesson you, shall be able to
- **state the constructional features of carpenter vice**
- **state the uses of carpenter vice**
- **state the size of carpenter 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 two types of vice

1 Quick release vice

2 Saw 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).

– 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.

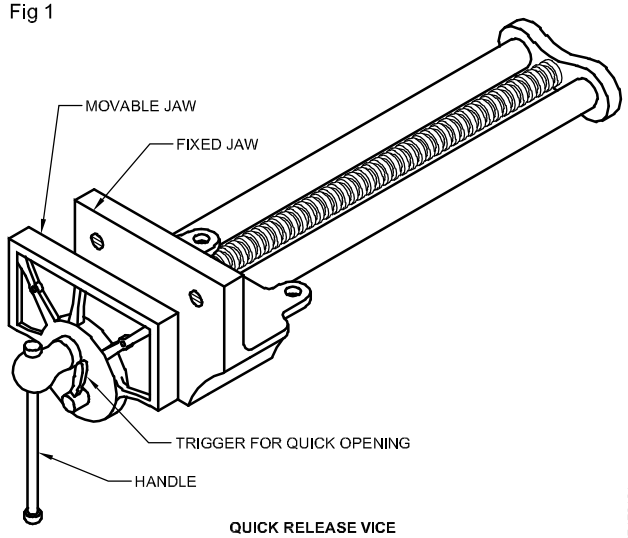
Constructional feature of saw vice. (Fig 2)

– 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.

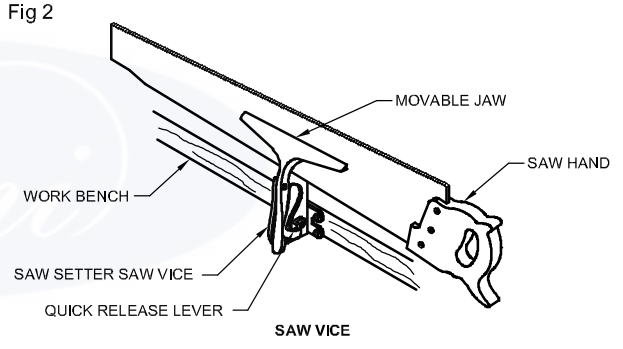
– It is not useful for any other kind of works.

Fig 1



QUICK RELEASE VICE

Fig 2



SAW VICE

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.

Try square and Mitre square

Objectives: At the end of this lesson you shall be able to
- **name the parts of try square**
- **state the use of try square**
- **name the parts of mitre square**
- **state the use of mitre square.**

Try square

The try square is a precision Instrument.

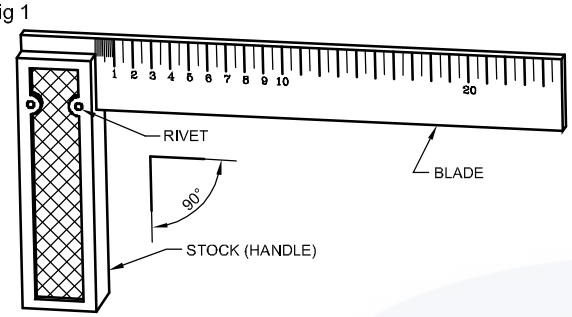
– which is used to check squareness of a surface.

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

– which is accurate enough for most work shop purposes.

– the blade is fixed to the stock at 90^0. (Fig 1)

Fig 1



Uses

The try square is used

– to check the flatness of the surface. (Fig 2)

– To check the squareness of edge. (Fig 3)

– To check the inside squareness. (Fig 4)

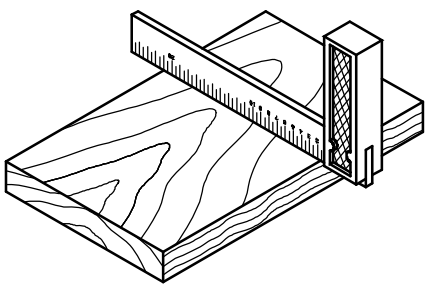
– Try squares are made of hardened steel.

– The stock is made of hard wood or cast iron a mild steel.

– The try squares are specified according to their lengths.

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

Fig 2



SURFACE CHECKING

Fig 3

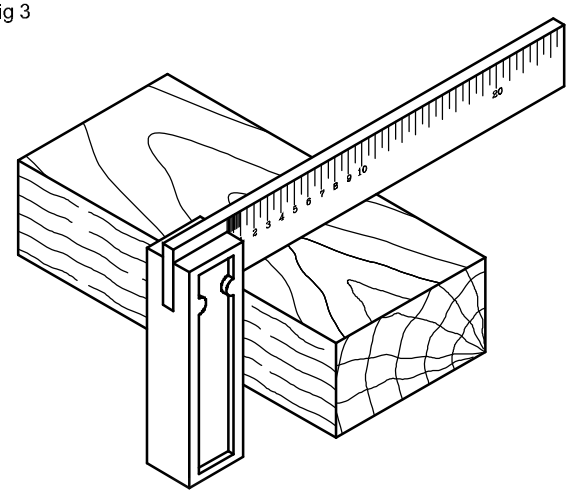
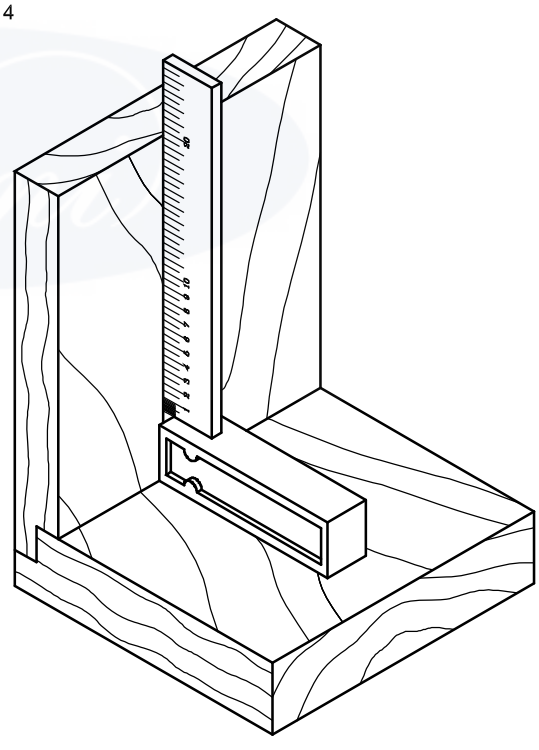


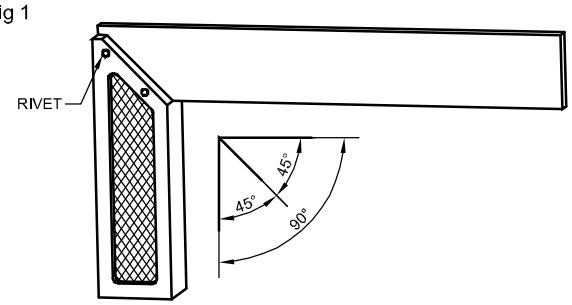
Fig 4



Mitre square (Fig 1)

– To mark 45^0 and to test 45^0 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 200 mm to 350mm. There are graduations on its blade.

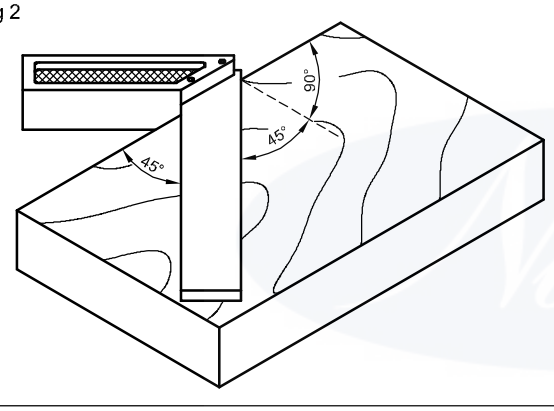
Fig 1



– The only difference between try square and mitre square is that the blade and stock are fixed at 90^0 in the try square and 45^0 in the mitre square.

– The try square and mitre square is also useful for angle 45^0, 90^0 and 135^0 (Fig 2).

Fig 2

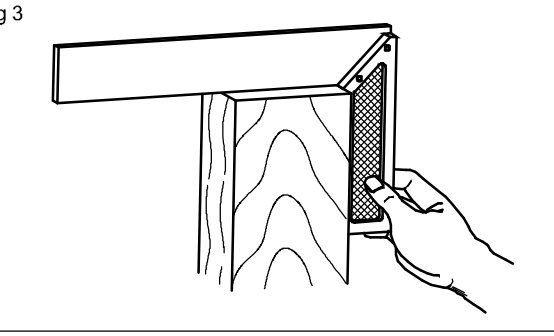


– The mitre square is useful for setting out mitres at 45 testing chamfers and other work 45^0 or 135^0.

– The blade is permanently fixed so the stock is at an angle of 45^0 to the length of the blade which is 200mm to 350mm.

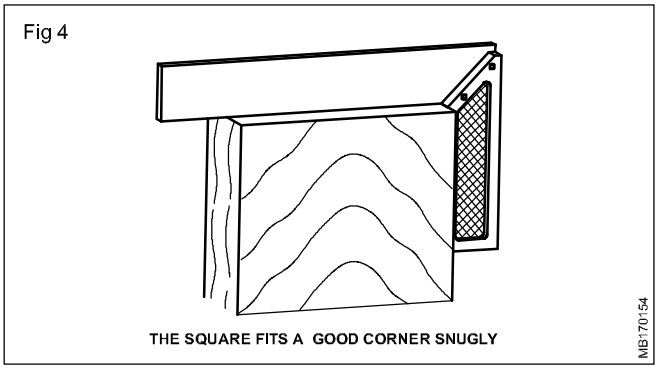
– To check ends for squareness hold the handle against one edge and the blade against the end to be tested. (Fig 3).

Fig 3



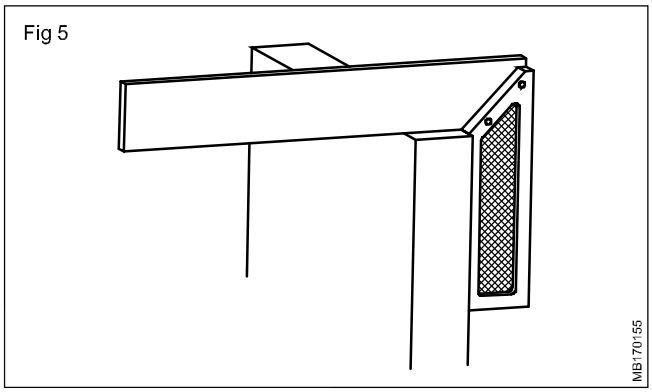
– The square fits a good corner snugly. (Fig 4)

Fig 4



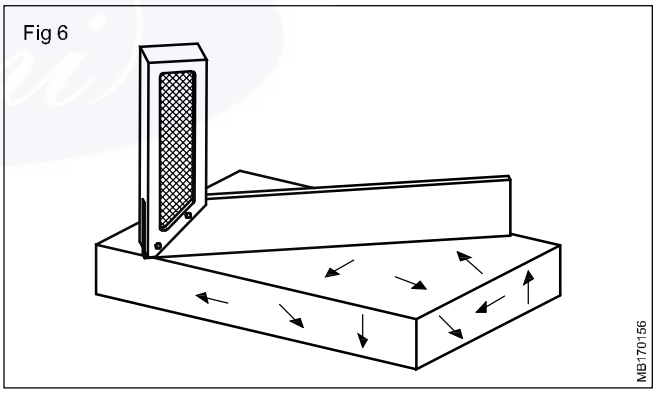
– To test the surface for trueness of flatness. Hold the edge of the blade firmly against the surface. (Fig 5)

Fig 5



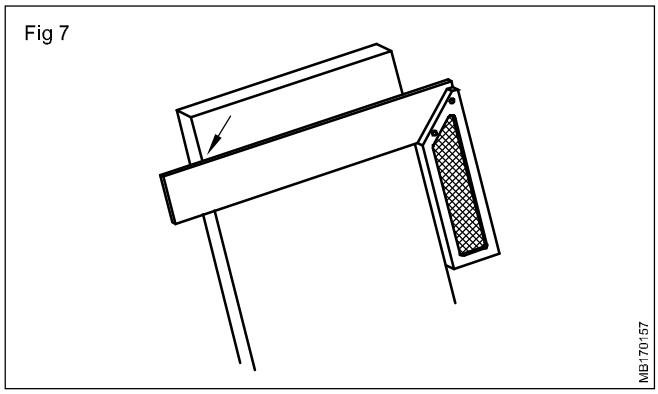
– To make the same test in many places on the surface: Across and along the grain of the wood and at an angle to it as shown in (Fig 6).

Fig 6



– To scribe along the top edge. (Fig 7)

Fig 7



Saw horse or trestle

Objectives: At the end of this lesson you shall be able to
- **state constructional feature of saw horse**
- **state application of a saw horse.**

– Saw horse is used when sawing long reapers.

– It is made of hard wood.

Fig 1

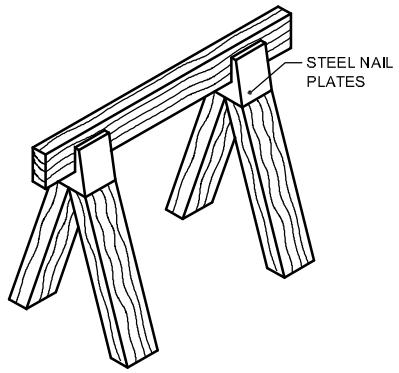
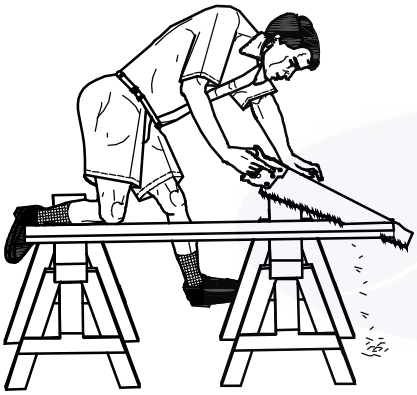


Fig 2



– It consists of two wide piece of timber joined at a top closely and at the bottom widely as shown in (Fig 1).

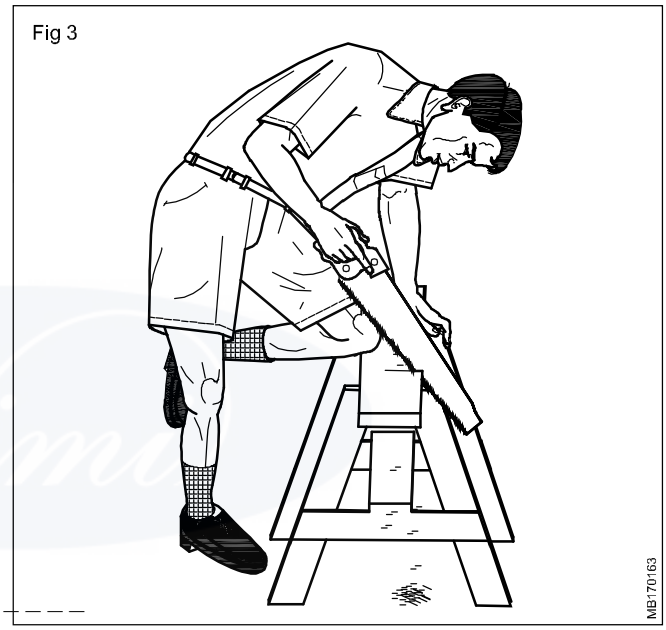
– Long piece of timber or wood piece by placing piece on the trestle as shown (Fig 2), along the grain.

– For short planks a single horse or Trestle can be used by clamping or across the grains.

– Holding steady with a knee or foot shown in (Fig 3).

– When sawing thinner planks across the grains use more support between the trestles.

Fig 3



Straight edge

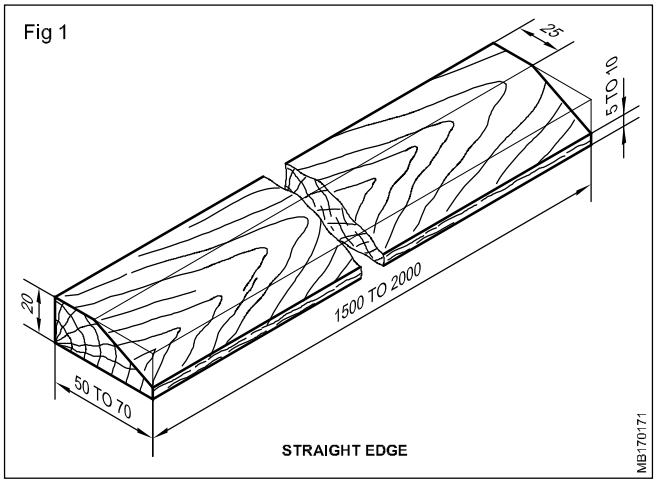
Objectives : At the end of this lesson you shall be able to
- **state the constructional features of straight edge**
- **state the uses of straight edge**
- **state the size of the straight edge.**

– Straight edge made of steel or wood with perfectly straight parallel edges, although some times has only one straight edge. (Fig 1)

Uses: For testing the straightness of surface and edges.

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

Fig 1



Kinds of Saws

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

Types of Saw

1 Straight cutting saw

2 Curve cutting saw.

Straight cutting saw

1 Rip saw

2 Cross cut saw

3 Hand saw

4 Panel saw

5 Tenon saw

6 Dove tail saw.

Curve cutting Saw

1 Bow saw

2 Coping saw

3 Fret saw

4 Compass saw

5 Nest saw

6 Key hole saw.

Rip Saw (Fig 1)

– Used for sawing along the grain

– Teeth of rip saw vary in size as per the need of the fitness of work to be done

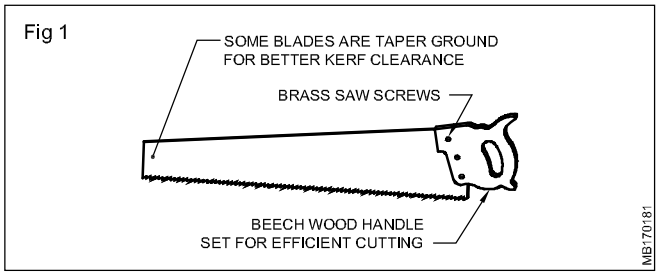
– It has two teeth per centimetre length

– length of the blade is 50 to 70cm

– Specified by its length

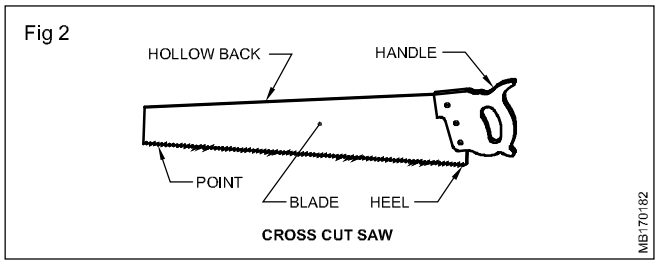
– Teeth angle is less than 90^0

– It has 3 to 5 teeth per cm.



Cross cut saw (Fig 2)

– Used for cutting across the grains



– Length of blade is 50 to 70cm

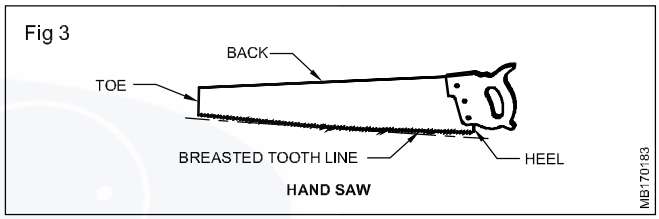
– It has 3 to 4 teeth per cm

– Cutting angle of the teeth 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.

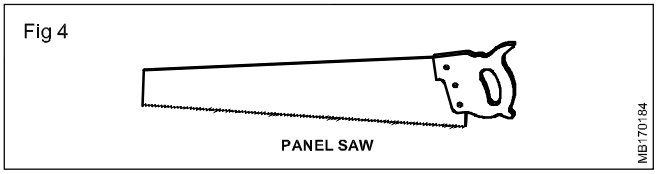
Hand Saw (Fig 3)



– 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

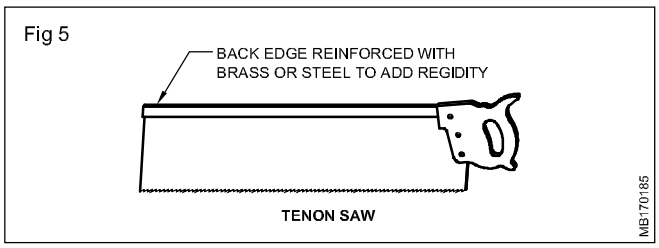
– It is available in many sizes

– It has 3 to 4 teeth per cm

– length is 50cms

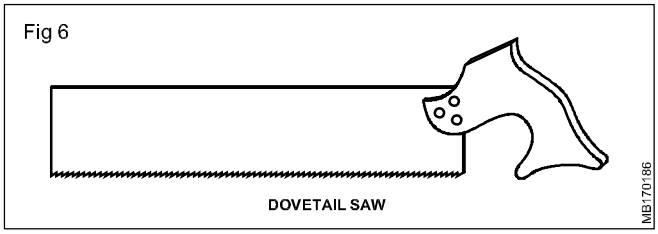
– Specifically used for cutting panels for door shutters.

Tenon Saw (Fig 5)



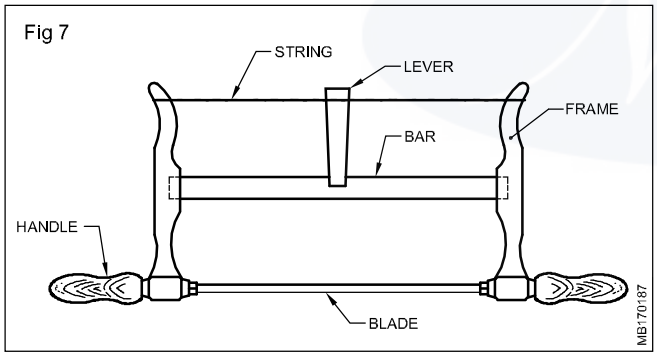
– It is rectangular in shape
– Length is 25 to 40cm long
– It has 5 to 8 teeth per cm.
– It is used for finer works like tenon
– Main use is making short and straight cuts
– A reinforcing strip on back is provided at the top to avoid bending of blade.
– Closed handle.

Dove tail saw (Fig 6)



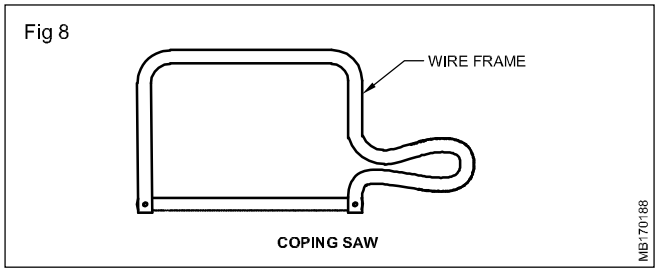
– By appearance is like tenon saw
– Its blade is thinner and narrower
– Its wooden handle is open and free to move to full length of blade
– It is used for finer work
– Specifically used for cutting tongues for dove tail joints
– Length of blades is 20 to 30cm and carries 6 points/cm

Bow saw (Fig 7)



– 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.

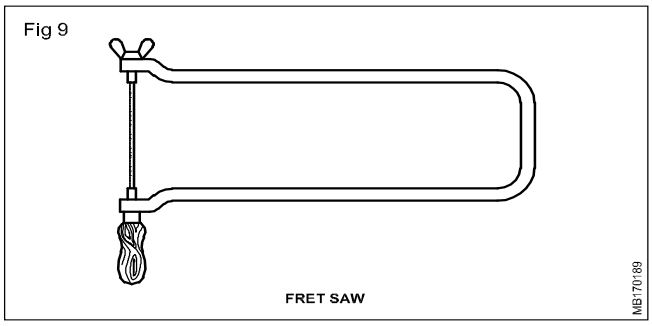
Coping saw (Fig 8)



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

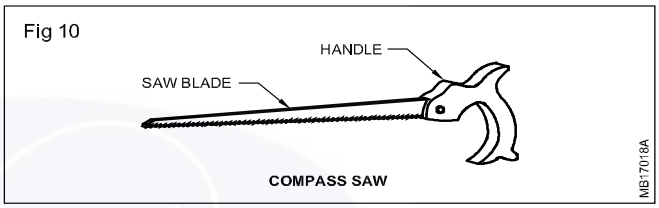
Fret saw (Fig 9)

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



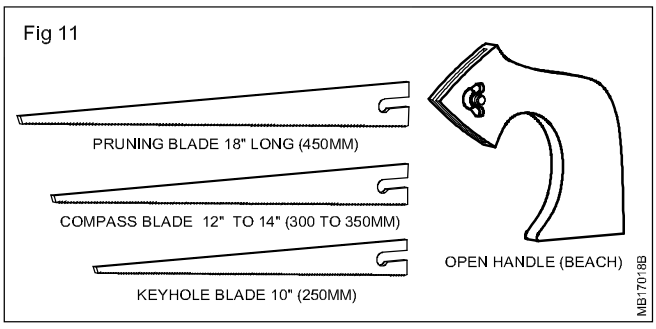
Compass saw (Fig 10)

– 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.



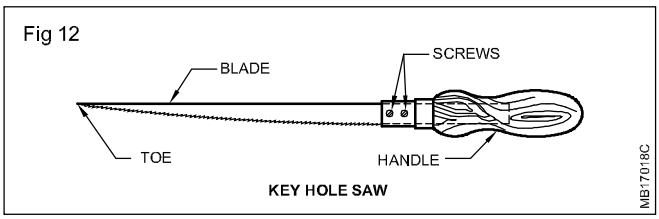
Nest of saw (Fig 11)

– 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 12)

– 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.



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.**

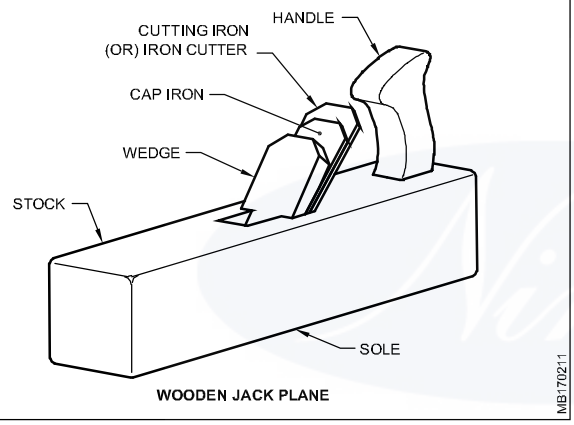
A plane is a hand tool used for smoothing or shaping pieces of wood.

Common types are

1 Jackplane
2 Smoothing plane
3 Trying plane
4 Toothing plane
5 Finishing plane
6 Router plane
7 Plough plane

1 Jack plane (Fig 1)

Fig 1



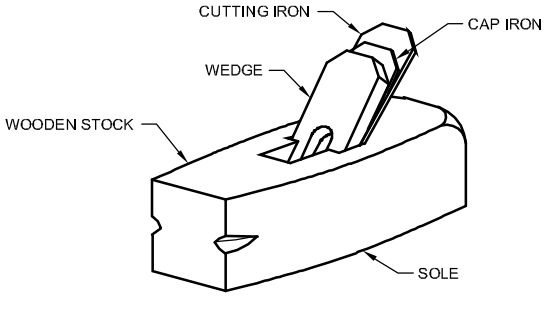
WOODEN JACK PLANE

This plane is used for planing the job to size quickly and truly.

The size is 240 mm x 66 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)

Fig 2



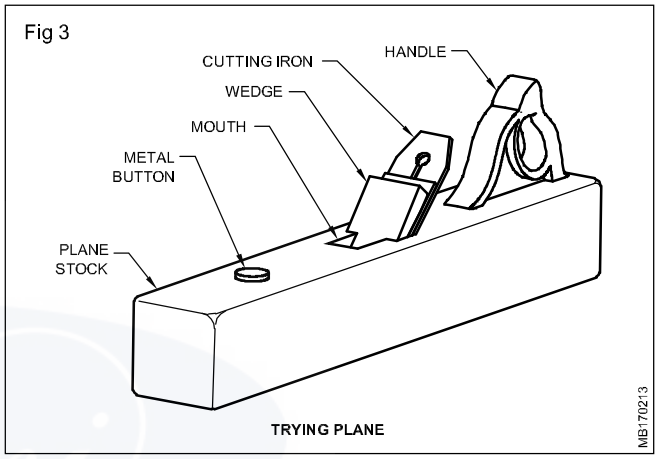
SMOOTHING PLANE

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°.

3 Trying plane (Fig 3)

Fig 3

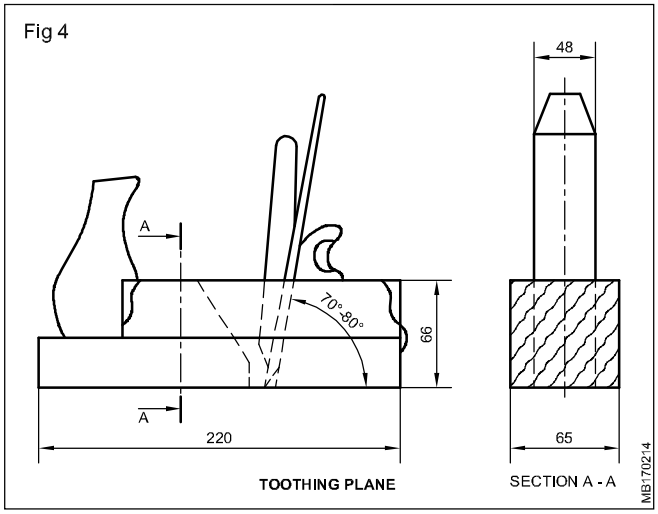


TRYING PLANE

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.

4 Toothing plane (Fig 4)

Fig 4

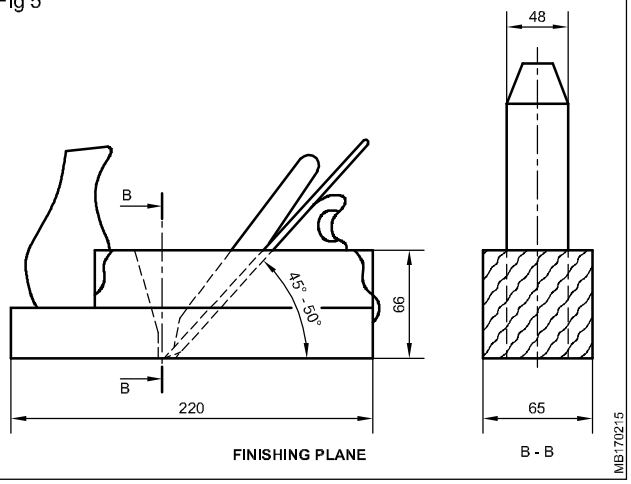


TOOTHING PLANE SECTION A - A

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 (Fig 5)

Fig 5

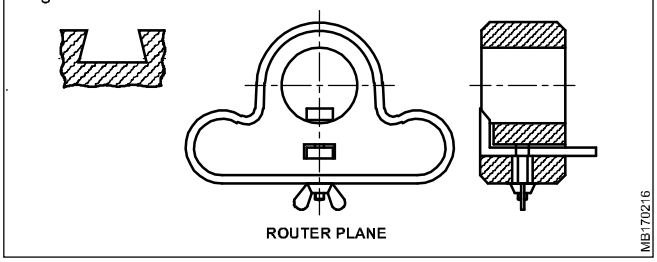


This is slightly smaller than smoothing plane. Its cutting angle is 45 to 50°. It prevents the tearing of wood and gives a good finish. This is also called reform-finishing planes.

6 Router planes (Fig 6)

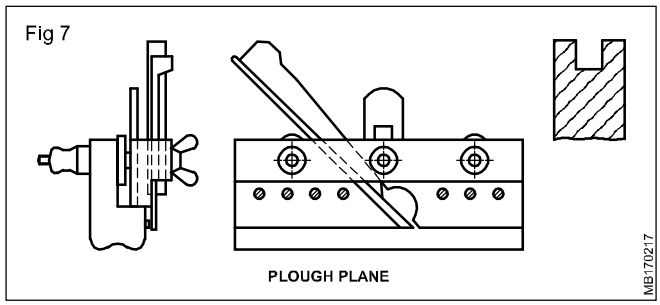
It is used to clean and level grooves and recesses. It is used across the grain. The cutting iron is lowered after each cut until required depth is reached.

Fig 6



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.

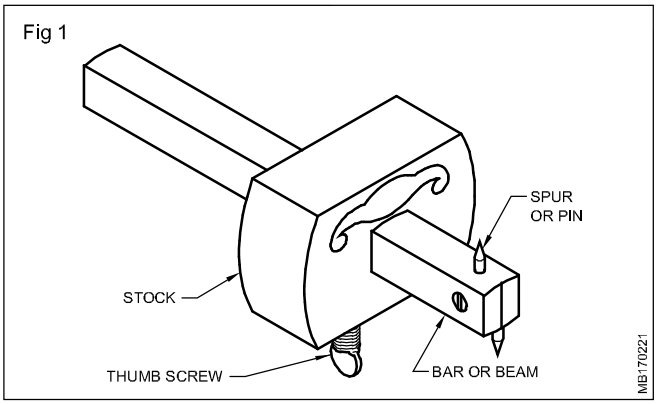
Marking gauge

Objectives : At the end of this lesson you shall be able to
- **state the uses of marking gauge**
- **state constructional features of marking gauge.**

For layout lines parallel to one edge of work piece marking gauge is used.

Construction (Fig 1)

Fig 1



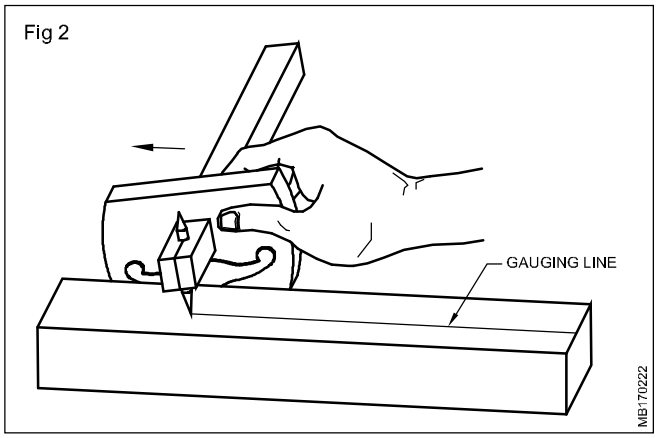
The marking gauge can be made of wood or steel. The gauge consists of square, wooden bar or beam on which wooden block or stock is sliding. This block can be fastened at any required measurement by use of a thumb screw.

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 held against the wood and pushed in forward direction. (Fig 2)

Fig 2



Carpenter's Hammer

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.**

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)

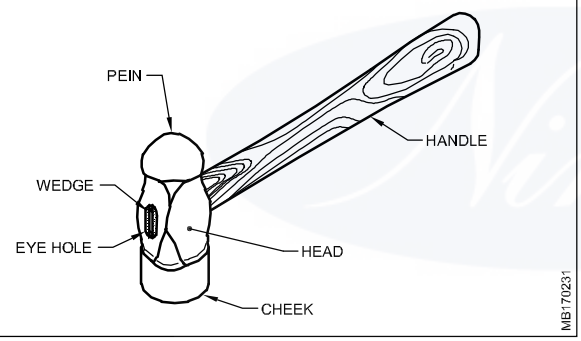
Handle

Pein

Cheek

Eye hole

Fig 1



Cheek

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

Pein (Fig 2)

The pein is the other end of the head.

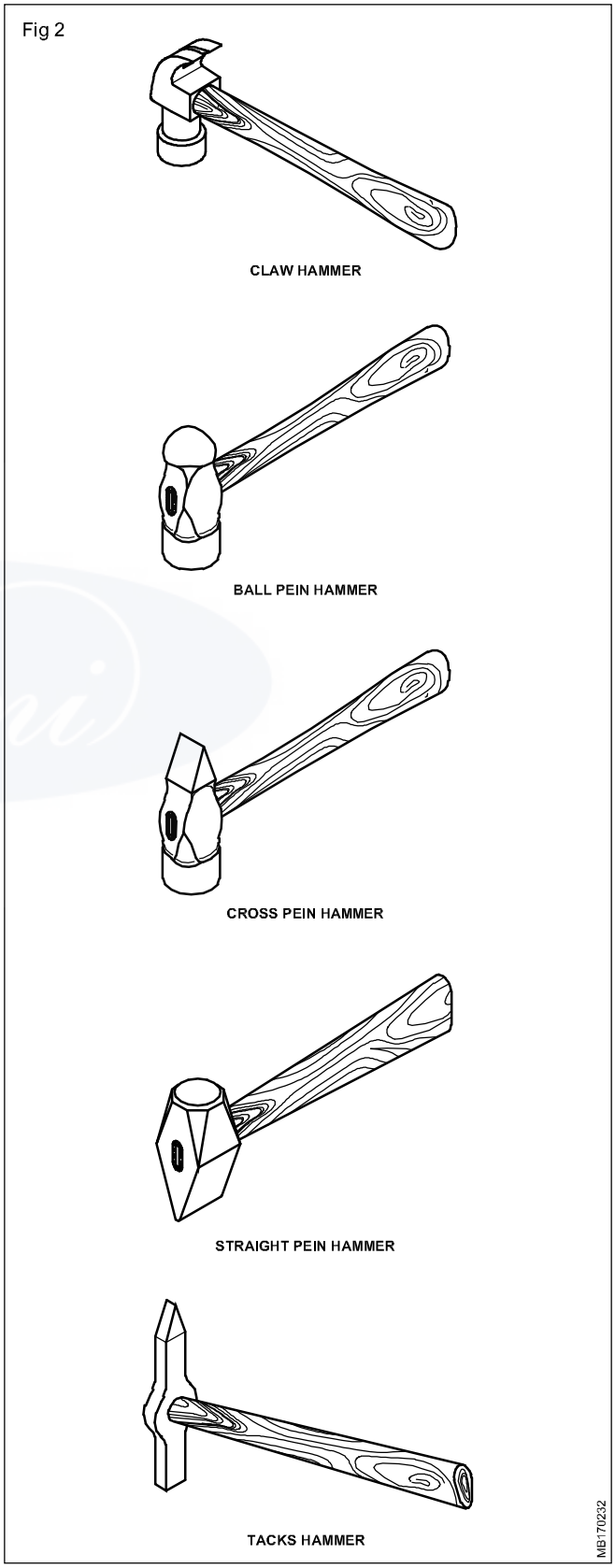
It is used for shapping and forming. Work like Rivetting and bending the pein is of different shapes like

1 Ball pein (hammer)
2 Cross pein (hammer)
3 Straight pein (hammer)
4 Claw (hammer)
5 Tacks (hammer)

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.

Fig 2



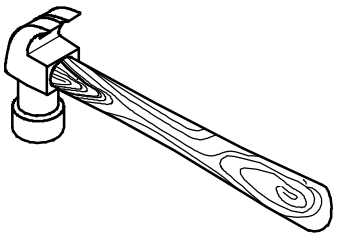
Specification

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)

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.

Fig 3



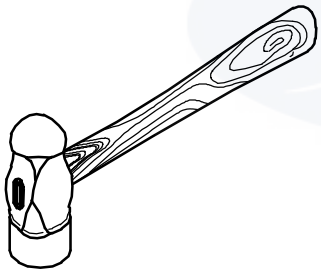
CLAW HAMMER

MB170233

Ball pein hammer (Fig 4)

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.

Fig 4



BALL PEIN HAMMER

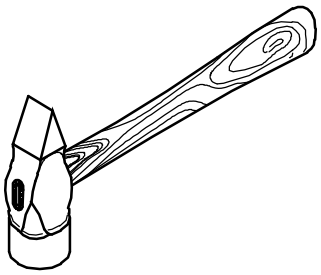
MB170234

Cross pein hammer (Fig 5)

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.

Fig 5



CROSS PEIN HAMMER

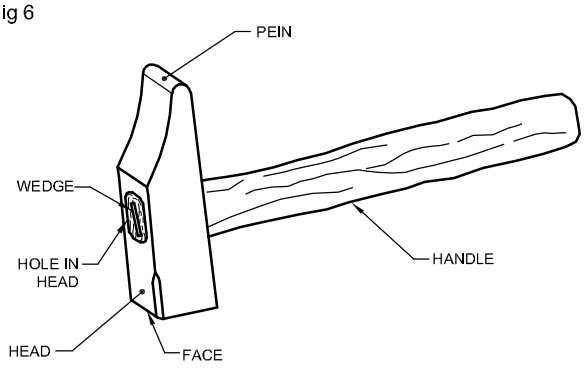
MB170235

Carpenters' hammer (Fig 6)

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 hole.

Fig 6



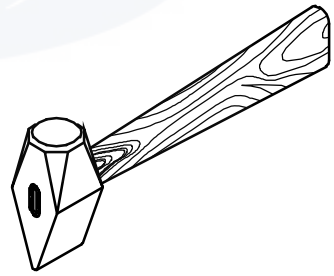
MB170236

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.

Straight pein hammer (Fig 7)

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 rivetting and to extend metal frames. Its weight is 110gm and varies up to 900gms.

Fig 7

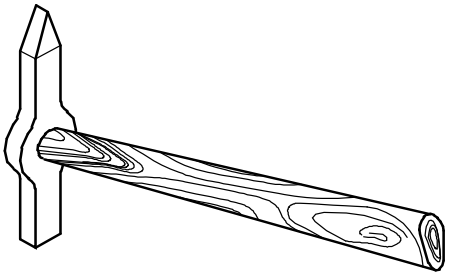


MB170237

Tack hammer (Fig 8)

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.

Fig 8



TACKS HAMMER

MB170238

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.

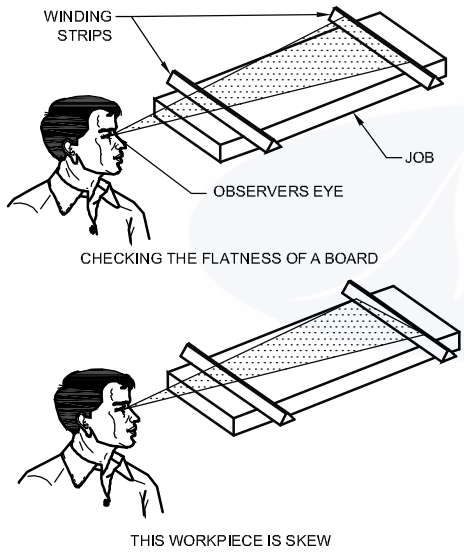
Winding strips

Objectives: At the end of this lesson you shall be able to
- **state the use of winding strip**
- **state constructional features of a winding strip.**

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.

Testing the job for flatness, one stick is placed across one end and the other stick across the other end of the piece being tested.(Fig 1)

Fig 1

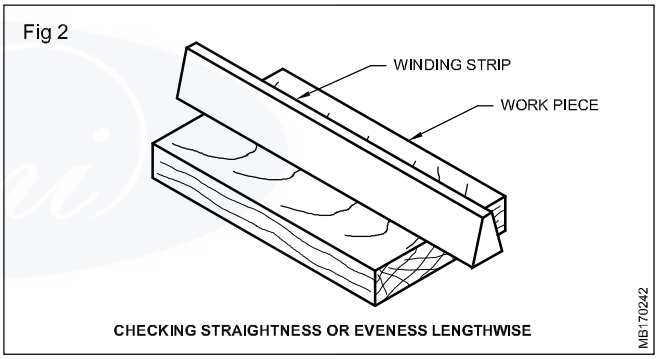


The top edges of the sticks are sighted and if they are not parallel, the surface is said to be uneven, or they are said to be `in winding'.

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.

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

Fig 2



Oil stone

Objectives: At the end of this lesson you shall be able to
- **state the different types of oil stones**
- **state 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

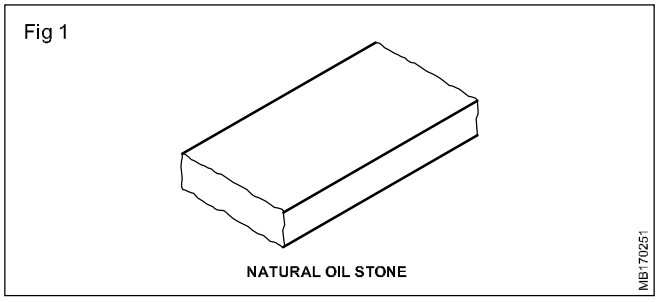
1 Natural oil stones

2 Artificial oil stones

3 Slip stones

Natural oil stones (Fig 1)

Fig 1



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

Soft oil stones

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

Natural oil stones

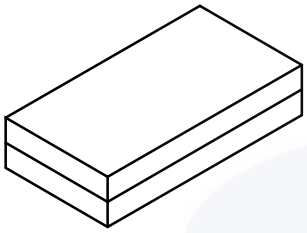
For natural oil stones, oil should be used for fine grained stones out of two "WASHITA" and "ARKASAS" oil stones.

ARKASAS produces the keen cutting edge and is most expensive.

Artificial oil stones (Fig 2)

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.

Fig 2



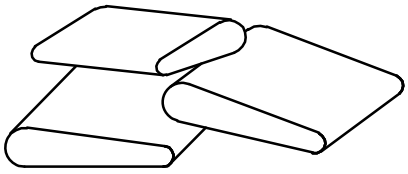
ARTIFICIAL OIL STONE

MB170252

Slip stones (Fig 3)

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 can not be honed on the flat surface of an ordinary oil stones.

Fig 3



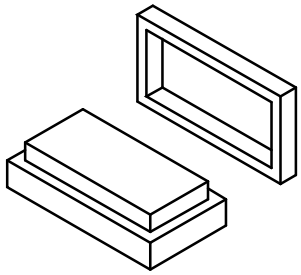
SLIPS FOR CURVED TOOLS

MB170253

Oils (Fig 4)

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. Nearest foot 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".

Fig 4



ARTIFICIAL OIL STONE IN A CASE

MB170254

Chisels commonly used in carpentry

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.**

All chisels consist of four main parts

1 The handle

2 The blade

3 Tang

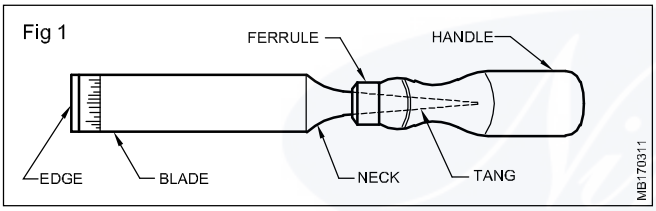
4 Ferrule

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

TYPES OF CHISELS

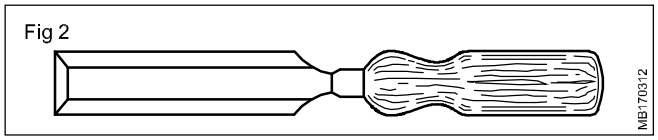
1 Bench firmer chisel (Fig 1)

This is used for general chiseling purposes. Strongly made, it can be used for light chiseling 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. (Fig 1)



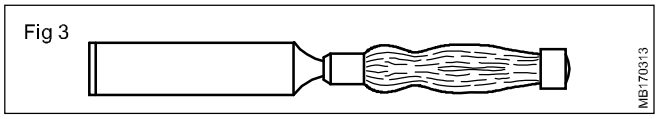
2 Bevel edge firmer chisel (Fig 2)

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)

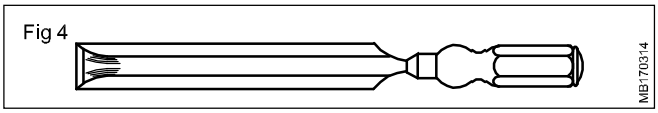
It is used for heavy work such as mortising. The use of mallet is necessary here. It is stronger than ordinary firmer chisel. It has a thicker blade and iron ferrule, at both ends of handle. A leather washer is provided between the shoulder of the blade and the handle to act as shock absorber when the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



4 Paring chisel (Fig 4)

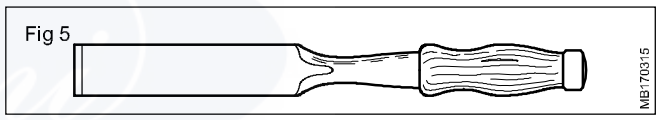
It is most suitable for all paring work such as finishing off joints. It has an extra long thin blade with bevelled edges. It should never be used with a mallet. The handle is made of beech and octagonal in section.

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.



Chisels of which the blades are of a circular section are called

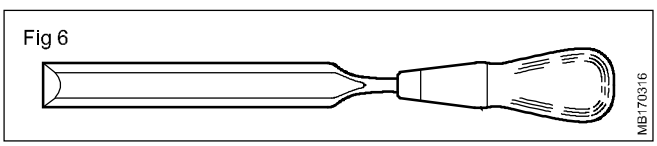
GOUGES

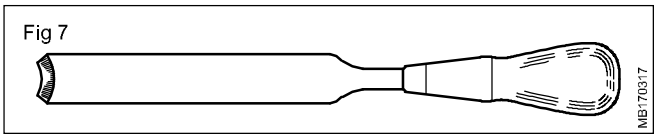
OR

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)

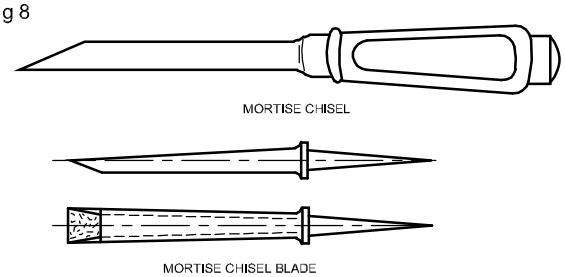
The mortise chisel is designed to with stand hard, rough wear and the thickness of the blade permits the leverage necessary to clear the mortise and keep the blade true.

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 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.

Fig 8



Marking tools

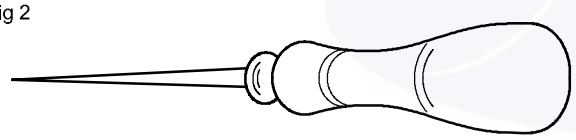
Objectives: At the end of this lesson you shall be able to
- **state constructional features of marking knife and steel scriber**
- **state uses of marking knife and steel scriber.**

Marking knife (Fig 1)

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.

Steel scriber (Fig 2)

Fig 2



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 3)

Fig 3

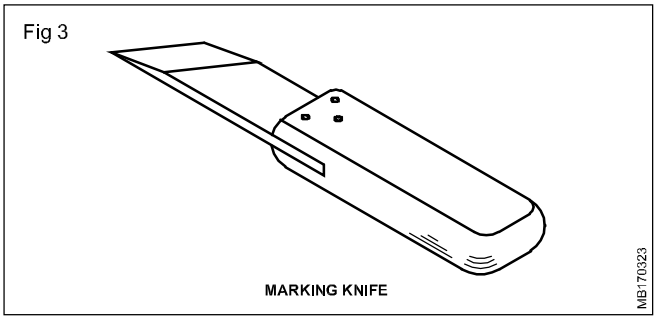
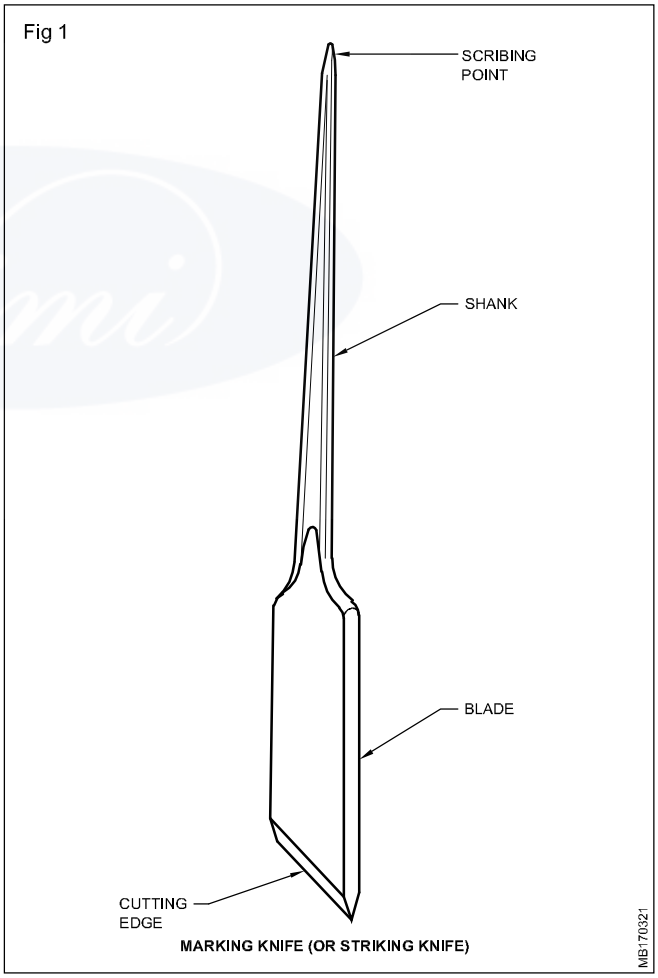


Fig 1



The Mallet

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

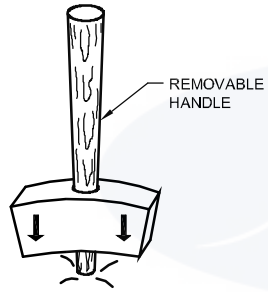
Mallet are used for driving wood chisels and for adjusting wooden planes. It is used for assembling and dismantling wooden works and for adjusting stop dogs in the work bench.

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.

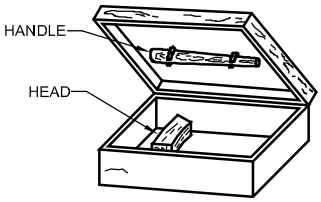
Some mallets have removable handles (Fig 1) which can be taken out of the head easily so that parts can be stored easily. Fig 2.

Fig 1



The striking faces of mallet heads are so bevelled so that they can hit the chisel. For most purposes a head of 110 mm long, 80mm wide and 60 mm thick is suitable. The

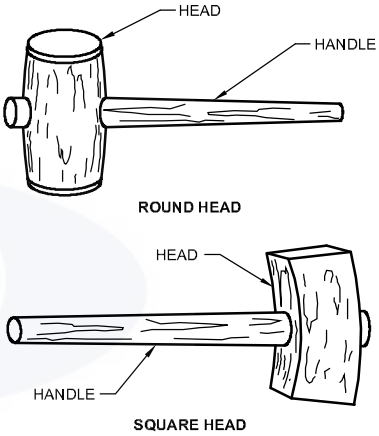
Fig 2



handle is driven in from the top and is tapered in its width. Its head is either round or square. (Fig 3)

The mallet is held upside down and dropped once or twice on the work bench, the head of the mallet will be tightened on the handle.

Fig 3



Mitre box and mitre block

Objectives: At the end of this lesson you shall be able to
- **state the use of mitre box and mitre block.**

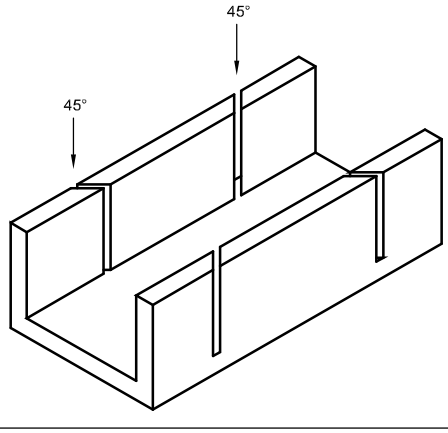
The mitre box (Fig 1)

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

The mitre block (Fig 2)

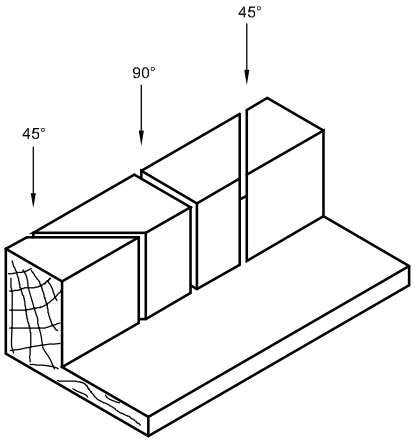
This is used to mitre small sections of wood accurately. It is made of two pieces of wood with 3 cuts in the top piece. 45° cuts left and right and 90° cut in the centre to help in sawing accurately square. (Fig 2)

Fig 1



Mitre boxes and mitre blocks should be made of very hard wood and the saw cuts should be made with same saw which is used in them.

Fig 2



Plumb bob

Objectives: At the end of this lesson you shall be able to
- **state the use of plumb bob**
- **state the construction of a plumb bob.**

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 a 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 1)

Fig 1

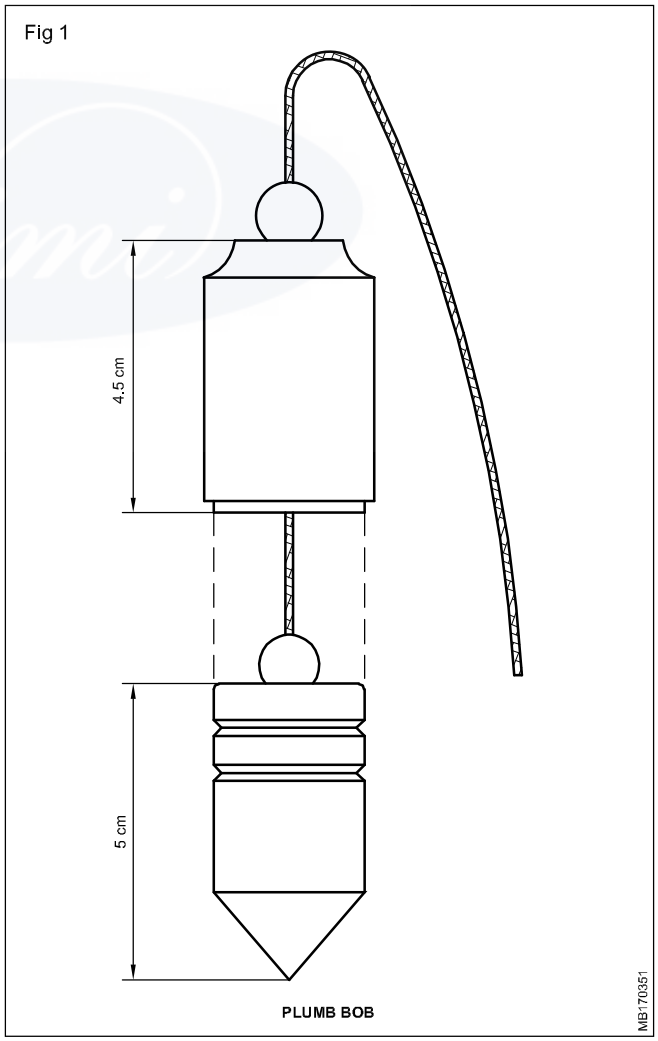
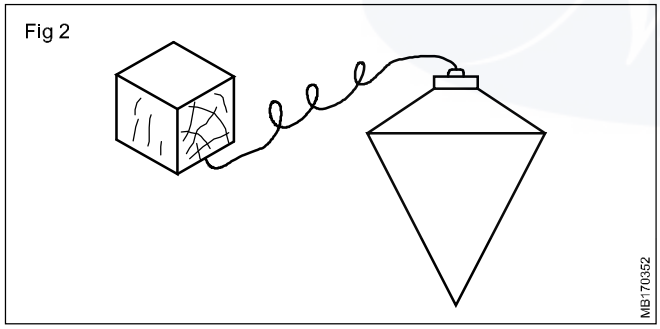


Fig 2



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. (Fig 2)

Shooting board and planing trough

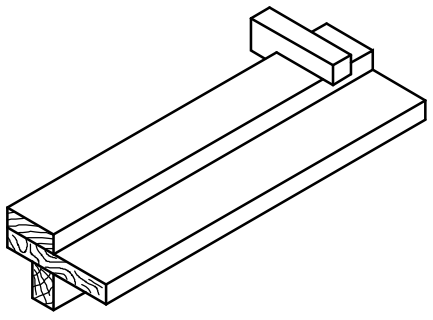
Objectives: At the end of this lesson you shall be able to
- **state the uses of shooting board**
- **state the use of planing trough.**

Shooting board

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

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.

Fig 1



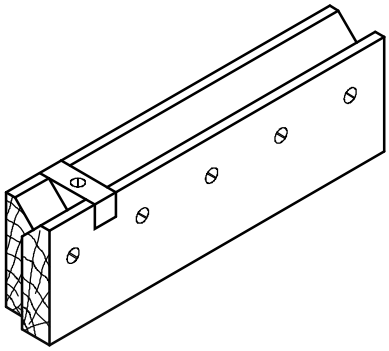
SHOOTING BOARD

MB170361

Planing troughs

Two wooden planks planed at an angle of 45° at ends and 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. (Fig 2)

Fig 2



PLANNING TROUGH

MB170362

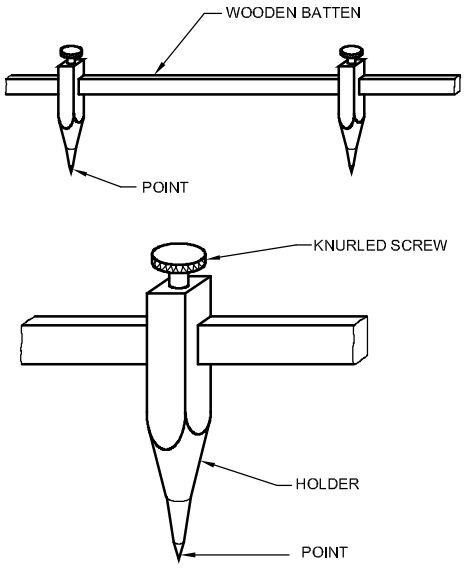
Trammel points

Objectives: At the end of this lesson you shall be able to
- **state the constructional features of trammel points**
- **state the uses of trammel points.**

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. (Fig 1)

Fig 1

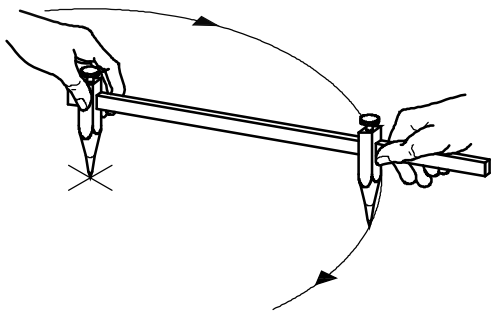


TRAMMEL POINTS

MB170371

Sometimes one of the points can be replaced by a pencil lead.(Fig 2)

Fig 2



USING THE TRAMMEL POINT

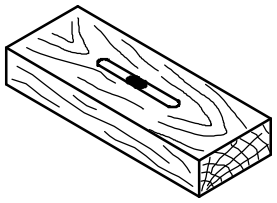
MB170372

Spirit level

Objectives: At the end of this lesson you shall be able to
- **state the construction of spirit level**
- **state the uses and features of spirit level.**

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 1)

Fig 1



MB170381

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 perpendicularity of walls and windows. (Fig 2)

Fig 2



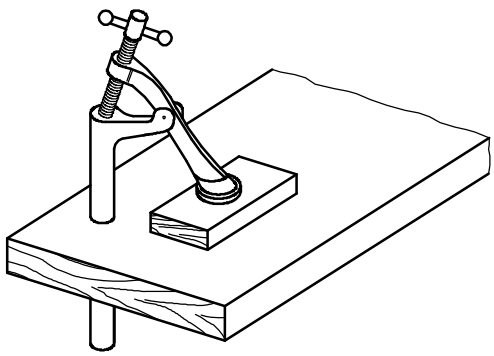
CARPENTER LEVEL

MB170382

Bench hold fast (Fig 3)

In wooden planks to make holes the planks are held 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.

Fig 3

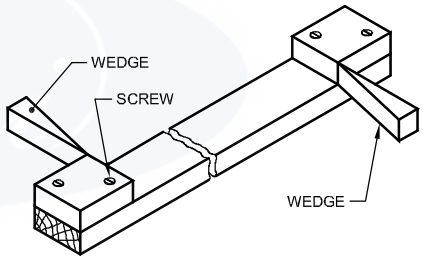


MB170723

The cleat (Fig 4)

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.

Fig 4



MB170724

Mortise gauge

Objectives: At the end of this lesson you shall be able to
- **state the construction of mortise gauge**
- **state the features of the mortise gauge**
- **state the uses of mortise gauge.**

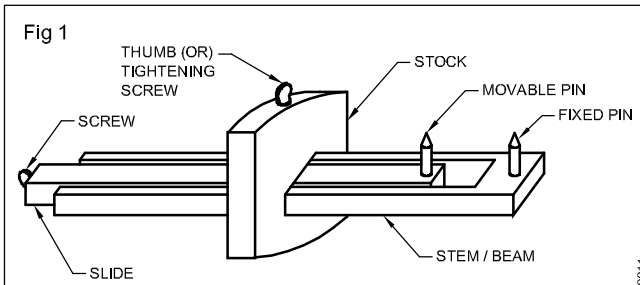
A mortise gauge is a marking gauge with two spurs. The two spurs can be spaced at different distances and mark two parallel lines at a time. (Fig 1)

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

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 on the ordinary marking gauge.

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

Fig 1



MORTISE GAUGE

MB170811

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

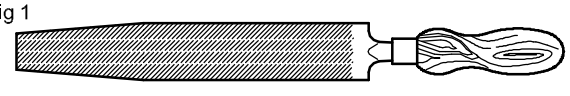
Files and Rasps

Objectives: At the end of this lesson you shall be able to
- **state the difference between file and rasp**
- **state the parts of file**
- **state the classification of files**
- **explain the method of cleaning wood file and rasp.**

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

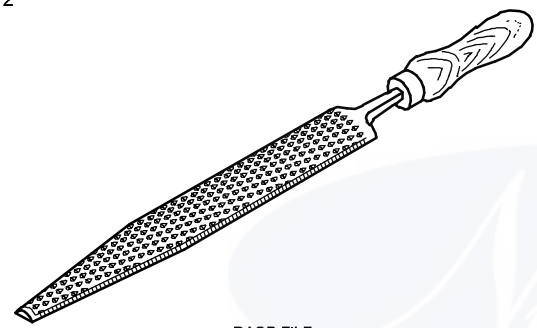


WOOD FILE

MB170821

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

Fig 2



RASP FILE

MB170822

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

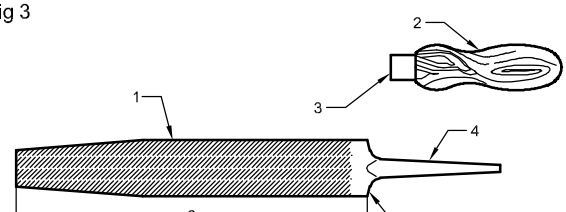
3 Steel ferrule

4 Tang

5 Shoulder (heel)

6 Length on inches

Fig 3



PARTS OF A FILE

MB170823

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

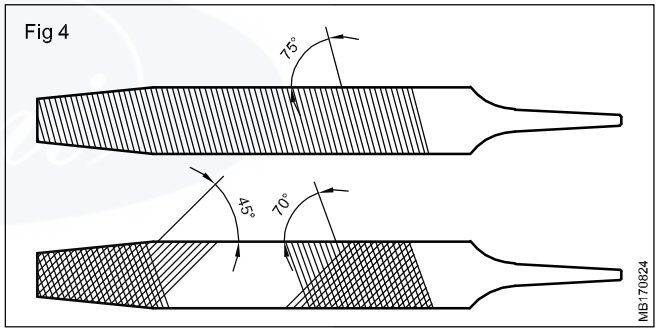
a) Teeth patterns

b) Coarseness

c) Shapes

a) Teeth patterns (Fig 4)

Fig 4



MB170824

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.

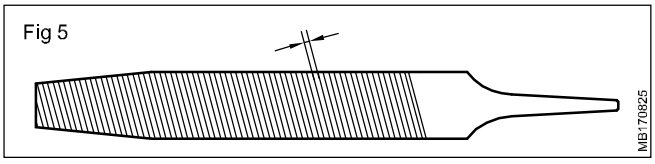
"Double cut" consist of two series of cutting teeth.

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



MB170825

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.

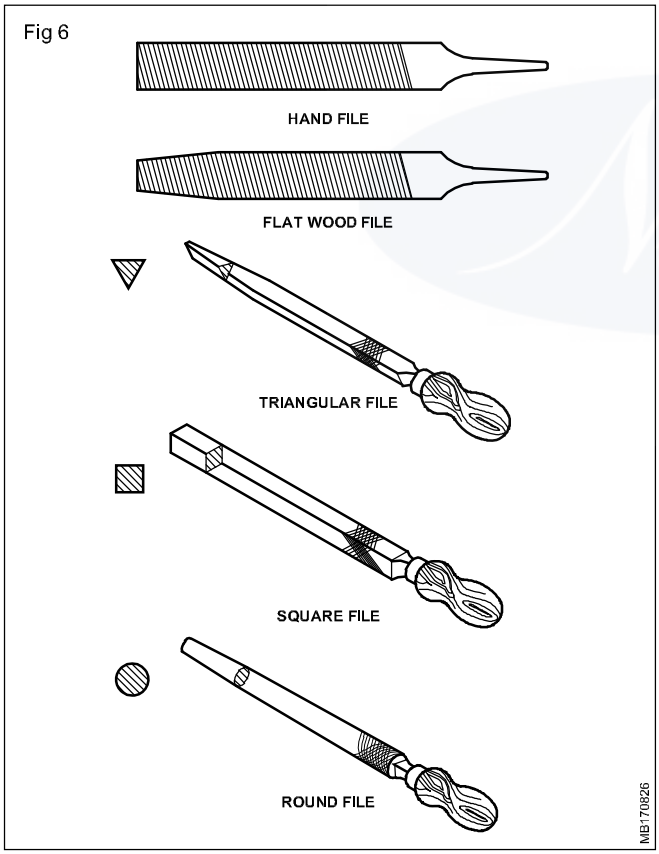
File shapes (Fig 6)

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.

Fig 6



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.

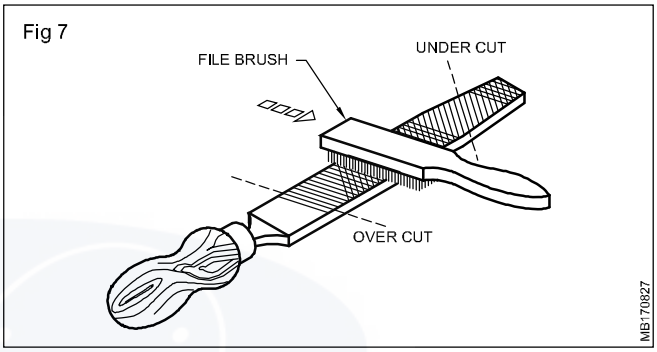
Files, generally in use by the carpenter are

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

They are used in this successive order.

Cleaning files: The teeth of a file should be sharp. If the teeth are worn or dulled, less wood will be scraped away. (Fig 7)

Fig 7



Clogging by wood dust and wood resin also impedes filing.

Files need cleaning in order to keep the cutting edges in good condition.

This is done with a "file card" which is a metal brush fixed on a wooden supporting handle.

Move the file card obliquely to clean the teeth of the file.

Wood files are easily clogged up with resin (a component of wood).

After use the files and rasps should be stored.

The handle should be undamaged and fastened securely to the tang.

Never use a file as a chisel or a screw driver and avoid dropping it.

Tool Box

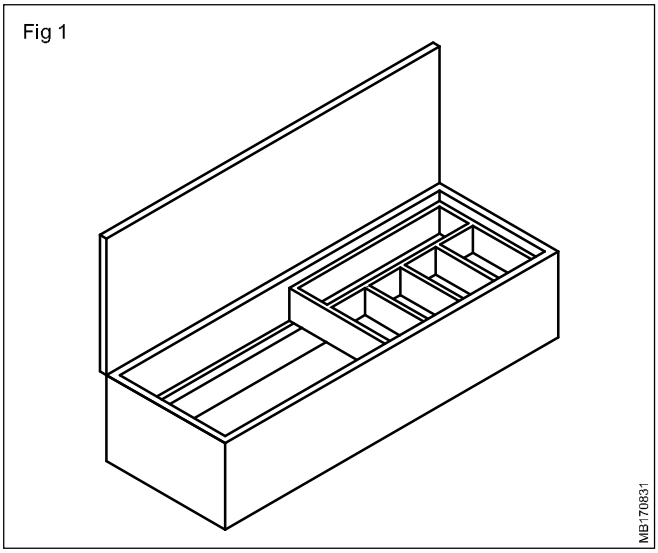
Objectives: At the end of this lesson you shall be able to
- **state the use of tool box in shop floor**
- **state the necessity of tool box.**

Hand tools should be maintained properly with sharpness and in such a way that they serve for us for a longer duration.

Hand tool are to be kept neatly, without rust, for that we have to keep it separately in a tool box or a cup board.

The sketch shown in a tool box with so many separation for long tools, short tools, sharp tools heavy tools, etc. By keeping the tools in this box separated the tools can be saved for a long time without rusting, and without abrading each other and without becoming blunt. (Fig 1)

Fig 1



General classification of 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 places where the joints are used.**

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.

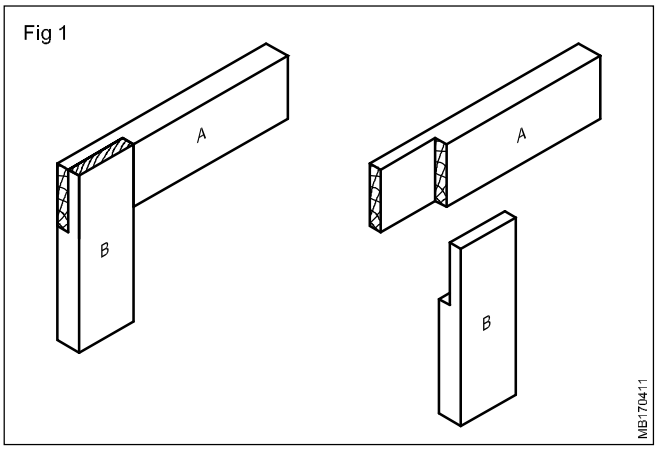
Half lap joints

Objectives: At the end of this lesson you shall be able to
- **state meaning of half lap joints**
- **state various types half-lap joints**
- **state purpose and 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.
- 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)
- If it is in dovetail joint it is called half-lap dovetail joint.
- Dove tails joints are always stronger and offer greater resistance to tension.

Fig 1



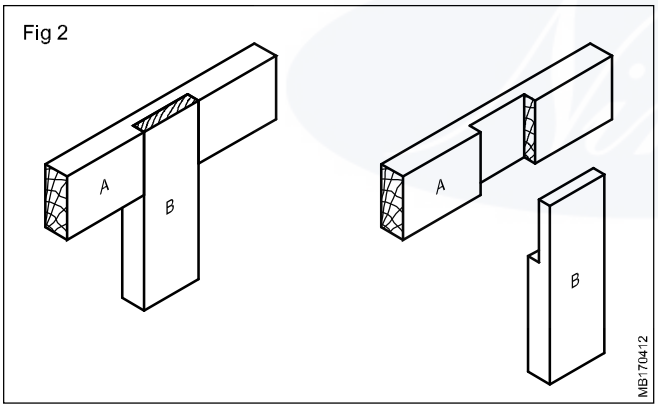
- Half lap joints are glued and if needed are reinforced by means of concealed screws.
- It is to be noted that a halved joint is always lapped but a lapped joint is not always halved.

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)

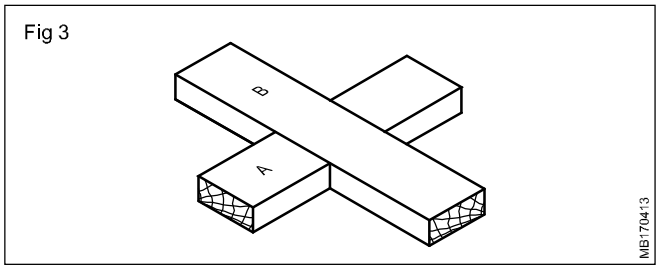
Fig 2



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)

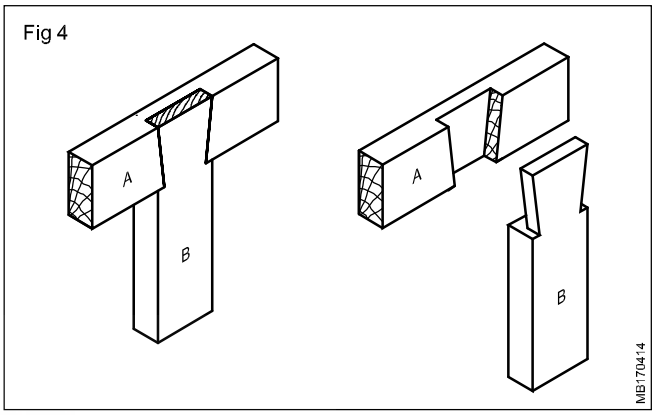
Fig 3



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

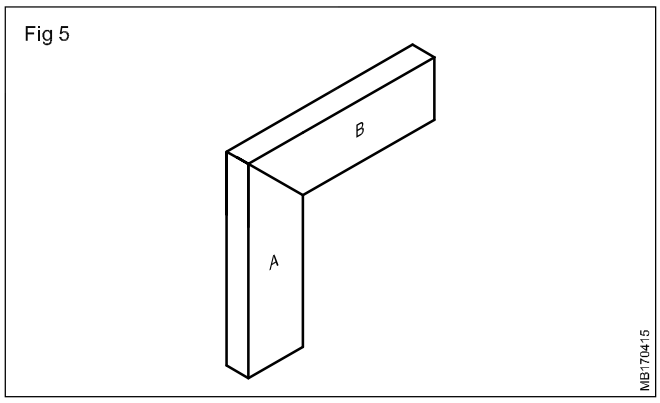


Mitre half lap joint

The mitre- half lap joint is used to hide end grains of woods in picture frames, mouldings rafter and drip caps etc. (Fig 5)

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



Wooden trysquare

Objectives: At the end of this lesson you shall be able to
- **state the construction of wooden try square**
- **state uses of wooden try square.**

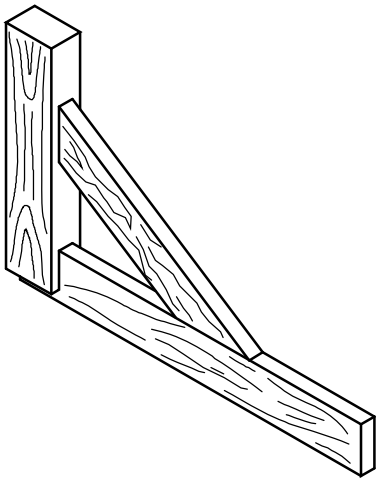
The try square is fully made of wood. Its handle is slightly heavier than the blade. The length of blade is 600mm (24") and width is 50mm (2"). The length of the handle is 400mm some times up to the length of 450mm. (Fig 1)

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.

Fig 1



MB170421

Housing joints

Objectives: At the end of this lesson you shall be able to
- **state the meaning of housing joint**
- **identify its purpose and uses**
- **state the types of housing joints.**

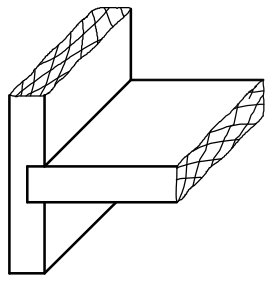
The housing joint consists of sinking the one end or edge of one member into a groove or trench in the face of another member. It is mainly used in fixing shelves or divisions in book-cases, cabinets, treads of step ladders, treads of stairs etc.,

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)

Fig 1

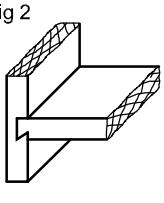


MB170511

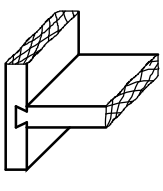
Dovetailed housing joint (Fig 2)

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 2b)

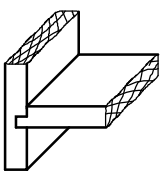
Fig 2



(a)



(b)



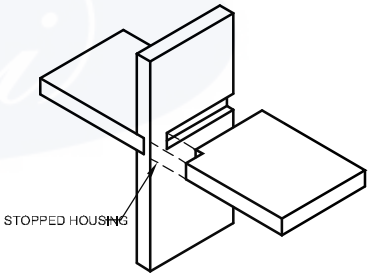
(c)

MB170512

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

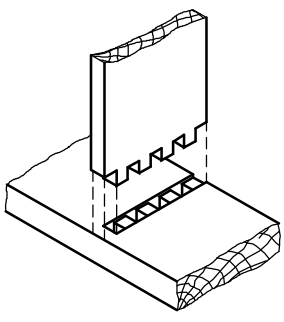


MB170513

Care 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

MB170514

`T' bevel or bevel square

Objectives: At the end of this lesson you shall be able to
- **state the construction of the bevel square**
- **state the parts of bevel square**
- **state the features of 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 transfering angles from the drawing to the work piece. THE PARTS OF THE BEVEL SQUARE. (Fig 1 & 2).

Handle

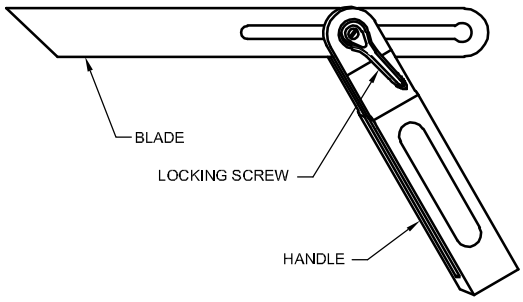
Handle is made of hard wood, cast iron and aluminum. The top edge is half rounded and there is a slot to fix the bevel square.

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.

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.

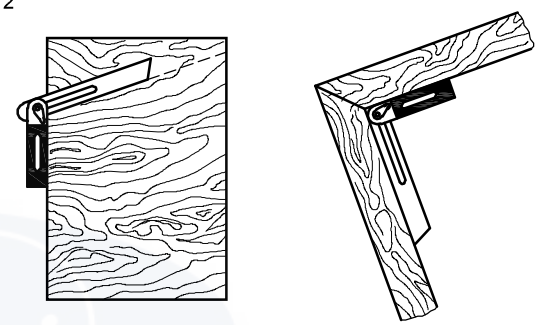
Fig 1



T BEVELS

MB170521

Fig 2



MB170522

Locking nut

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

Bridle joints

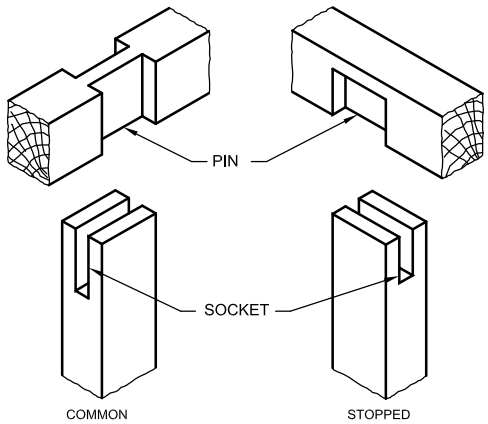
Objectives: At the end of this lesson you shall be able to
- **state the various types bridle joint**
- **state the uses of bridle joint.**

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)

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.

Fig 1

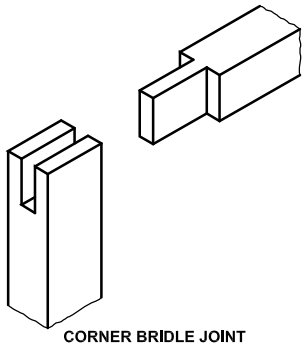


TEE BRIDLE JOINT

MB170611

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



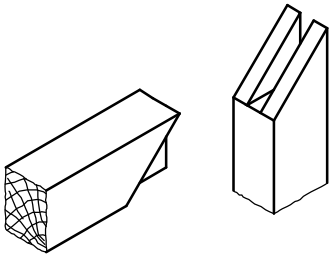
CORNER BRIDLE JOINT

MB170612

Mitre corner bridle joint (Fig 3)

One or both sides of the socket may be mitered 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

MB170613

Wing compass

Objectives: At the end of this lesson you shall be able to
- **state use of a wing compass in marking**
- **state the construction of wing compass.**

It consists of a pair of dividers (legs) made of steel.

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

They are fixed at the required radius by means of a set screw. (Fig 1)

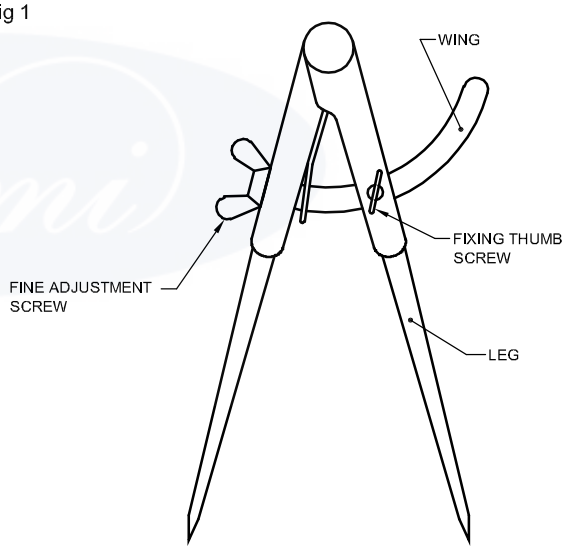
Uses

1 For setting out arcs of circles.

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

3 To mark curves.

Fig 1



WING COMPASSES

MB170621

Types of Calipers

Objectives: At the end of this lesson you shall be able to
- **name the commonly used calipers**
- **compare the features of firm joint and spring joint calipers**
- **state the advantages of spring joint 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 1)

In the case of firm joint calipers, both legs are pivoted 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.

Spring Joint Calipers (Fig 2)

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.

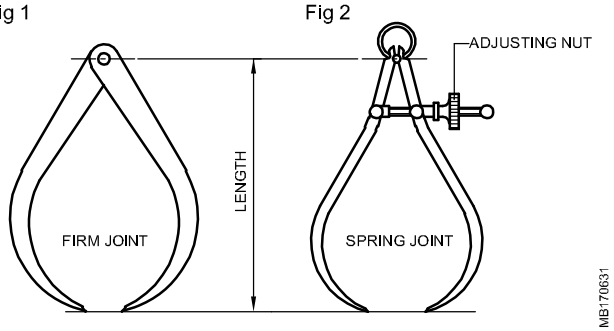
Spring joint calipers have the advantage of quick setting. The setting made will not change unless the nut is turned. The size of a caliper is specified by its length, which is the distance between the pivot centre and the tip of the leg.

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.

Types of Legs

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

Fig 1 Fig 2



Calipers used for outside measurements are known as outside calipers.(Fig 3) The calipers used for internal measurements are known as inside calipers.(Fig 4)

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.

Fig 3

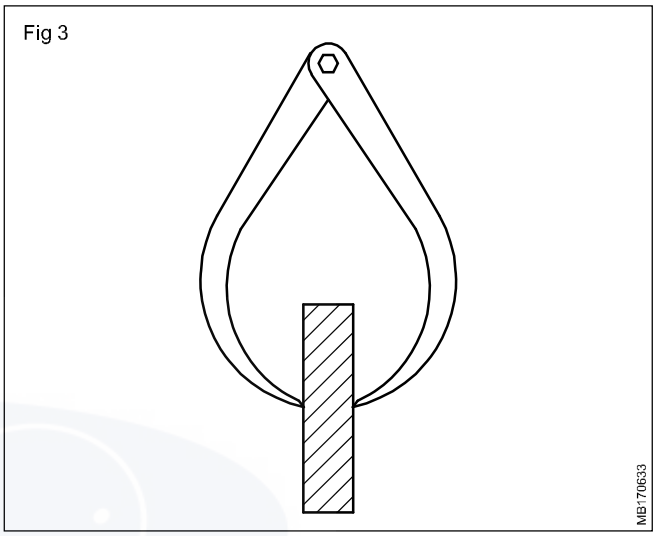
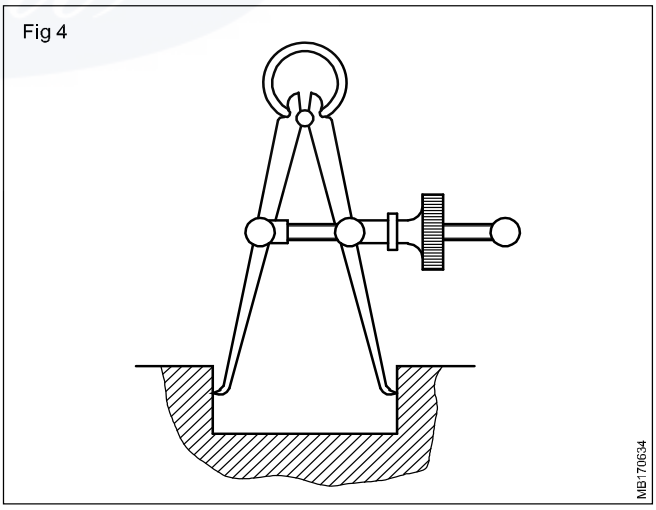


Fig 4



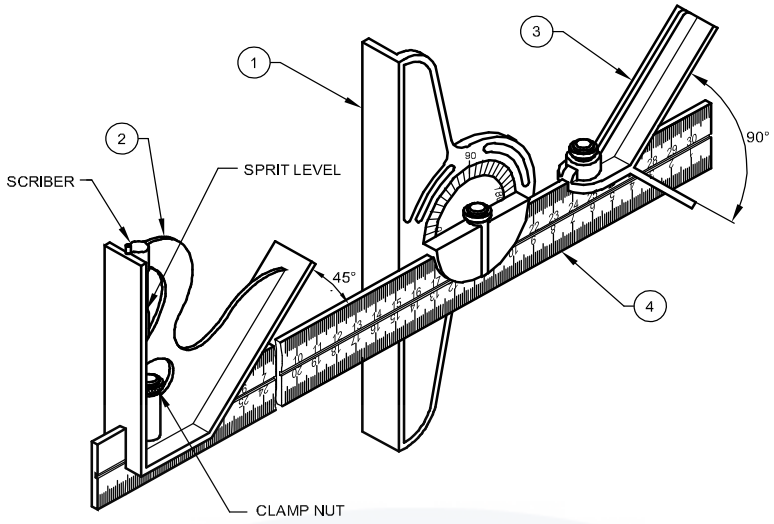
Combination set

Objectives: At the end of this lesson you shall be able to
- **identify the parts of a combination set**
- **state the uses of each attachment in a combination set.**

Combination sets can be used for different types of work, like layout work, measurement and checking of angles. The combination set (Fig 1) has a

protractor head (1)
square head (2)
centre head (3) and a
rule (4)

Fig 1



Protractor Head

The protractor head can be rotated and set to any required angle.

The protractor head is used for marking and measuring angles within an accuracy of 1°. The spirit level attached to this is useful for setting jobs in a horizontal plane. (Fig 6)

Fig 6

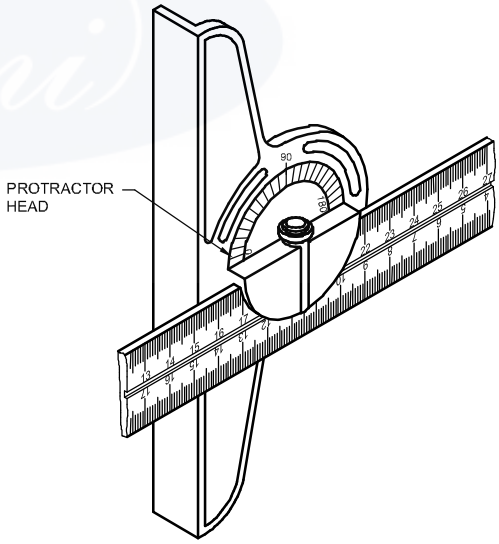


Fig 2

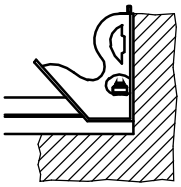


Fig 4

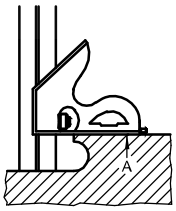


Fig 3

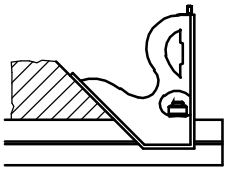
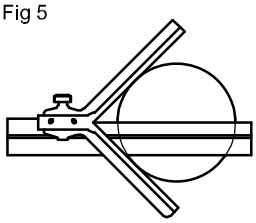


Fig 5



Square Head

The square head has one measuring face at 90° and another at 45° to the rule.

It is used to mark and check 90° and 45° angles. It can also be used to set workpieces on the machines and measure the depth of slots. (Fig 2,3 and 4)

Centre Head

This along with the rule is used for locating the centre of cylindrical jobs. (Fig 5)

For ensuring accurate results, the combination set should be cleaned well after use and should not be mixed with cutting tools, either while using or storing.

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.**

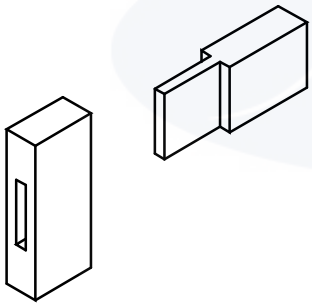
The most common and strongest form of framing joint. There are many forms of mortise and tenon joints. These are mainly used parallel frames of doors, carcasses of cabinets and for joining rails to leg of table and chairs.

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 (Fig 1)

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



THROUGH MORTISE AND TENON

MB170711

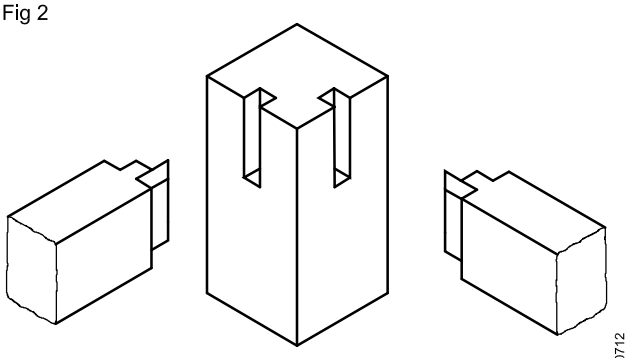
Haunched mortise and tenon (Fig 2)

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.

Barefaced mortise and tenon joint (Fig 3)

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.

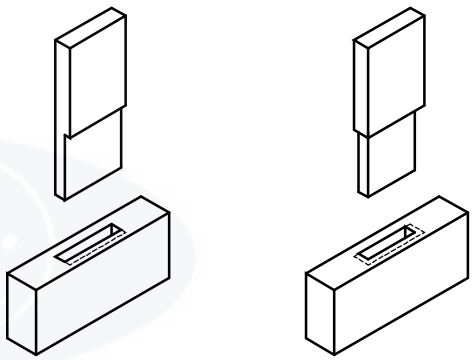
Fig 2



HAUNCHED AND MITRED MORTISE AND TENON

MB170712

Fig 3



BAREFACED M&T (HAUNCHED)

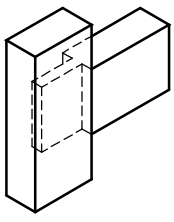
MB170713

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.

Stub mortise and tenon or (stump) (Fig 4)

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



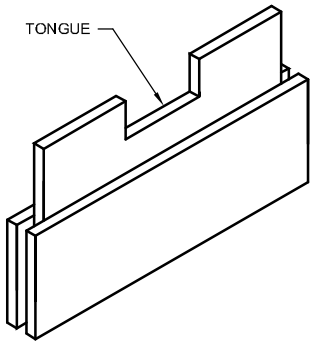
STUB MORTISE AND TENON

MB170714

Double mortice and tenon (Fig 5)

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



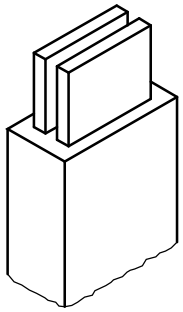
DOUBLE MORTISE AND TENON

MB170715

Twin mortice and tenon (Fig 6)

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



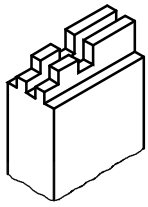
TWIN TENONS

MB170716

Compound tenon (Fig 7)

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



COMPOUND TENONS

MB170717

Miscellaneous hand tools

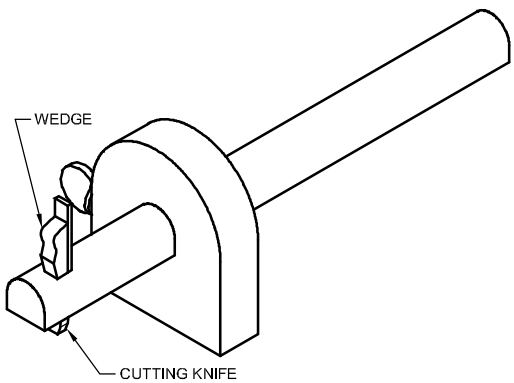
Objectives: At the end of this lesson you shall be able to
- **state the function of cutting gauge**
- **state the function of panel gauge**
- **state the function of bench-hold fast**
- **state the function of cleat.**

Cutting gauge (Fig 1)

This is just like the construction of a marking gauge.

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

Fig 1



CUTTING GAUGE

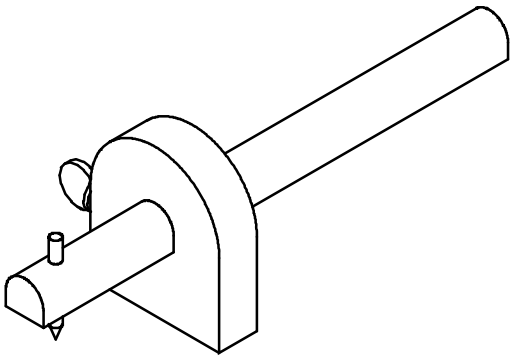
MB170721

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 2)

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 2



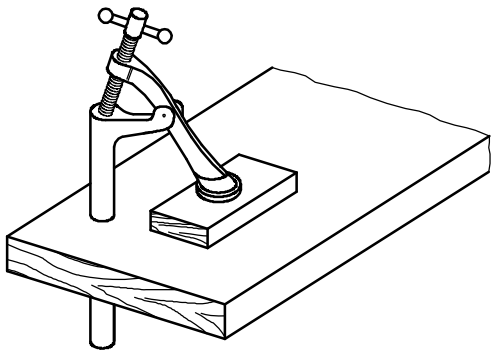
PANEL GAUGE

MB170722

Bench hold fast (Fig 3)

In wooden planks to make holes the planks are held 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.

Fig 3

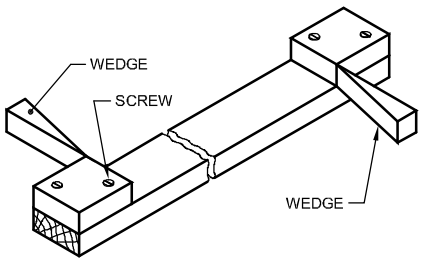


MB170723

The cleat (Fig 4)

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.

Fig 4



MB170724

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.

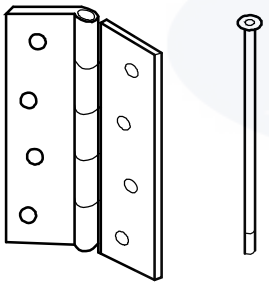
Butt Hinges

The ordinary steel butt hinges is cheap and durable and is the most common.

Hinge for doors and casements (Fig 1)

It consists of two halves called leaves and flaps held together by a pin when doors are shut the two leaves are folded together.

Fig 1



BUTT HINGE

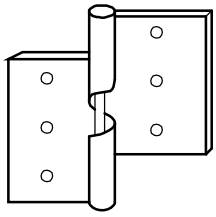
MB140211

The leaves are usually set into recesses in the door and post.

Rising butt Hinges (Fig 2)

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.

Fig 2



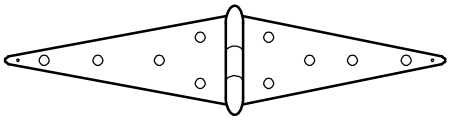
RISING BUTT HINGE

MB140212

Strap Hinges (Fig 3)

Strap hinge is also used for ledged and braced doors and for heavy such as for garages, stables, gates etc.

Fig 3



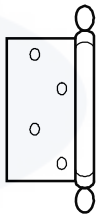
STRAP HINGE

MB140213

Spring Hinges (Fig 4)

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.

Fig 4



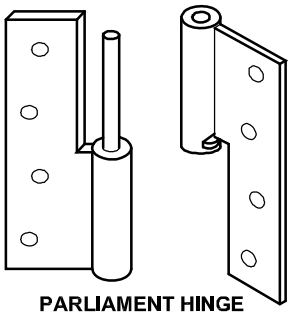
DOUBLE ACTING SPRING HINGE

MB140214

H. Hinges (Parliament Hinges) (Fig 5)

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.

Fig 5



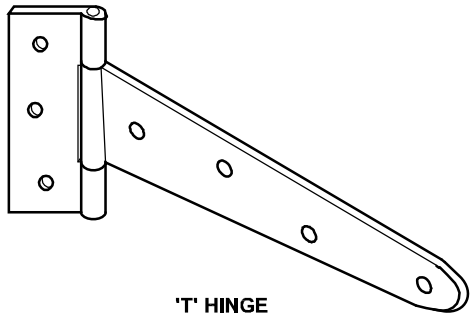
PARLIAMENT HINGE

MB140215

"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.

Fig 6



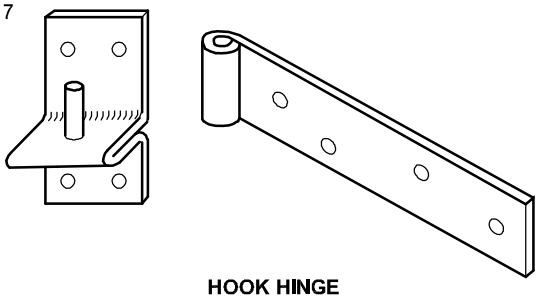
'T' HINGE

MB140216

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 7



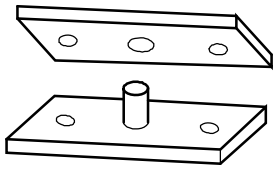
HOOK HINGE

MB140217

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

MB140218

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.**

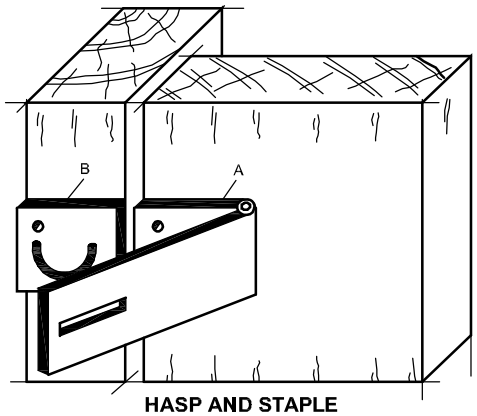
Hasp and staple (Fig 1)

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.

Fig 1



HASP AND STAPLE

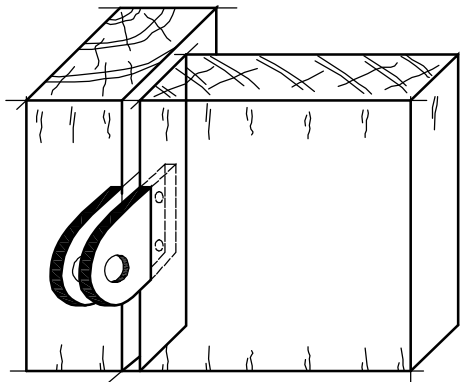
MB140221

The device shown in (Fig.2) is an alternative to the hasp and staples.

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.

Fig 2



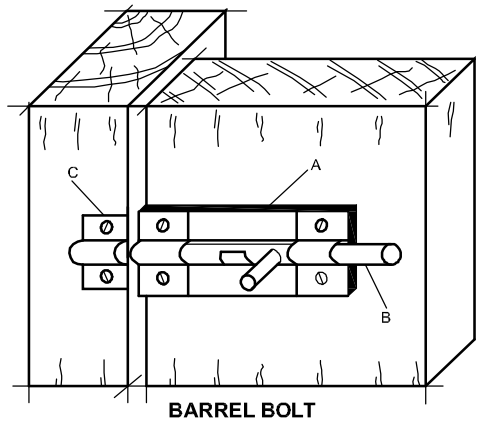
ALTERNATIVE OF HASP AND STAPLE

MB140222

Barrel bolts (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.

Fig 3



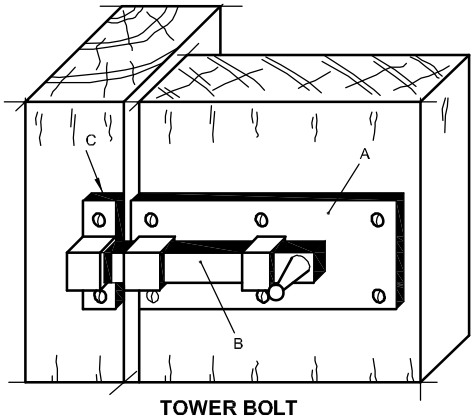
BARREL BOLT

MB1402223

Tower bolt (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.

Fig 4



TOWER BOLT

MB1402224

Locks and fittings

Objectives: At the end of this lesson you shall be able to
- **state the different types of locks and fittings**
- **explain the constructional feature of locks and fittings.**

Locks and fittings

- There are many kinds of locks and fittings 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...

- mortice lock
- rim lock
- pad lock

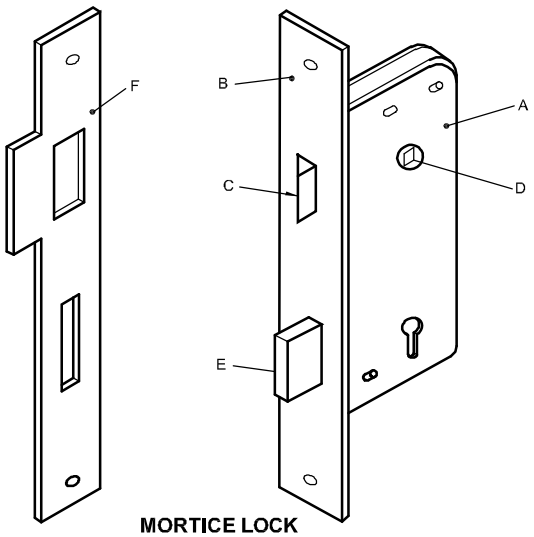
The most common types of fittings are...

- The hasp and staple
- The barrel bolt
- The tower bolt
- The case and fastener

Mortice locks (Fig 1)

- Mortice 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.
- The two bolts fit into holes in the striking plate (f) which is attached by screws to the door post. The mortice lock fits in to a mortice in the edge of the door.

Fig 1



MORTICE LOCK

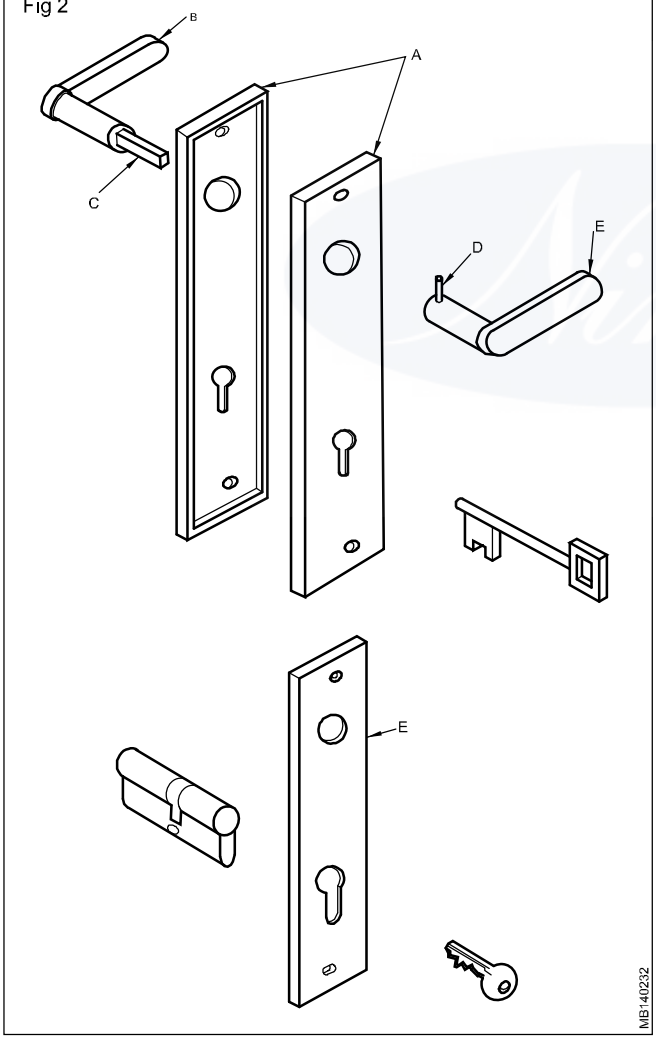
MB1402231

- The stroke should fit tightly against the sides of the mortice so that the door itself faces the strain not the screws which only hold the lock in position. Mortice locks can only be installed in doors which are thick enough to receive a mortice. They are different to force open, since they are inside the door.

Door furniture for mortice locks (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.

Fig 2



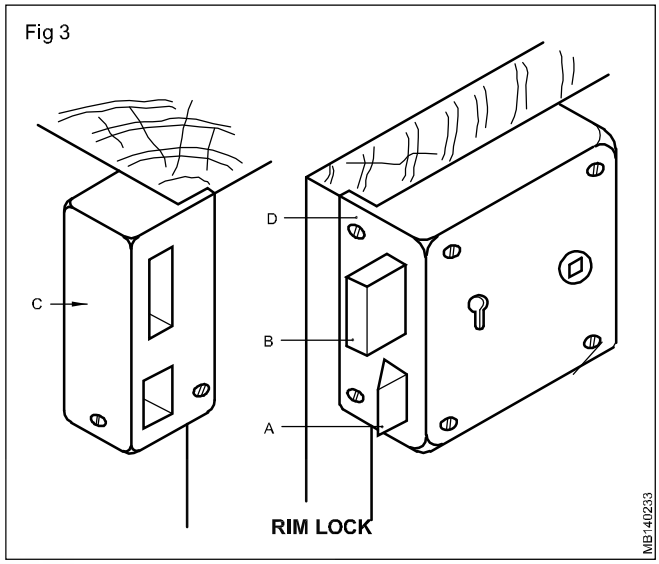
- The leaf plate for a mortice lock with a cylinder (e) has an opening into which the locking cylinder fits instead of a key hole.

Rim locks (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.

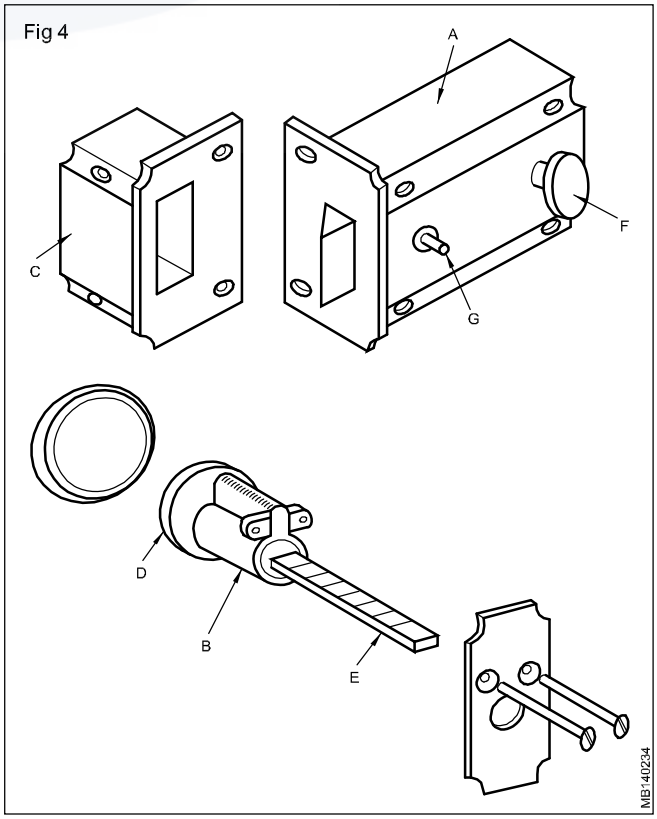
Fig 3



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 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 mortice lock.

Bolts

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of bolts**
- **state the uses of bolts.**

A bolt comprises of two parts a shank and a head.

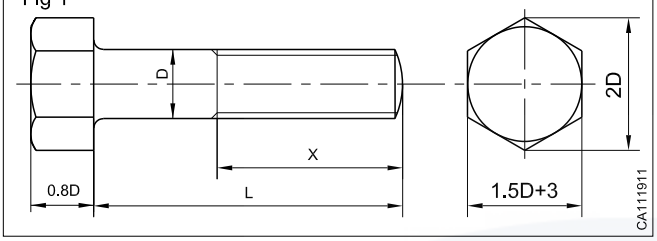
The shank is cylindrical and is threaded at the tail end for a sufficient length to engage with a nut.

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



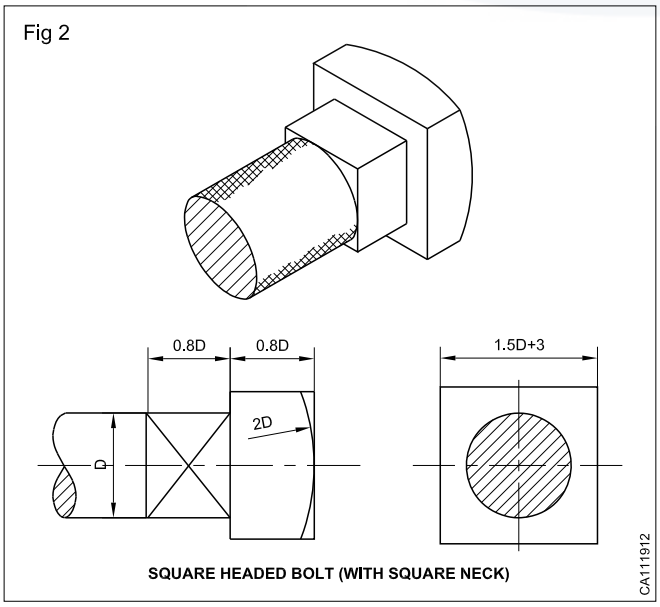
This is the most common form of a bolt.

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



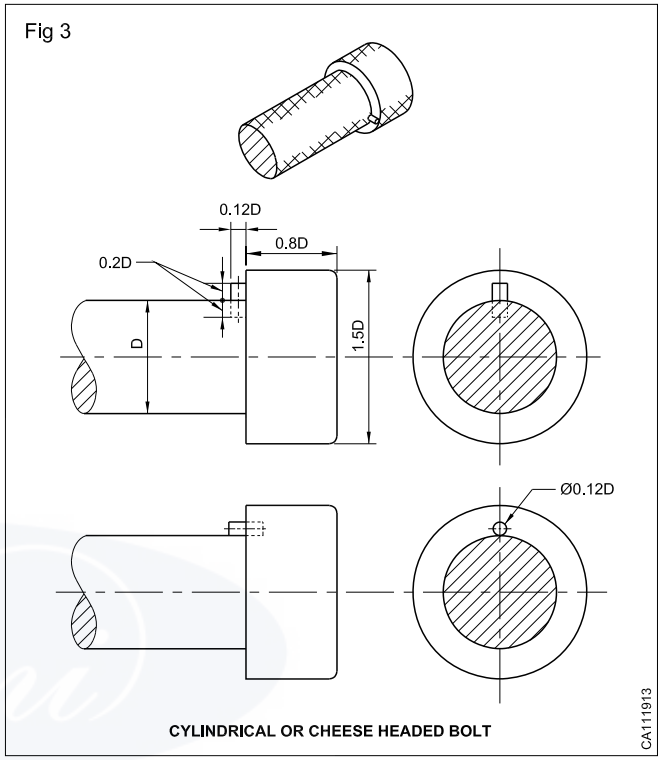
This bolt is generally used when the head is to be accommodated in a recess. This recess also is made of square shape. So that the bolt is prevented from turning when the nut is screwed on or off it.

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.

The rotation of the bolt is prevented by means of a pin inserted into the shank just below the head.

The projecting part of this pin fits into a corresponding groove in the adjacent piece.

This pin is very often inserted in the bolt head.

Cup headed or round headed bolt (Fig 4)

It is provided with a snug forged on the shank just below the head.

It fits into a corresponding recess in the adjacent piece to prevent rotation of the bolt.

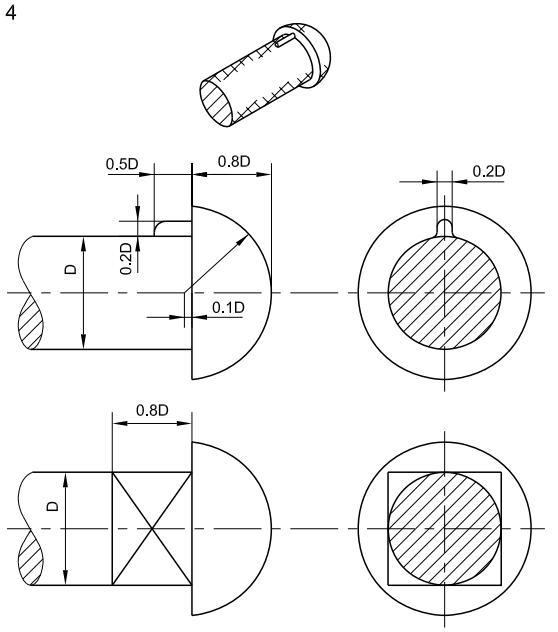
This bolt is often provided with a square neck.

T. Headed bolt (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.

Fig 4



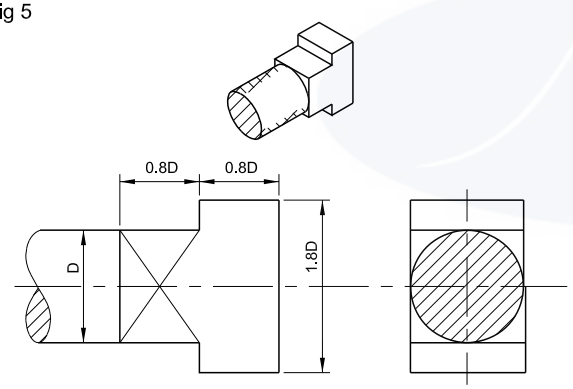
CUP HEADED OR ROUND HEADED BOLT

CA111914

The T-head bolt is made use of in gland and stuffing box an arrangement in boiler mounting such as top valve, feed check value etc.,

Counter sunk headed bolt (Fig 6)

Fig 5



T - HEADED BOLT (NON-STANDARD)

CA111915

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.

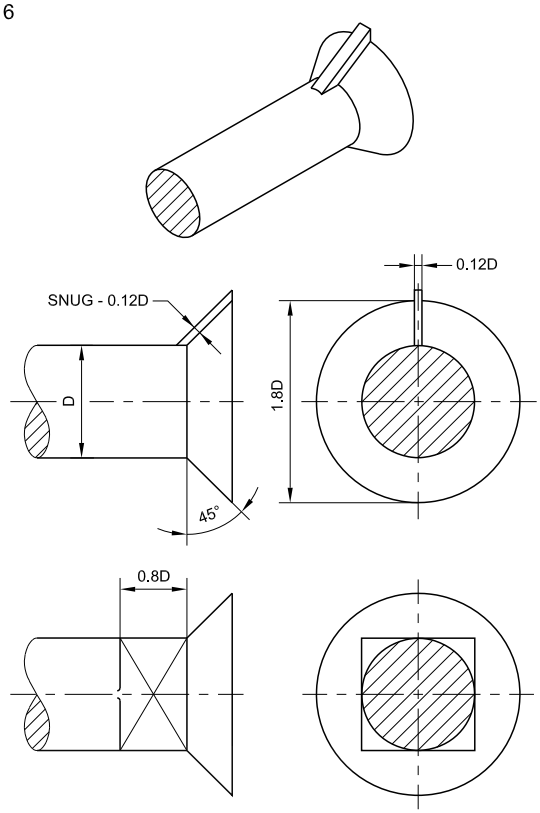
Hook bolt (Fig 7)

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.

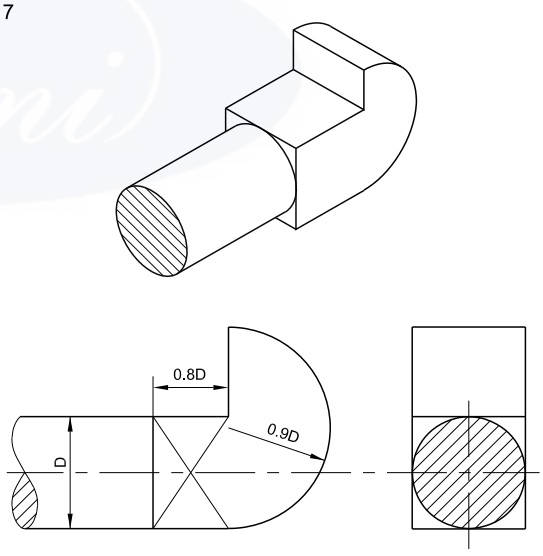
Fig 6



COUNTER SUNK - HEAD BOLT

CA111916

Fig 7



HOOK BOLT

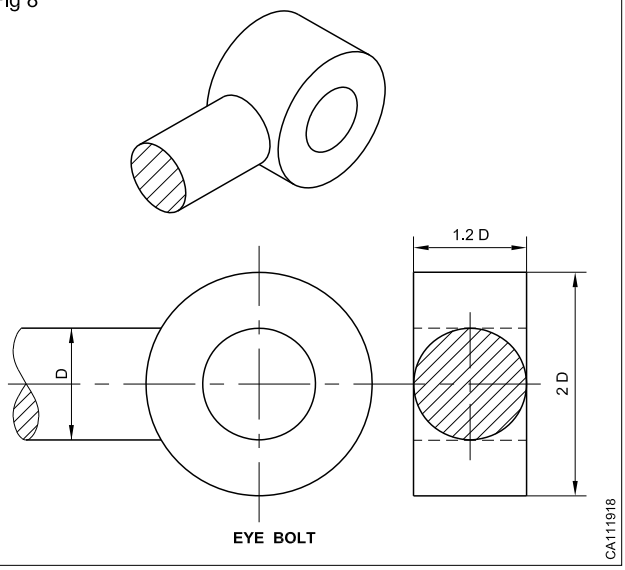
CA111917

Eye bolt (Fig 8)

This bolt has a circular ring of rectangular cross sections as its head.

Head can be conveniently held to prevents its rotation.

Fig 8



Washers

Objectives: At the end of this lesson you shall be able to
- **state the constructional detail and uses of washers.**

A washer is in cylindrical hollow piece of metal placed below the nut to provide smooth bearing surface for the nut to turn on.

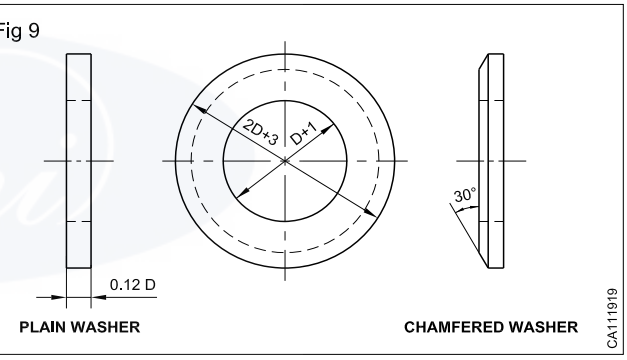
It spreads the pressure of the nut over a greater area.

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.

Fig 9

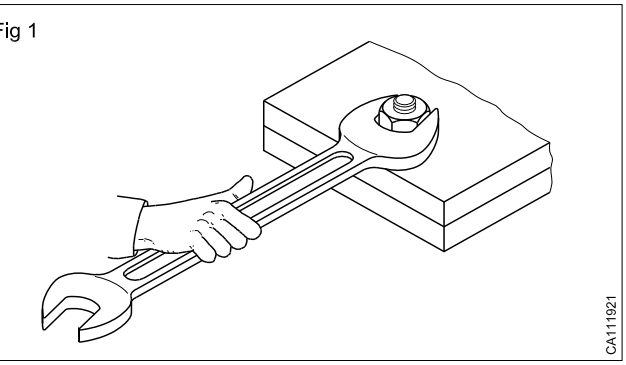


Spanners

Objectives: At the end of this lesson you shall be able to
- **state the uses of different sizes of spanners**
- **identify the size of a spanner.**

A spanner is a hand tool with jaws or opening or a ring at one end or at both ends of tightening or slacening nuts and bolts and screw heads. (Fig 1) It is made of drop forged, high utensil or alloy steel and heat treated for strength.

Fig 1



Types of spanners

- Open end spanners
- Ring spanners

Open end spanner

They can be single ended or double ended.

Nuts

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of different types of nuts**
- **state the uses of nuts.**

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.

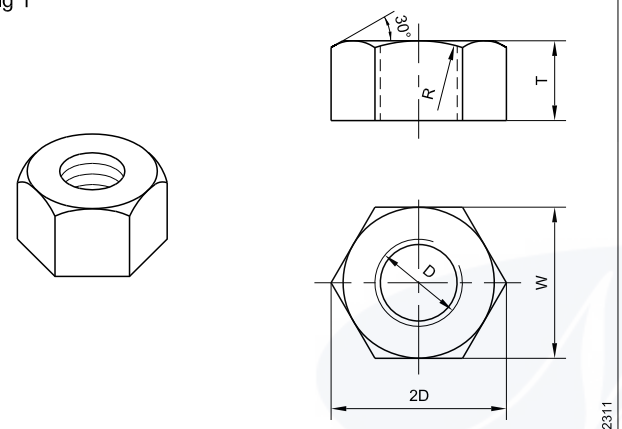
Hexagonal nut (Fig 1)

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.

Fig 1



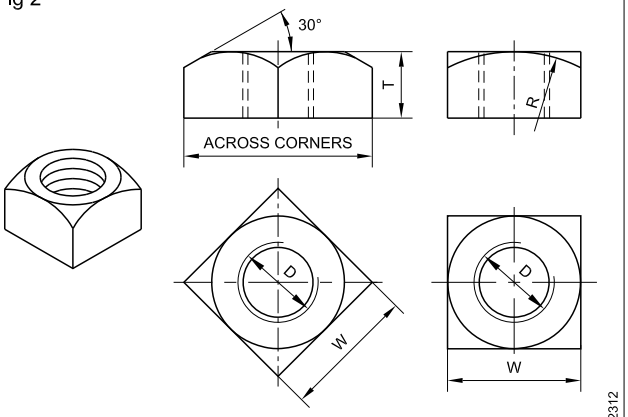
HEXAGONAL NUT

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 2)

The upper corners of the square nut are also chamfered in the same manner of the hexagonal nut.

Fig 2



SQUARE NUT

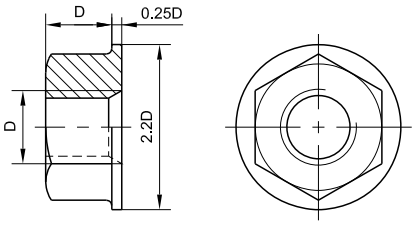
The widths across flats of a square nut and a hexagonal nut for the same size of the bolt are also equal.

Flanged nut (Fig 3)

This is an hexagonal nut with a washer, ie a flat circular disc is attached to it.

It is thus provided with a larger bearing surface.

Fig 3



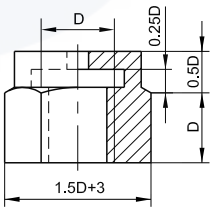
FLANGED NUT

A bolt can be used in a comparatively large size hole with the help of this nut.

Cap nut (Fig 4)

It is also a hexagonal nut provided with a cylindrical cap at the tops to protect the end of the bolt from corrosion.

Fig 4

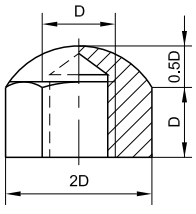


CAP NUT

It also prevents leakage through the threads.

Dome unit (Fig 5)

Fig 5



DOME NUT

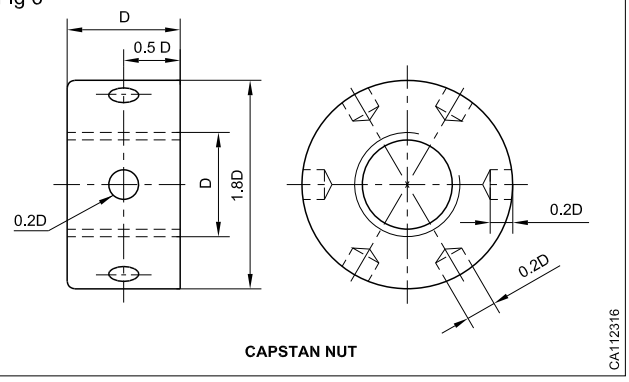
It is a form of a cap nut having a spherical dome at the top.

Cylindrical or capstan nut (Fig 6)

This nut is cylindrical in shape

- Holes are drilled in the curved surface for turning with a tommy bar.

Fig 6



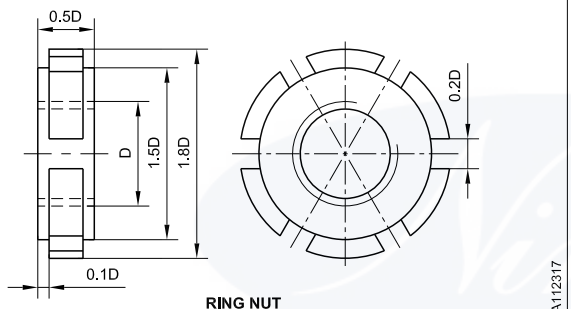
CAPSTAN NUT

Some times holes are drilled in the upper face for use of a pin spanner for turning it.

Ring Nut (Fig 7)

It is in the form of a ring provided with slots in the curved surface for a special ‘C’ spanner.

Fig 7



RING NUT

These nuts are generally used in pairs.

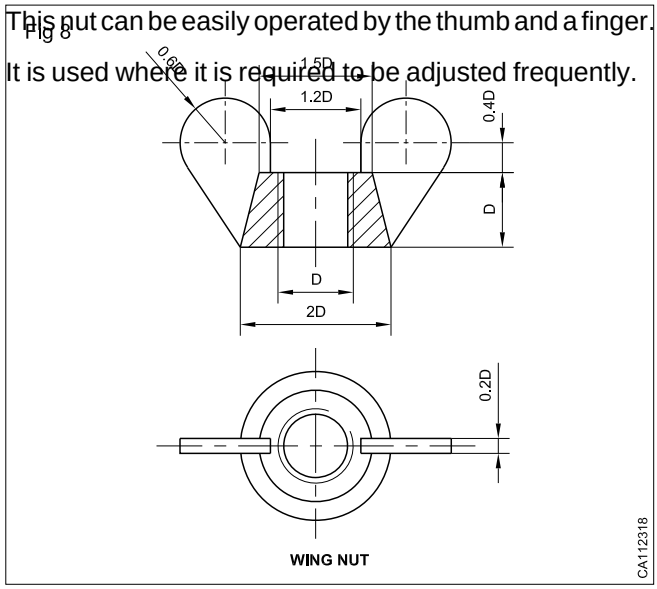
One nut acting as a lock-nut for the other.

Wing nut (Fig 8)

This nut can be easily operated by the thumb and a finger.

It is used where it is required to be adjusted frequently.

Fig 8



WING NUT

Drill - Holding Devices

Objectives: At the end of this lesson you shall be able to
- **name the types of drill-holding devices**
- **state the features of drill chucks**
- **state the functions of drill sleeves**
- **state the function of drift.**

For drilling holes on materials, the drills are to be held accurately and rigidly on the machines.

The common drill-holding devices are drill chucks and sleeves and sockets.

Drill chuck

Straight shank drills are held in drill chucks. For fixing and removing drills, the chucks are provided either with a pinion and key or a knurled ring.

The drill chucks are held on the machine spindle by means of an arbor fitted on the drill chuck. (Fig 1)

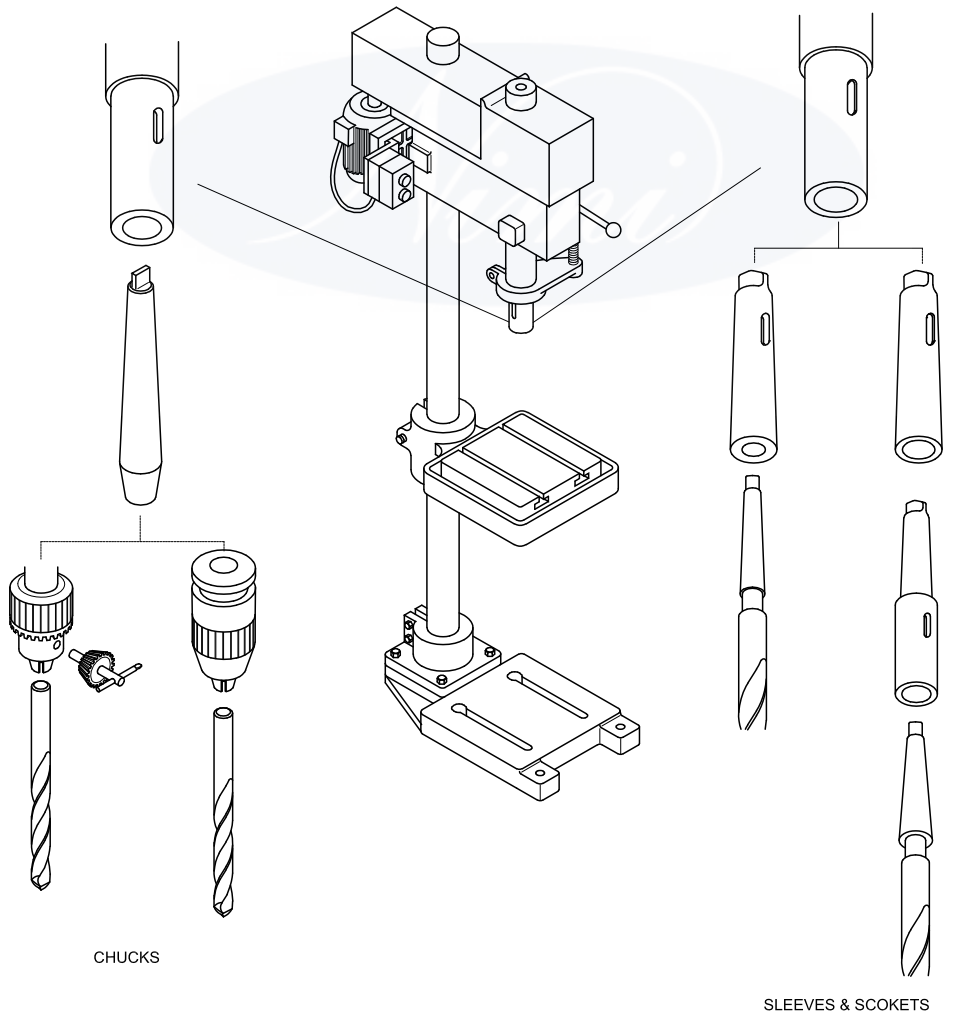
Taper sleeves and sockets (Fig 1)

Taper shank drills have a Morse taper.

Sleeves and sockets are made with the same taper so that the taper shank of the drill, when engaged, will give a good wedging action. Due to this reason Morse tapers are called self-holding tapers.

Drills are provided with five different sizes of Morse tapers, and are numbered from MT1 to MT5.

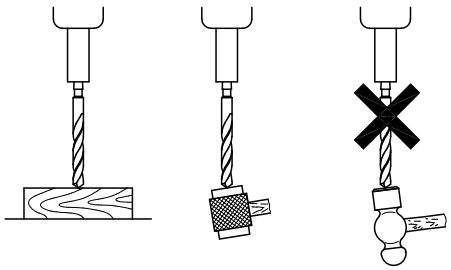
Fig 1



In order to make up the difference in sizes between the shank of drills and the type of machine spindles, sleeves of different sizes are used. When the drill taper shank is bigger than the machine spindle, taper sockets are used. (Fig 1)

While fixing the drill in a socket or sleeve, the tang portion should align in the slot. (Fig 2) This will facilitate the removal of drill or sleeve from the machine spindle.

Fig 2

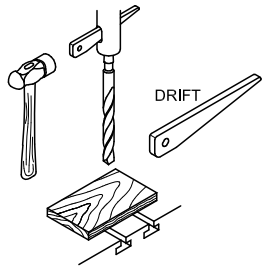


CA130512

Use a drift to remove drills and sockets from the machine spindle. (Fig 3)

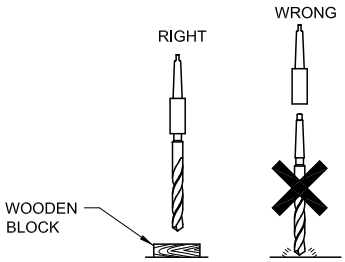
While removing the drill from the sockets/sleeves, don't allow it to fall on the table or jobs. (Fig 4)

Fig 3



CA130513

Fig 4



REMOVING A TAPER SHANK DRILL

CA130514

Radius gauges

Objectives : At the end of this lesson you shall be able to
- **state the uses of radius gauges**
- **state the features of radius gauges.**

Radius gauges are used to check internal and external radius of workpieces.

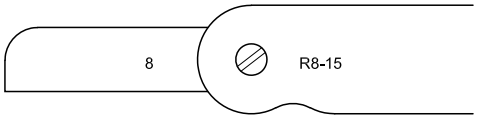
These gauges are made of high quality steel sheets, and are finished to accurate radius.

Radii of parts are checked by comparing the radius of the gauges.

Radius gauges are available in sets of several blades held in a holder. Each blade can be separately pulled out of the holder when wanted for use.

The size of the radius is marked on the individual blades of the gauges. (Fig 1)

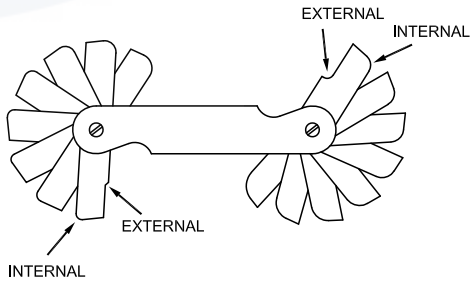
Fig 1



CA130521

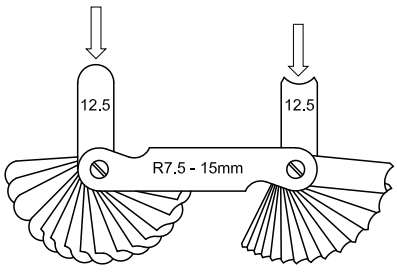
These gauges are available in different combinations with internal and external radius. (Figs 2 and 3)

Fig 2



CA130522

Fig 3



CA130513

Individual gauges are also available for different radii.(Fig 4)

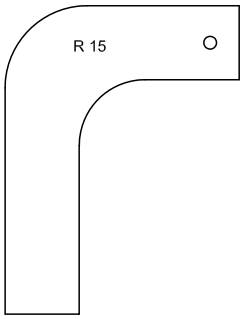
Before using radius gauges

- ensure the gauges are perfectly clean,

- remove burrs, if any, from the workpieces,

- check and make sure there is no damage to the profile of the gauge.

Fig 4



CA130514

– – – – – – – – – –

Cutting Speed and RPM

Objectives: At the end of this lesson you shall be able to
- **define cutting speed**
- **state the factors for determining the cutting speed**
- **differentiate between cutting speed and r.p.m.**
- **determine r.p.m. spindle speed**
- **select r.p.m. for drill sizes from tables.**

For a drill to give satisfactory performance, it must operate at the correct cutting speed and feed.

Cutting speed is the speed at which the cutting edge passes over the material while cutting, and is expressed in metres per minute.

Cutting speed is also sometimes stated as surface speed or peripheral speed.

The selection of the recommended cutting speed for drilling depends on the materials to be drilled, and the tool material.

Tool manufacturers usually provide a table of cutting speeds required for different materials.

The recommended cutting speeds for different materials are given in the table. Based on the cutting speed recommended, the r.p.m., at which a drill has to be driven, is determined.

Materials being drilled for HSS	Cutting speed (m/min)
Aluminium	70-100
Brass	35-50
Bronze(phosphor)	20-35
Cast iron (grey)	25-40
Copper	35-45
Steel (medium carbon/mild steel)	20-30
Steel (alloy, high tensile)	5-8
Thermosetting plastic (low speed due to abrasive properties)	20-30

Calculating r.p.m.

$$v = \frac{n \times d \times \pi}{1000} \text{ m/min}$$

$$n = \frac{v \times 1000}{d \times \pi} \text{ r.p.m.}$$

n = r.p.m
v = cutting speed in m/min
d = diameter of the drill in mm
π = 3.14

Example

Calculate the r.p.m. for a high speed steel drill ∅ 24mm to cut mild steel.

The cutting speed for MS is taken as 30m/min from the table.

It is always preferable to set the spindle speed to the nearest available lower range. The selected spindle speed is 300 r.p.m.

The r.p.m. will differ according to the diameter of drills. The cutting speed being the same, large diameter drills will have lesser r.p.m. and small diameter drills will have higher r.p.m.

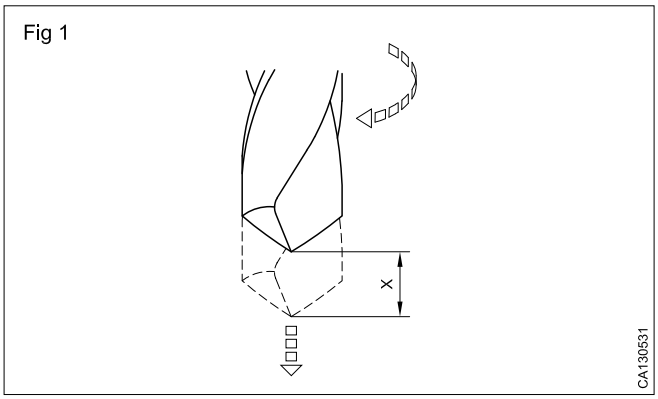
The recommended cutting speeds are achieved only actual experiments.

Feed in Drilling

Objectives: At the end of this lesson you shall be able to
- **state what is meant by feed**
- **state the factors that contribute to an efficient feed rate.**

Feed is the distance (X) a drill advances into the work in one complete rotation. (Fig 1)

Fig 1



Feed is expressed in hundredth's of a millimetre.

Example - 0.040mm.

The rate of feed is dependent upon a number of factors.

* Finish required

* Type of drill (drill material)

* Material to be drilled

Factors like rigidity of the machine, holding of workpiece and the drill, will also have to be considered while determining the feed rate. If these are not to the required standard, the feed rate will have to be decreased.

It is not possible to suggest a particular feed rate taking all the factors into account.

The table for the feed rate given here is based on the average feed values suggested by the different manufacturers of drills. (Table 1)

Drill diameter (mm) H.S.S.	**Rate of feed** (mm/rev)
1.0 - 2.5	0.040-0.060
2.6 - 4.5	0.050-0.100
4.6 - 6.0	0.075-0.150
6.1 - 9.0	0.100-0.200
9.1 -12.0	0.150-0.250
12.1 -15.1	0.200-0.300
15.1 -18.0	0.230-0.330
18.1 -21.0	0.260-0.360
21.1 -25.0	0.280-0.380

Too coarse a feed may result in damage to the cutting edges or breakage of the drill.

Too slow a rate of feed will not bring improvement in surface finish but may cause excessive wear of the tool point, and lead to chattering of the drill.

For optimum results in the feed rate while drilling, it is necessary to ensure the drill cutting edges are sharp. Use the correct type of cutting fluid.

Drill angles

Objectives: At the end of this lesson you shall be able to
- **identify the various angles of a twist drill**
- **state the functions of each angle**
- **list the tool types for drill as per ISI**
- **distinguish the features of different types of drills**
- **designate drills as per BIS recommendations.**

Like all cutting tools the drills are provided with certain angles for efficiency in drilling.

Angles

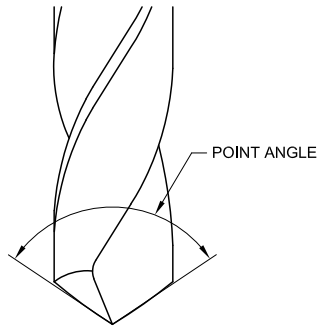
There are different angles for different purposes. They are listed below.

Point angle, Helix angle, Rake angle, Clearance angle and Chisel edge angle.

Point angle/Cutting angle (Fig 1)

The point angle of a general purpose (standard) drill is 118°. This is the angle between the cutting edges (lips). The angle varies according to the hardness of the material to be drilled.

Fig 1

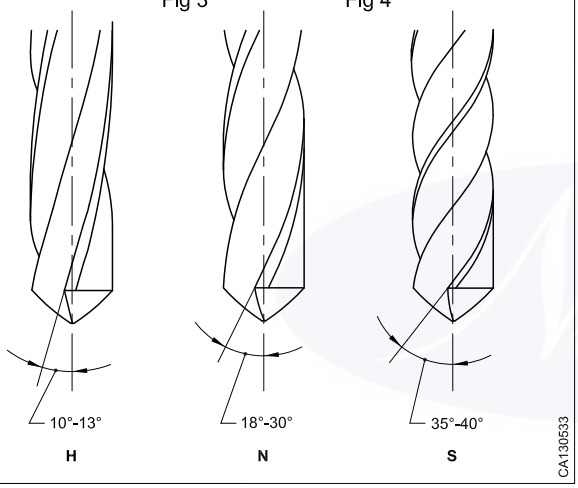


Helix angle (Figs 2, 3 and 4)

Twist drills are made with different helix angles. The helix angle determines the rake angle at the cutting edge of the twist drill.

The helix angles vary according to the material being drilled. According to Indian Standard, three types of drills are used for drilling various materials.

Fig 2 Fig 3 Fig 4



Type N - for normal low carbon steel

Type H - for hard and tenaceous materials

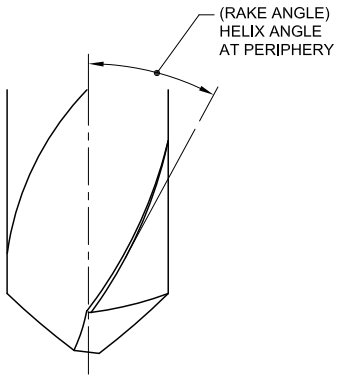
Type S - for soft and tough materials

The type of drill used for general purpose drilling work is type N.

Rake angle (Fig 5)

Rake angle is the angle of flute (Helix angle).

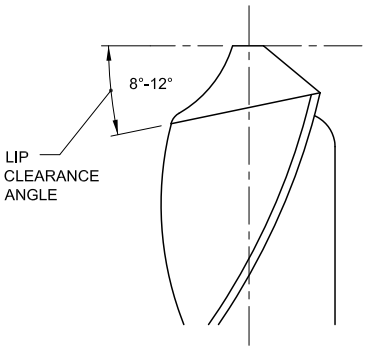
Fig 5



Clearance angle (Fig 6)

Clearance angle is to prevent the friction of the tool behind the cutting edge. This will help in the penetration of the cutting edges into the material. If the clearance angle is too much, the cutting edges will be weak, and if it is too small, the drill will not cut.

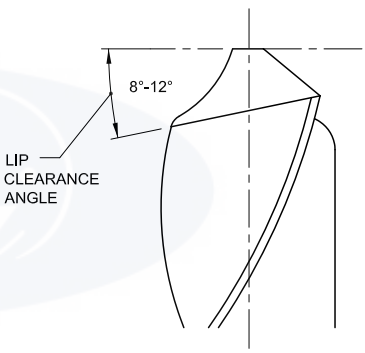
Fig 6



Chisel edge angle/Web angle (Fig 7)

This is the angle between the chisel edge and the cutting lip.

Fig 6



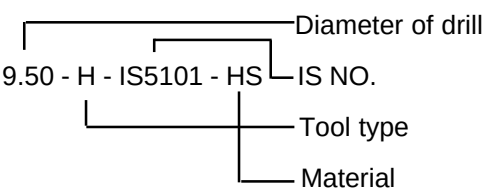
Designation of drills

Twist drills are designated by the

- diameter
- tool type
- material.

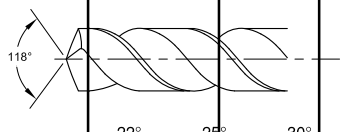
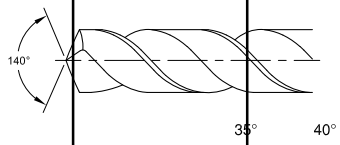
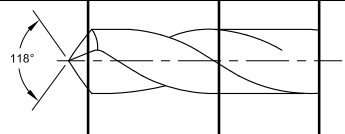
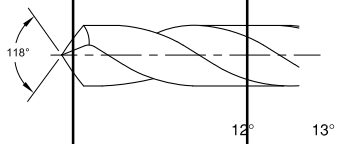
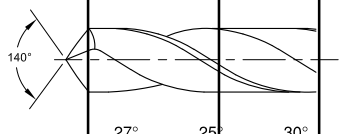
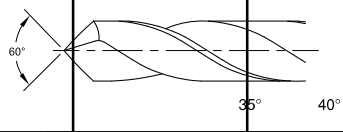
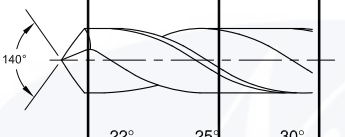
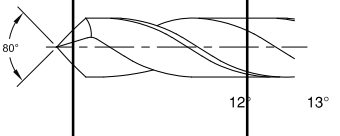
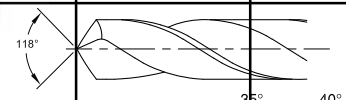
Example

A twist drill of 9.50 mm dia., of tool type 'H' for right hand cutting and made from HSS is designated as



If the tool type is not indicated in the designation, it should be taken as Type 'N' tool.

DRILLS FOR DIFFERENT MATERIALS

Recommended drills						
Material to be drilled	Point angle	Helix angle d=3.2..5	5-10	10	Material to be drilled	Point angle	Helix angle d=3.5..mm	5mm
Steel and cast steel up to 70 kgf/mm2 strength Gray cast iron Malleable cast iron Brass German silver, nickel					Copper (up to 30 mm drill diameter) Al-alloy,forming curly chips Celluloid			
Brass, CuZn 40					Austenitic steels Magnesium alloys			
Steel and cast steel 70...120 Kgf/mm2					Moulded plastics (with thickness s>d)			
Stainless steel Copper (drill diameter more than 30mm) Al-alloy, forming short broken chips					Moulded plastics, with thickness s<d Laminated plastics Hard rubber (ebonite) Marble, slate, coal			
					Zinc alloys			

Drilling defects and causes

Objectives: At the end of this lesson you shall be able to
- **state the common drilling defects**
- **identify the causes for drilling defects**
- **suggest remedial steps for preventing drill failures.**

The common defects in drilling are listed below.

* Oversized holes
* Overheated drills
* Rough holes
* Unequal and interrupted flow of chips
* Split webs or broken drills.

Oversized holes

Oversized holes can be due to the

- unequal length of the cutting edges
- unequal angle of the cutting edges
- unequal point-thinning
- the spindle running out of centre
- the drill point not in centre.

Remedy .....
.....

Overheated drills

The drills may get overheated if the

- cutting speed is too high
- feed rate is too high
- clearance angle is incorrect

- cooling is ineffective
- point angle is incorrect
- drill is not sharp.

Remedy .....
.....

Rough holes

Rough holes are caused if the

- feed rate is too much
- drill cutting edges are not sharp
- cooling is ineffective.

Remedy .....
.....

Unequal flow of chips

Unequal flow of chips is caused if the cutting edges are not equal and the point angle is not in the centre of the drill.

Remedy .....
.....

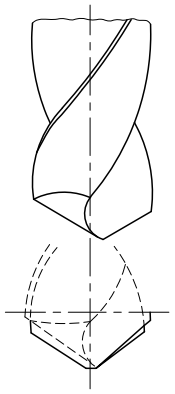
Broken drill or split web

Broken drill or split web occurs when the

- cutting speed is too high or the feed rate is too high
- work is not rigidly held
- drill is not held correctly
- drill is not sharp
- point angle is incorrect
- cooling is insufficient
- flutes are clogged with chips.

Remedy .....
.....

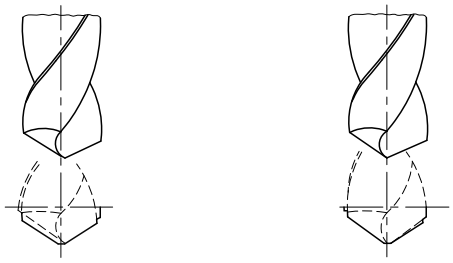
Fig 1



UNEQUAL LIP LENGTH

CA130541

Fig 2

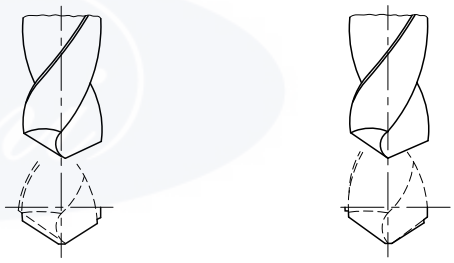


UNEQUAL ANGLE

UNEQUALE ANGLE AND LENGTH

CA130542

Fig 2



UNEQUAL ANGLE

UNEQUALE ANGLE AND LENGTH

CA130542

Cutting fluids (Coolants)

Objectives: At the end of this lesson you shall be able to
- **state the function of cutting fluids**
- **compare the characteristics of soluble oils,synthetic oils and neat cutting oils**
- **state the method of mixing soluble oil**
- **state the applications of soluble oil, synthetic oil and neat cutting oil**
- **identify the common types of cutting fluids for different materials and applications.**

Cutting fluids play an important role in reducing the wear of cutting tools.

They help to:
- carry away the heat generated during cutting operations
- flush away the chips from the cutting point
- maintain accurate dimensions
- produce good quality finish
- prevent corrosion
- operate machines on a high cutting speed and feed.

Cutting fluids of different types are available, but only those commonly used are explained here.

Soluble oil

Soluble oil is the most popular variety of cutting fluid. Soluble oils of different types are available.

This is an emulsified oil, which, when mixed with water, is an excellent cutting fluid. Soluble oil is comparatively cheap, and can be used for a number of machining operations.

Soluble oil should be mixed correctly and the proportions of oil and water as recommended by the manufacturer should be strictly followed.

It may be noted that for preparing a stable emulsion, oil should always be added to the water and not vice versa. While mixing, it should be continuously stirred.

Indian Oil Corporation produces three types of soluble cutting oils,

SERVO CUT 'S'
SERVO CUT XL
SERVO CUT CLEAR.

Servo Cut 'S' oil when mixed with water, forms a milky emulsion. This oil has high cooling and lubricating properties. It is capable of minimizing tool-wear and improving the surface finish. This oil is recommended for a variety of cutting operations of ferrous and non-ferrous metals. It is used in a concentration of 5% for general machining operations, and for grinding, more dilute emulsions are prepared.

Servo Cut XL is a superior quality soluble oil. This, when mixed with water, forms an opaque emulsion. This oil gives good performance in hard water.

Servo Cut Clear oil, when mixed with water and used, will give clear visibility during machining. This has excellent cooling and lubrication properties, and is capable of ensuring long tool life and improved surface finish.

Oil cutting fluids can cause metal cuttings to 'clog' in operations like fine grinding where fine particles of metal are removed. To overcome this, non-oily synthetic soluble cutting oils (chemicals solutions) are used.

Using the correct cutting fluid while machining is important for maintaining tool life, efficiency in cutting and for obtaining good quality surface finish.

Synthetic soluble cutting oils

These oils consist basically of a mixture of chemicals which are soluble in water and are mainly used as grinding coolants. These oils have high anti-rust properties. The cutting fluids of this type are SERVOSYNTH 2 and SERVOSYNTH 5.

Servosynth 2 is recommended for grinding for ferrous metals, high nickel and titanium alloys only.

Servosynth 5 is suitable for grinding iron, steel, non-alloyed and nickel chrome steel.

These oils are not recommended for the machining of non-ferrous metals.

Application	Material	Cutting fluid
General machining on central lathe, drilling machine, milling machine etc.	Mild steel	Soluble oil
Surface grinding, machine sawing	Mild steel	Chemical solution synthetic soluble oil.
General machining synthetic soluble oil	Cast iron	Non - machine dry (Cast iron has self-lubricating properties). Coolant tends to cause cuttings to 'clog'.
General machining	Brass	Can be machined dry or a chemical solution synthetic soluble oil may be used.
General machining	Copper	Chemical solution synthetic soluble oil.
General machining	Aluminium	Mineral oil in the form of paraffin or specially designed chemical solution since paraffin gives off noxious fumes, and is a fire hazard.

Countersinking

Objectives: At the end of this lesson you shall be able to
- **state what is countersinking**
- **list the purposes of countersinking**
- **state the angles of countersinking for the different applications**
- **name different types of countersinks**
- **distinguish between Type A and Type B countersink holes.**

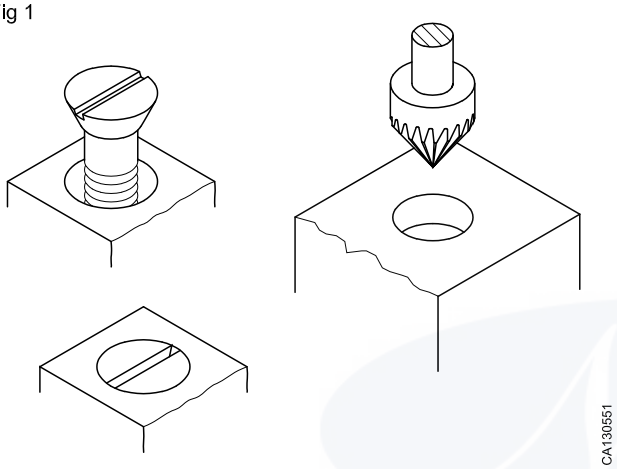
What is countersinking?

Countersinking is an operation of bevelling the end of a drilled hole. The tool used is called countersink.

Countersinking is carried out for the following purposes.

To provide a recess for the head of a countersink screw, so that it is flush with the surface after fixing (Fig 1)

Fig 1



To deburr a hole after drilling.

For accommodating countersink rivet heads.

To chamfer the ends of holes for thread cutting and other machining processes.

Angles for countersinking

Countersinks are available in different angles for different uses.

75° countersink riveting

80° countersink self-tapping screws

90° countersink head screws and deburring

120° chamfering ends of holes to be threaded or other machine processes.

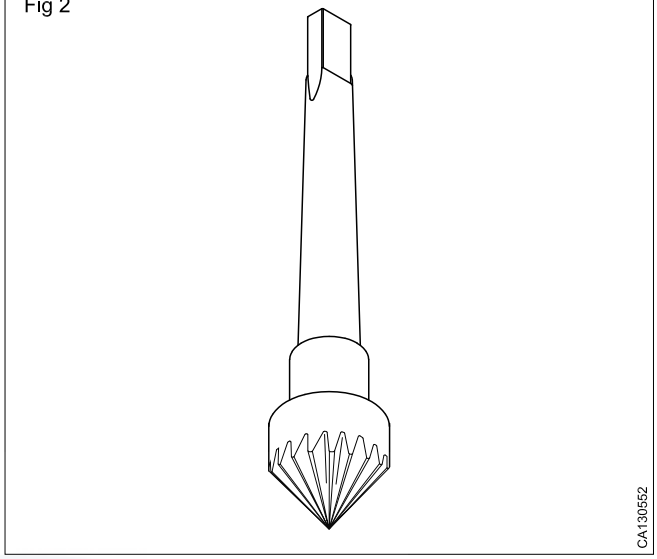
Countersinks (Tool)

Countersinks of different types are available.

The commonly used countersinks have multiple cutting edges and are available in taper shank and straight shank. (Fig 2)

For countersinking small diameter holes special countersinks with two or one flute are available. This will reduce the vibration while cutting.

Fig 2



Countersinks with pilots (Fig 3)

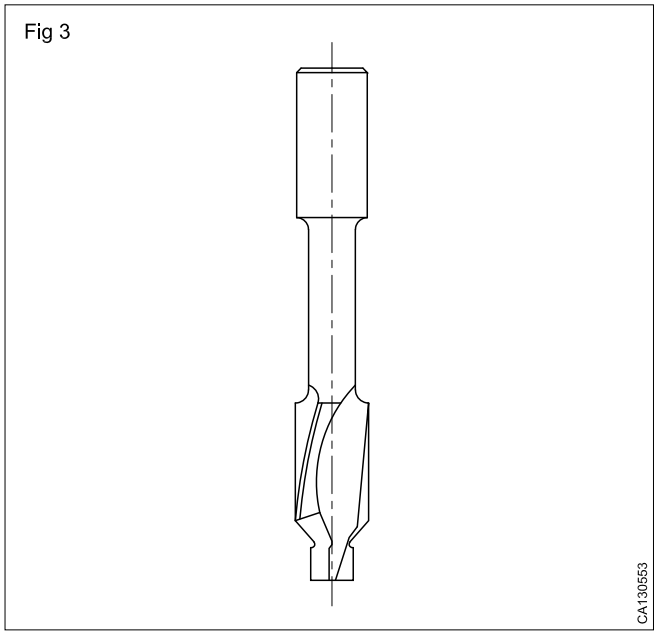
For precision countersinking, needed for machine tool assembling and after machining process, countersinks with pilots are used.

They are particularly useful for heavy duty work.

The pilot is provided at the end for guiding the countersink concentric to the hole.

Countersinks with pilots are available with interchangeable and solid pilots.

Fig 3



Countersink hole sizes

The countersink holes according to Indian Standard IS 3406 (Part 1) 1986 are of four types: Type A, Type B, Type C and Type E.

Type A is suitable for slotted countersink head screws, cross- recessed and slotted raised countersink head screws.

These screws are available in two grades i.e. medium and fine.

The dimensions of various features of the Type `A' countersink holes, and the method of designation are given in BIS standard.

Type `B' countersink holes are suitable for countersink head screws with hexagon socket.

The dimensions of the various features and the method of designation are given in BIS standard.

Type `C' countersink holes are suitable for slotted raised countersink (oval) head tapping screws and for slotted countersink (flat) head tapping screws.

The dimension of the various features and the method of designation are given in BIS standard.

Type `E' countersinks are used for slotted countersink bolts used for steel structures.

The dimensions of the various features and the method of designation are given in BIS standard.

METHODS OF REPRESENTING COUNTERSINK HOLES IN DRAWINGS

Countersink hole sizes are identified by code designation or using dimension.

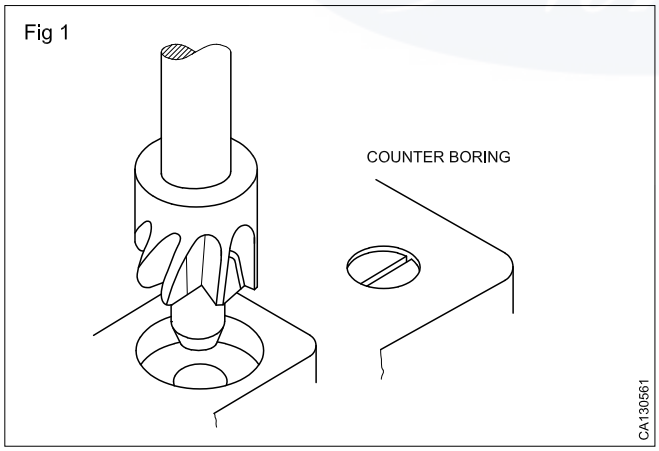
_ _ _ _ _ _ _ _ _

Counter boring and spot facing

Objectives: At the end of this lesson you shall be able to
- **differentiate between counterboring and spot facing**
- **state the different types of counterbores and their uses**
- **determine the correct counterbore sizes for different holes.**

Counterboring 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 counterbore tool. (Fig 1)

Fig 1



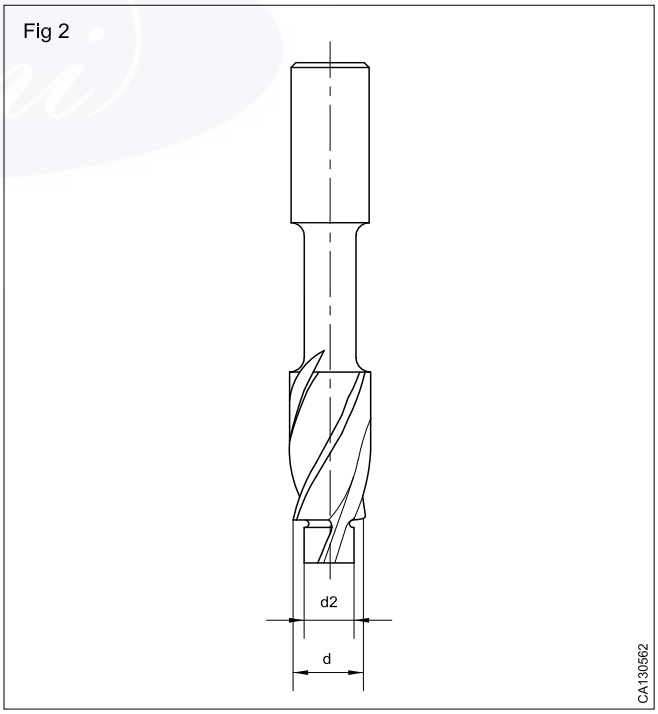
Counterbore (Tool)

The tool used for counterboring is called counterbore. (Fig 2) Counterbores 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 counterboring. (Fig 3)

Counterbores are available with solid pilots or with interchangeable pilots. The interchangeable pilot provides flexibility of counterboring on different diameters of holes.

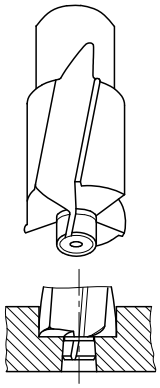
Fig 2



Spot facing

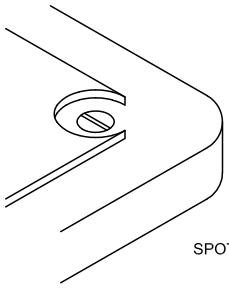
Spot facing is a machining operation for producing a flat seat for bolt head, washer or nut at the opening of a drilled hole. The tool is called a spot facer or a spot facing tool. Spot facing is similar to counterboring, except that it is shallower. Tools that are used for counterboring can be used for spot facing as well. (Fig 4)

Fig 3



CA130563

Fig 4



CA130564

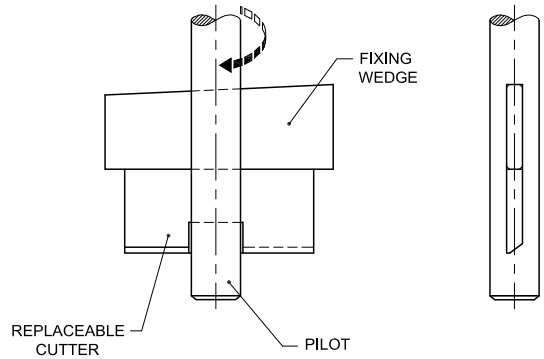
Spot facing is also done by fly cutters by end-cutting action. The cutter blade is inserted in the slot of the holder, which can be mounted on to the spindle. (Fig 5)

Counterbore sizes and specification

Counterbore sizes are standardised for each diameter of screws as per BIS.

There are two main types of counterbores. Type H and Type K.

Fig 5



CA130565

The type H counterbores are used for assemblies with slotted cheese head, slotted pan head and cross-recessed pan head screws. The type K counterbores are used in assemblies with hexagonal socket head-cap screws.

For fitting different types of washers, the counterbore standards are different in Type H and Type K.

The clearance hole d1 are of two different grades i.e. medium (m) and fine (f) and are finished to H13 and H12 dimensions.

While representing counterbores in drawings, they can be indicated either by code designation or using dimen-sions.

Counterbore and clearance hole sizes for different sizes of screws, are available as per BIS standard.

– – – – – – – – – –

Screw pitch gauge

Objectives: At the end of this lesson you shall be able to
- **state the purpose of a screw pitch gauge**
- **state the features of a screw pitch gauge.**

Purpose

A screw pitch gauge is used to determine the pitch of a thread.

It is also used to compare the profile of threads.

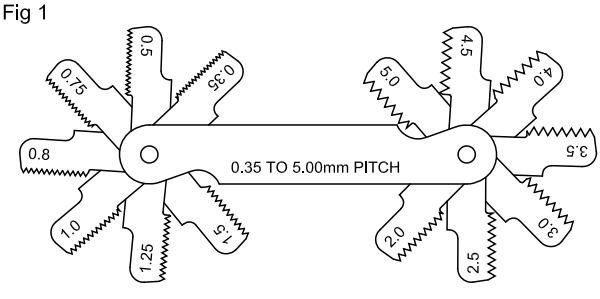
Constructional features

Pitch gauges are available with a number of blades assembled as a set. Each blade is meant for checking a particular standard thread pitch. The blades are made of thin spring steel sheets, and are hardened.

Some screw pitch gauge sets will have blades provided for checking British standard threads (BSW, BSF etc.) at one end and the metric standard at the other end.

The thread profile on each blade is cut for about 25 mm to 30 mm. The pitch of the blade is stamped on each blade. The standard and range of pitches are marked on the case. (Fig 1)

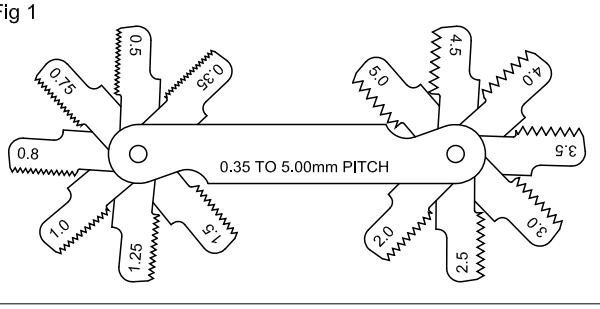
Fig 1



CA130571

For obtaining accurate results while using the screw pitch gauge, the full length of the blade should be placed on the threads. (Fig 2)

Fig 1



Screw thread and elements

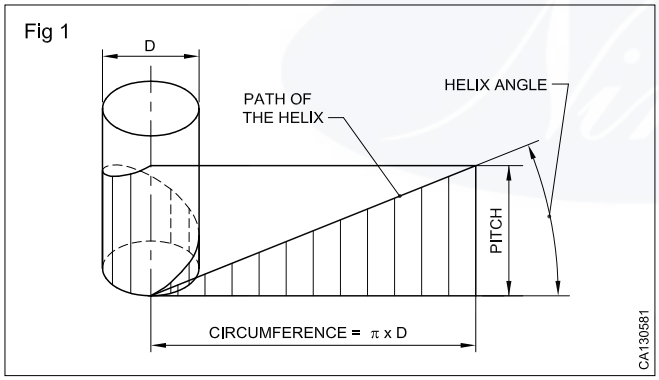
Objectives: At the end of this lesson you shall be able to
- **state the uses of screw threads**
- **differentiate between external and internal threads**
- **state the elements of screw threads.**

What is a screw thread?

A screw thread is a ridge of uniform section formed helically on the surface of a cylindrical body. (Fig 1)

An external screw thread is formed on the outer surface of a cylindrical part. *Examples*: bolts, screws, studs, threaded spindles, etc. (Fig 1)

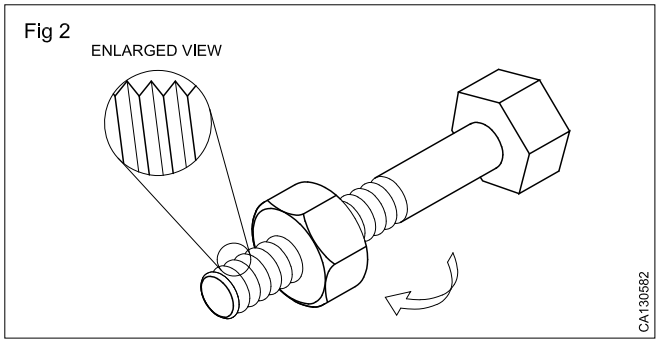
Fig 1



An internal screw thread is formed on the inner surface of a hollow cylindrical part. Examples: nuts, threaded lids etc.

External threads and internal threads are assembled together for different engineering uses. (Fig 2)

Fig 2

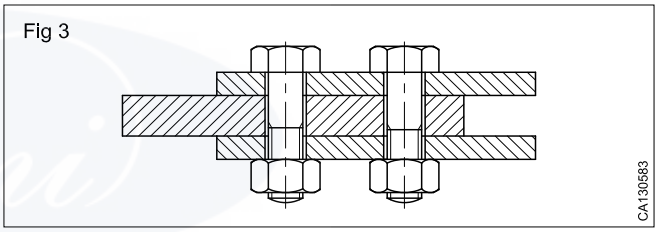


USES OF SCREW THREADS

Screw threads are used:

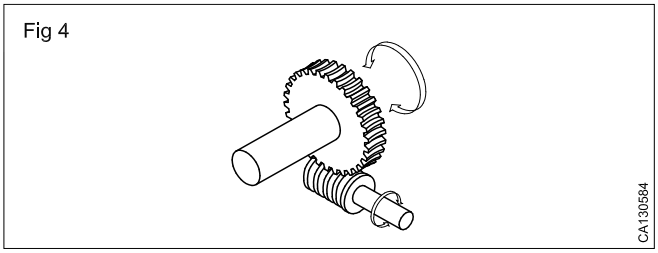
- as fasteners to hold together and dismantle components when needed (Fig 3)

Fig 3



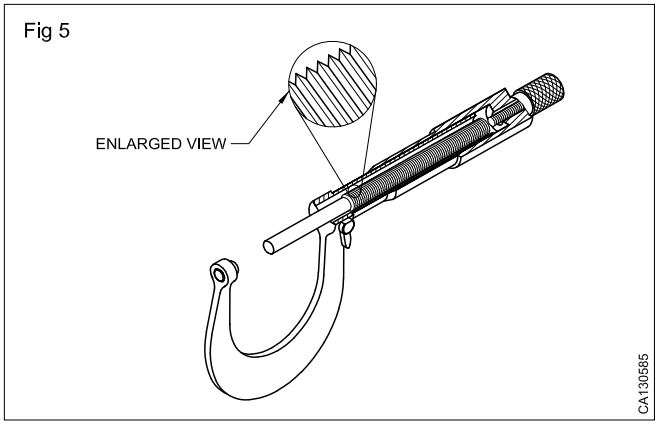
- to transmit motion on machines from one unit to another (Fig 4)

Fig 4



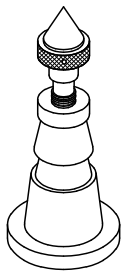
- to make accurate measurements (Fig 5)

Fig 5



- to apply pressure (Fig 6)

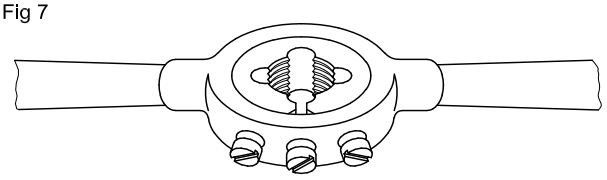
Fig 6



CA130586

- to make adjustments.(Fig 7)

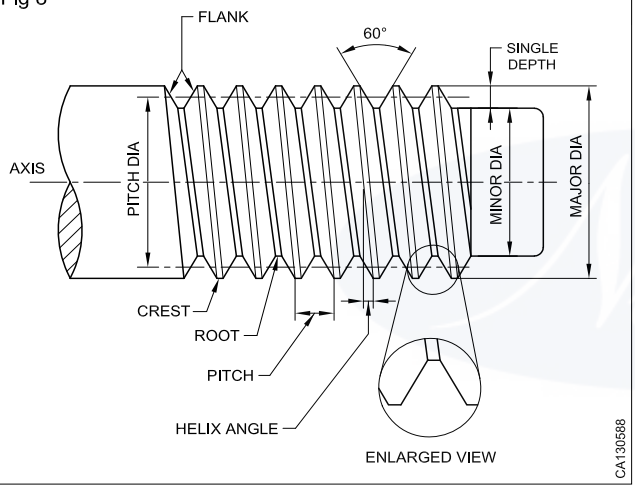
Fig 7



CA130587

Parts of a screw thread (Fig 8)

Fig 8



CA130588

Crest

The top surface joining the two sides of a thread.

Root

The bottom surface joining the two sides of adjacent threads.

Flank

The surface joining the crest and the root.

Thread angle

The included angle between the flanks of adjacent threads.

Depth

The perpendicular distance between the roots and crest of the thread.

Major diameter

In the case of external threads it is the diameter of the blank on which the threads are cut and in the case of internal threads it is the largest diameter after the threads are cut that is known as the major diameter. (Fig 8a)

This is the diameter by which the sizes of screws are stated.

Minor diameter

For external threads, the minor diameter is the smallest diameter after cutting the full thread. In the case of internal threads, it is the diameter of the hole drilled for forming the thread which is the minor diameter.

Pitch diameter (effective diameter)

The diameter of the thread at which the thread thickness is equal to one half of the pitch.

Pitch (Fig 8)

It is the distance from a point on one thread to a corresponding point on the adjacent thread measured parallel to the axis.

Lead

The lead is the distance a threaded component moves along the matching component during one complete revolution. For a single start thread, the lead is equal to the pitch.

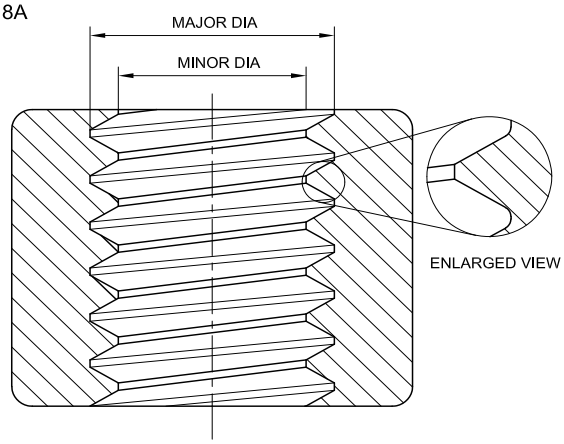
Helix angle

The angle of inclination of the thread to the imaginary perpendicular line.

Hand

The direction in which the thread is turned to advance. A right hand thread is turned clockwise to advance, while a left hand thread is turned anticlockwise. (Fig 9)

Fig 8A



CA130589

Tap drill size

Objectives: At the end of this lesson you shall be able
- **state what is tap drill size**
- **choose the tap drill sizes for different threads from tables**
- **calculate the tap drill sizes for ISO metric and ISO inch.**

What is a tap drill size?

Before a tap is used for cutting internal threads, a hole is to be drilled. The diameter of the hole should be such that it should have sufficient material in the hole for the tap to cut the thread.

Tap drill sizes for different threads

ISO Metric thread

Tapping drill size for M10 x 1.5 thread

Minor diameter = Major diameter – 2 x depth

depth of thread = 0.6134 x pitch of a screw

2 depth of thread = 0.6134 x 2 x pitch
=1.226 x 1.5 mm = 1.839 mm.

Minor dia (D1) = 10 mm – 1.839 mm
= 8.161mm or 8.2 mm.

This tap drill will produce 100% thread because this is equal to the minor diameter of the drill. For most fastening purposes a 100% formed thread is not required.

A standard nut with 60% thread is strong enough to be tightened until the bolt breaks without stripping the thread.

Further it also requires a greater force for turning the tap if a higher percentage formation of thread is required.

Considering this aspect, a more practical approach for determining the tap drill sizes is
Tap drill size = Major diameter
pitch = 10 mm - 1.5 mm = 8.5 mm.
Compare this with the table of tap drill sizes for ISO metric threads.

ISO Inch (Unified) threads formula
Tap drill size =

$$\text{Major diameter} - \frac{1}{\text{Number of threads per inch}}$$

For calculating the tap drill size for 5/8" UNC thread

Tap drill size = 5/8" – 1/11"
= 0.625" – 0.091"
= 0.534".
The next drill size is 17/32" (0.531 inches).

Compare this with the table of drill sizes for unified inch threads.

What will be the tapping size for the following threads?

(a) M 20
(b) UNC 3/8

Refer to the chart for determining the pitches of the thread.

– – – – – – – – – –

Hand taps and wrenches

Objectives: At the end of this lesson you shall be able to
- **state the uses of threading hand taps**
- **state the features of hand taps**
- **distinguish between different taps in a set**
- **name the different types of tap wrenches**
- **state the uses of 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.

Threads are cut on the surface, and are accurately finished.

To form the cutting edges, the flutes are cut across the thread.

For holding and turning the taps while cutting threads, the ends of the shanks are squared.

The ends of the taps are chamfered (taper lead) for assisting, aligning and starting of the thread.

The size of the taps and the type of the thread are usually marked on the shank.

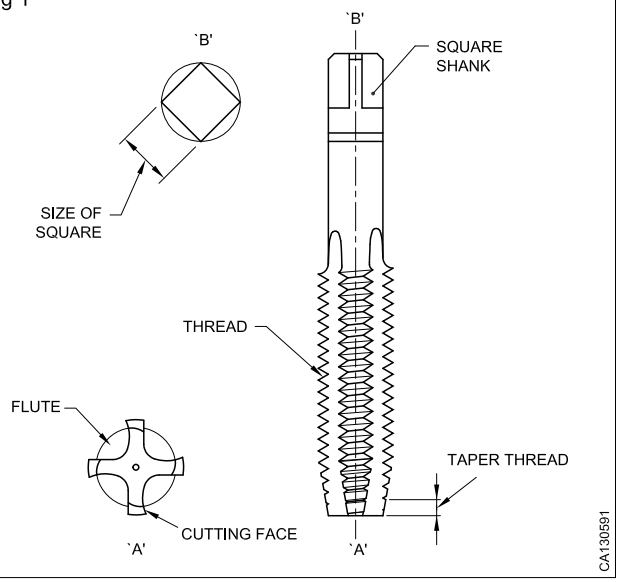
In certain cases, the pitch of the thread will also be marked.

Markings are also made to indicate the type of tap i.e. first, second and plug.

Types of taps in a set

Hand taps for a particular thread are available as a set consisting of three pieces. (Fig 2)

Fig 1



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.

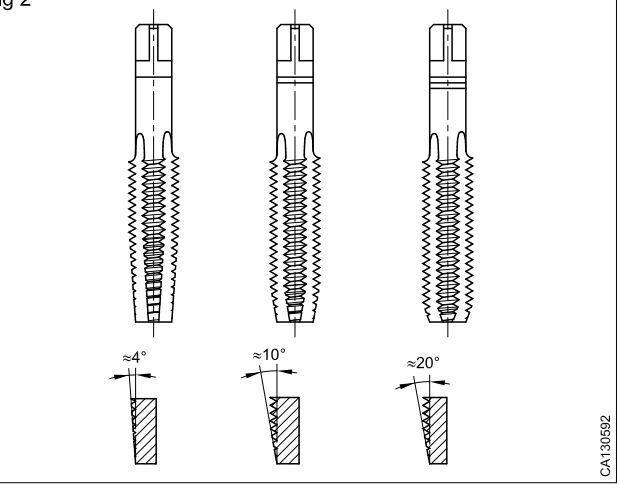
The taper tap is to start the thread. It is possible to form full threads by the taper tap in through holes which are not deep.

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 as 1, 2 and 3 or rings are marked on the shank.

The taper tap has one ring, the intermediate tap has two rings and the bottoming tap has three rings. (Fig 2)

Fig 2



Tap wrenches

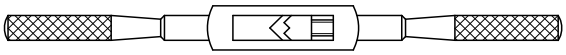
Tap wrenches are used to align and drive the hand taps correctly into the hole to be threaded.

Tap wrenches are of different types.

Double ended adjustable wrench, T-handle tap wrench, solid type tap wrench.

Double-ended adjustable tap wrench or bar type tap wrench (Fig 3)

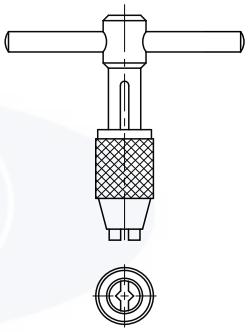
Fig 3



This is the most commonly used type of tap wrench. It is available in various sizes. 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.

T-Handle tap wrench (Fig 4)

Fig 4



These are small adjustable chucks with two jaws and a handle to turn the wrench.

This tap wrench is useful to work in restricted places, and is turned with one hand only.

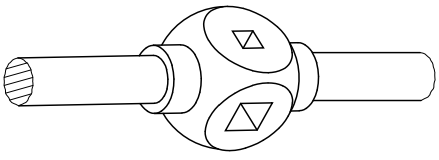
This wrench is not available for holding large diameter taps.

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



Corner braces

Objectives: 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.

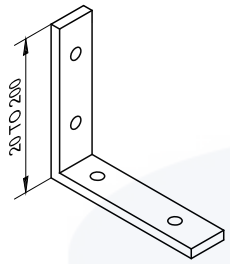
1 Narrow type (Fig 1)

2 Wide type (Fig 2)

The size of the narrow type varies from 20mm to 200mm and made of steel or brass.

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.

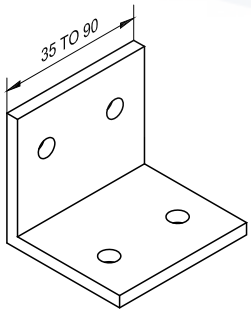
Fig 1



NARROW CORNER BRACE

CA130611

Fig 2



WIDE CORNER BRACE

CA130612

Plates (Fig 3 & 4)

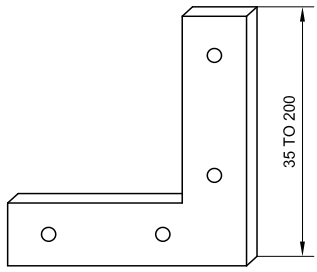
It is available in two types flats such as L-flat or T-flat and are useful in fastening two frames which are at 90°. And also used in large frame corners. In partition screens, racks, benches it is mostly used, and its size varies from 35 to 200. These are available in sizes 60 to 150mm and are made 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)

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.

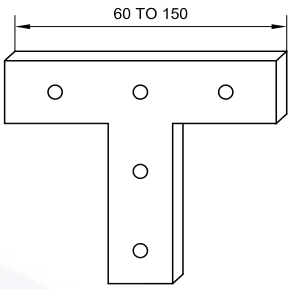
Fig 3



FLAT OR 'L' CORNER

CA130613

Fig 4

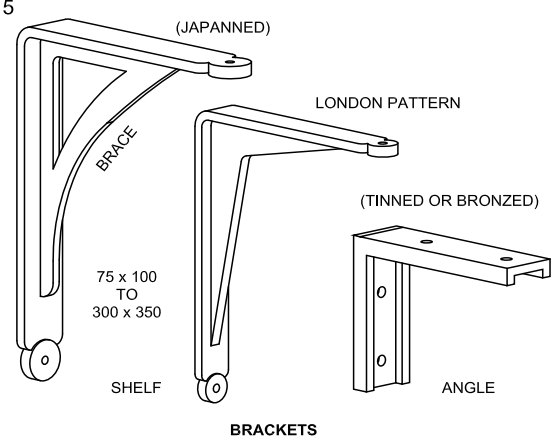


'T' PLATES

CA130614

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.

Fig 5



BRACKETS

CA130615

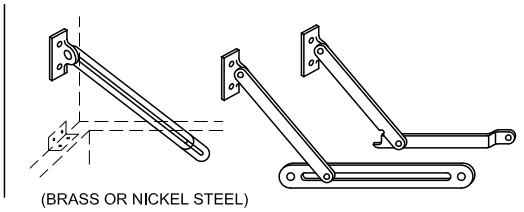
Lid supports (Fig 6)

Lid supports are made of brass or nickel steel. It is hinged to the lid of drums and boxes. Sometimes this may also riveted in the sides of the lids so as to make opening and closing boxes and drums easier. For bigger drum which are kept towards the edges of wall one end is hinged at the walls.

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.

Fig 6



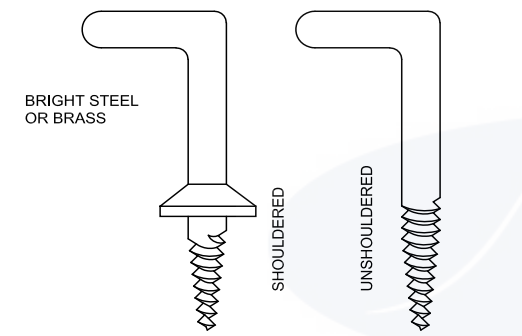
LID SUPPORTS

CA130616

Square hooks (Fig 7)

The square hooks are also available like cup type hooks. 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.

Fig 7



SQUARE HOOKS

CA130617

Table leg supports (Fig 8)

It consists of two flats and one which will be sliding in the slot of other flat. 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.

Fig 8

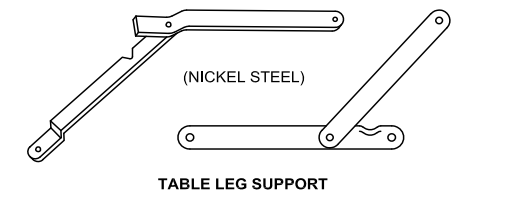


TABLE LEG SUPPORT

CA130618

Screw hooks (Fig 9)

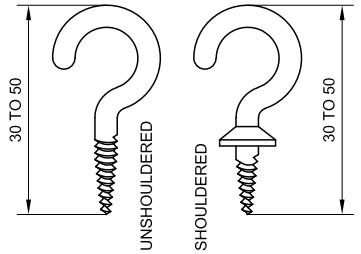
This is of two ore more types such as cup hooks, screw hooks. Cup hooks are of unshouldered and shouldered types. The size of unshouldered varies from 30 to 50mmm and the size of the shouldered is 50mm x 50mm and is made of bright steel or brass.

Screw eye (Fig 10)

It is made of steel or brass. Its size varies from 15 to 35mm.

It is used in fixing wire ropes and screens and for hanging purpose.

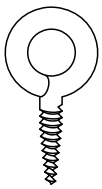
Fig 9



CUP HOOKS

CA130619

Fig 10



SCREW EYE

CA13061A

Rod brackets (Fig 11)

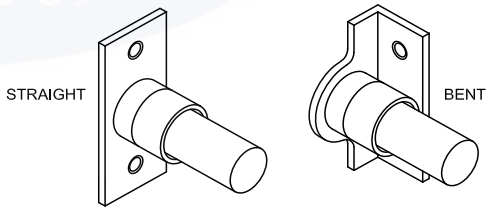
It is of two types

1 Straight type

2 Bend type

Its size varies from 9 to 15mm and it is made of brass , stainless steel and steel. It is used to make towel rail fixed in the brackets on both sides. Large screens are also fixed using these rod brackets.

Fig 11



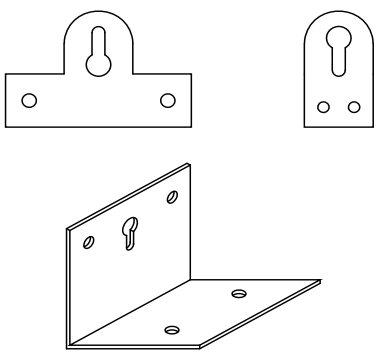
ROD BRACKETS

CA13061B

Hanging plates (Fig 12)

Hanging plates are made of steel, brass, stainless steel and aluminium and are available in various shapes as per the needs of household or in workshops. Used in hanging photo frames, large pictures, and other utilities.

Fig 12



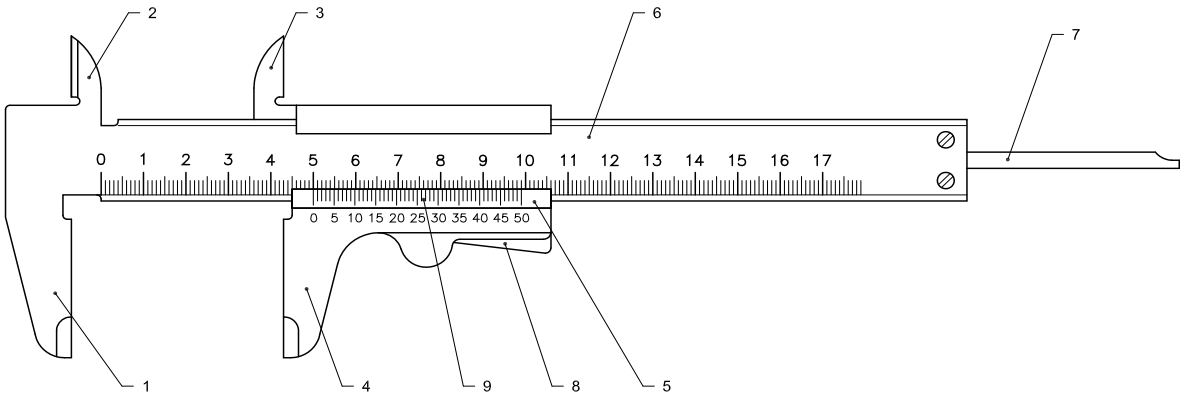
HANGING PLATES

CA13061C

Vernier calipers

Objectives : At the end of this lesson you shall be able to
- **identify the parts of a vernier caliper**
- **state the constructional features of a vernier caliper**
- **state the uses of vernier calipers.**

Fig 1



A vernier caliper is a precision measuring instrument. It is used to measure up to an accuracy of 0.02 mm. (Fig 1)

Parts of a vernier caliper (Numbers as per Fig 1)

Fixed jaws (1 and 2)

Fixed jaws are part of the beam scale. One jaw is used for taking external measurements, and the other for internal measurements.

Movable jaws (3 and 4)

Movable jaws are part of the vernier slide. One jaw is used for external measurements and the other for internal measurements. (Figs 2 and 3)

Fig 2

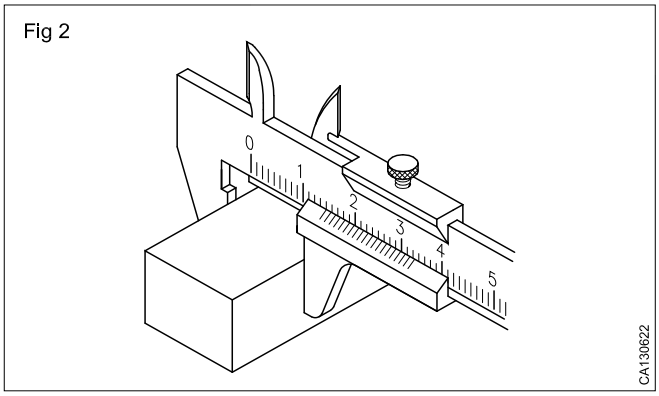
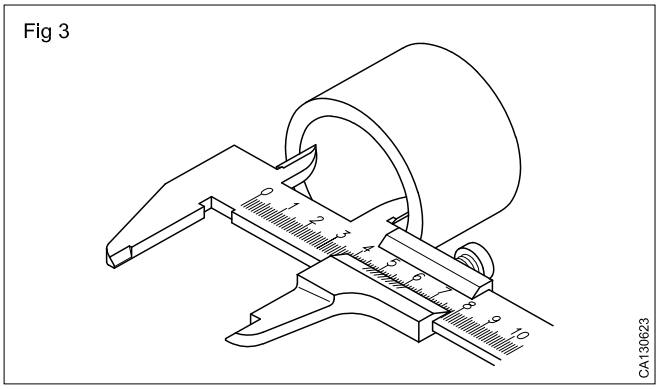


Fig 3



Vernier slide (5)

A vernier slide moves over the beam and can be set in any position by means of a spring-loaded thumb lever.

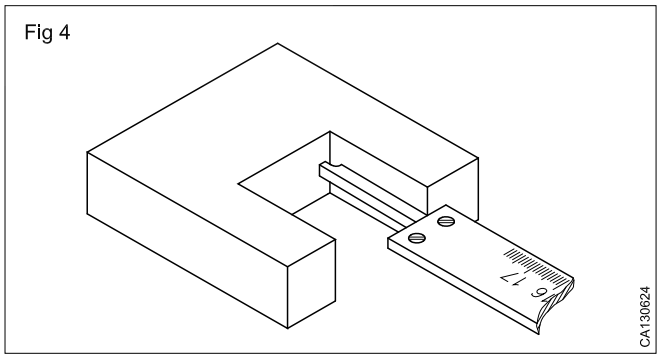
Beam (6)

The vernier slide, and the depth bar attached to it, slide over the beam. The graduations on the beam are called the main scale divisions.

Depth bar (7)

The depth bar is attached to the vernier slide and is used for depth measurements. (Fig 4)

Fig 4



Thumb lever (8)

The thumb lever is a spring- loaded lever which helps to set the vernier slide in any position on the beam scale.

Vernier scale (9)

The vernier scale is the graduation marked on the vernier slide. The divisions of this scale are called vernier divisions.

Main scale (10)

Main scale graduations or divisions are marked on the beam.

SIZES

Vernier calipers are available in sizes of 150 mm, 225 mm, 900 mm and 1200 mm. The selection of the size depends on the measurements to be taken. Vernier calipers are precision instruments, and extreme care should be taken while handling them.

Never use a vernier caliper for any purpose other than measuring.

Vernier calipers should be used only to measure machined or filed surfaces.

They should never be mixed with any other tools.

Clean the instrument after use, and store it in a box.

Graduations and reading of vernier calipers

Objectives: At the end of this lesson you shall be able to
- **determine the least count of vernier calipers**
- **state how graduations are made on vernier calipers with 0.02 mm least count**
- **read vernier caliper measurements.**

Vernier calipers

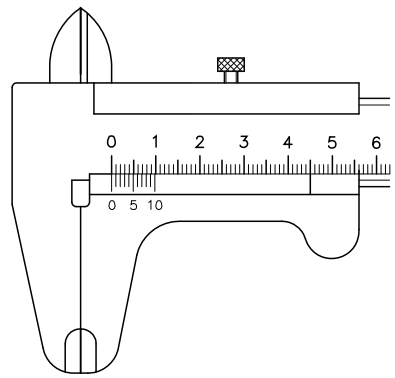
Vernier calipers are available with different accuracies. The selection of the vernier caliper depends on the accuracy needed and the size of the job to be measured.

This accuracy/least count is determined by the graduations of the main scale and vernier scale divisions.

Determining least count of vernier calipers

In the vernier caliper shown in figure 1, the main scale divisions (9mm) are divided into 10 equal parts in the vernier scale.

Fig 1

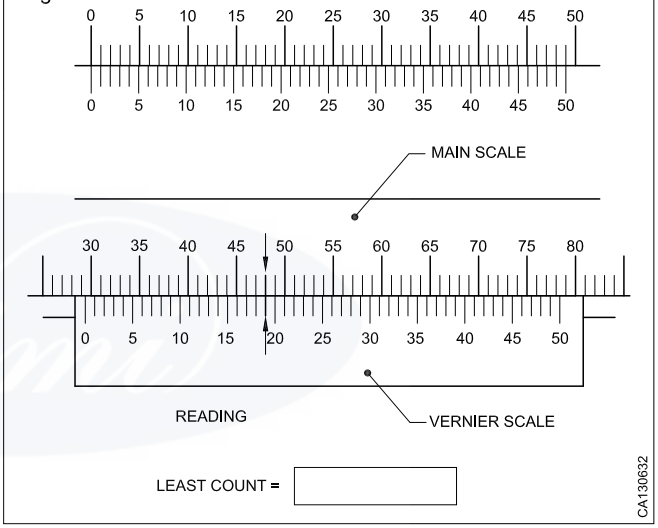


i.e.	One main scale division (MSD)	=	1 mm
	One vernier scale divisionP (VSD)	=	9/10 mm
	Least count is 1 mm - 9/10 mm	=	1/10 mm
	The difference between one MSD and one VSD	=	0.1 mm

Example

Calculate the least count of the vernier given in figure 2.

Fig 2



Reading vernier measurements

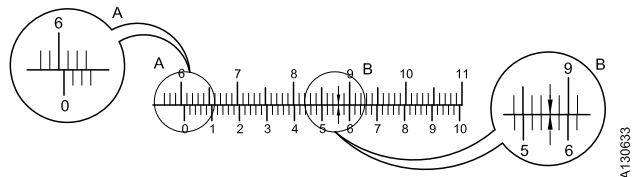
Vernier calipers are available with different graduations and least counts. For reading measurements with a vernier caliper the least count should be determined first. (The least count of calipers is sometimes marked on the vernier slide.)

The figure above shows the graduations of a common type of vernier caliper with a least count of 0.02 mm. In this, 50 divisions of the vernier scale occupy 49 divisions (49 mm) on the main scale.

Example for vernier caliper (Fig 3)

Main scale reading 60 mm.
The vernier division coinciding with the main scale is the 28th division. Value = 28 x 0.02
= 0.56 mm
Reading = 60 + 0.56 = 60.56 mm

Fig 3



CA130633

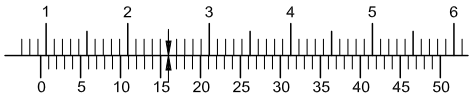
CLASSROOM EXERCISE

In figures 3, 4, 5, 6 and 7, 49 main scale divisions are divided into 50 equal parts on the vernier scale. Value of one M.S.D. is 1mm.

1 Calculate the least count.

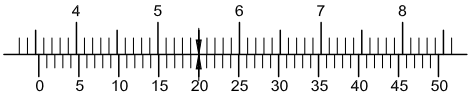
2 Record the reading of each figure in the space provided.

Fig 4



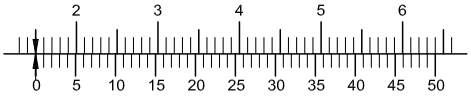
READING

Fig 5



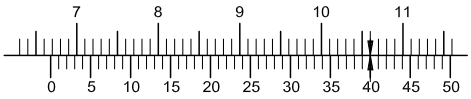
READING

Fig 6



READING

Fig 7



READING

CA130634

— — — — — — — — — —

Work-holding devices

Objectives: At the end of this lesson you shall be able to
- **state the purpose of work-holding devices**
- **name the devices used for holding work**
- **state the precautions to be observed while using work-holding devices.**

Workpieces to be drilled should be properly held or clamped to prevent them from rotating along with the drill. Improperly secured work is not only a danger to the operator but can also cause inaccurate work, and breakage to the drill. Various devices are used to ensure proper holding.

The machine vice

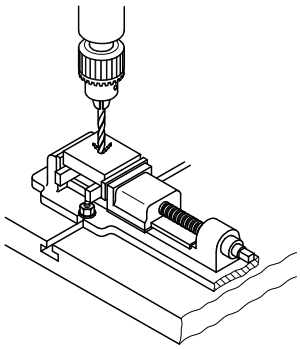
Most of the drilling work can be held in a machine vice. Ensure that the drill does not drill through the vice after it has passed through the work. For this purpose, the work can be lifted up and secured on parallel blocks providing a gap between the work and the bottom of the vice.(Fig 1)

Workpieces which are not accurate may be supported by wooden pieces. (Fig 2)

Clamps and bolts

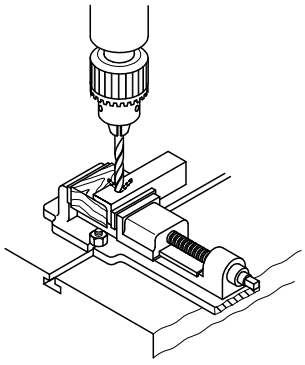
Drilling machine tables are provided with T-slots for fitting bolt heads. Using clamps and bolts, the workpieces can be held very rigidly. (Fig 3) While using this method, the packing should be, as far as possible, of the same height as the work, and the bolt nearer to the work. (Fig 4)

Fig 1



CA130641

Fig 2



CA130642

Fig 3

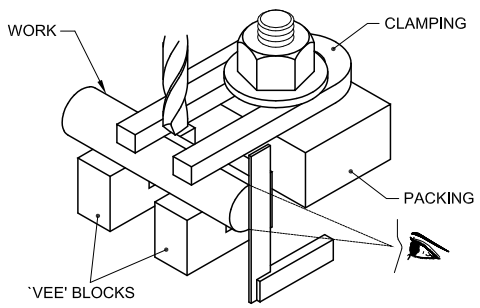
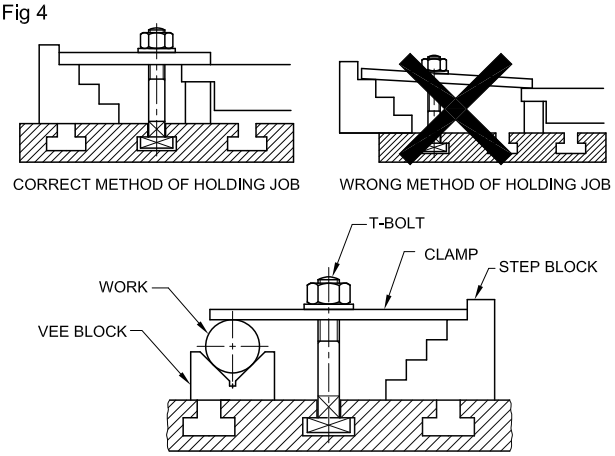


Fig 4



There are many types of clamps and it is necessary to determine the clamping method according to the work. (Figs 5 and 6)

Fig 5

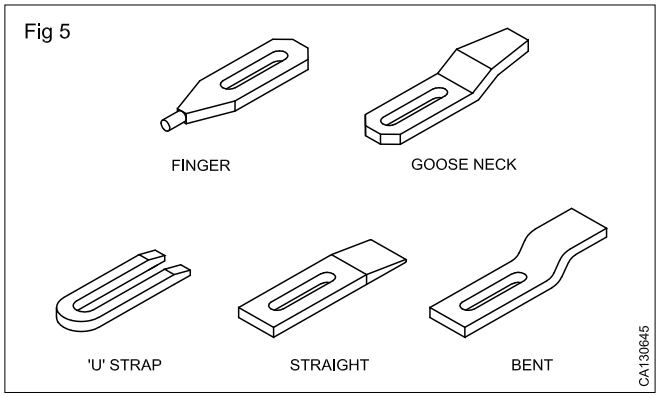
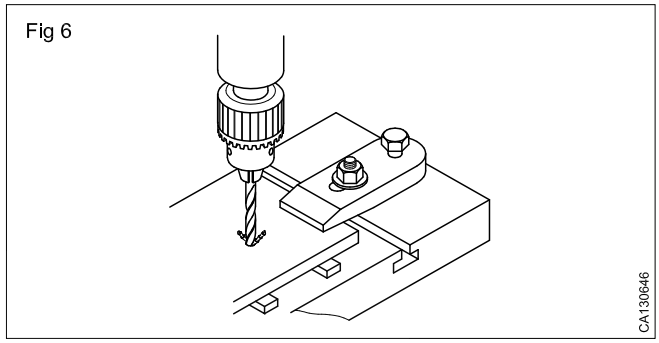


Fig 6



Angle plates

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

- **state the constructional features of different types of angle plates**
- **identify the types of angle plates**
- **state the uses of different types of angle plates**
- **state the grades of angle plates**
- **specify angle plates.**

Constructional features

Angle plates have two plane surfaces, machined perfectly flat and at right angles. Generally these are made of closely grained cast iron or steel. The edges and ends are also machined square. They have ribs on the unmachined part for good rigidity and to prevent distortion.

Types of angle plates

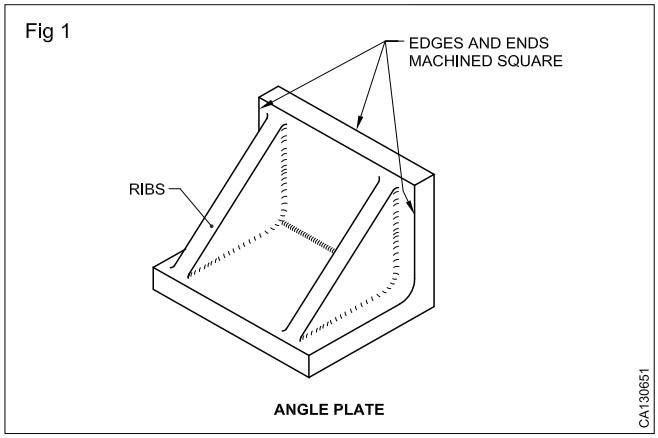
Plain solid angle plates (Fig 1)

Among the three types of angle plates normally used, the plain solid angle plate is the most common. It has the two plane surfaces perfectly machined at 90° to each other. Such angle plates are suitable for supporting workpieces during layout work. They are comparatively smaller in size.

Slotted type angle plates (Fig 2)

The two plane surfaces of this type of angle plate have the slots milled. It is comparatively bigger in size than the plain solid angle plate.

Fig 1



The slots are machined on the top plane surfaces for accommodating clamping bolts. This type of angle plate can be tilted 90° along with the work for marking or machining. (Figs 3 and 4)

Fig 2

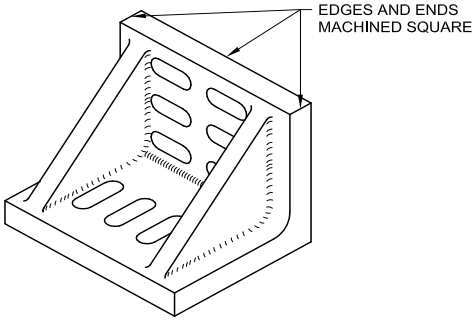


Fig 3

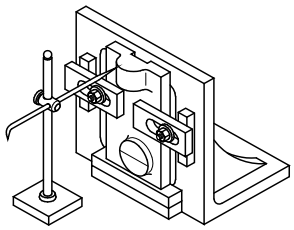
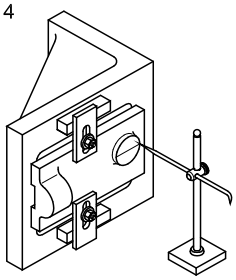


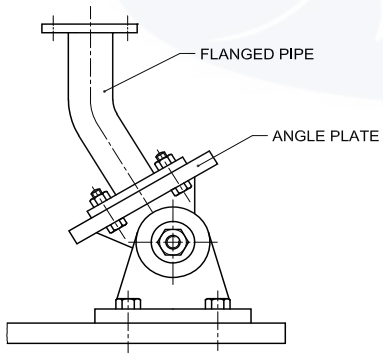
Fig 4



Swivel type angle plate (Fig 5)

This is adjustable so that the two surfaces can be kept at an angle. The two machined surfaces are on two separate pieces which are assembled. Graduations are marked on one to indicate the angle of tilt with respect to the other. When both zeros coincide, the two plane surfaces are at 90° to each other. A bolt and nut are provided for locking in position.

Fig 5



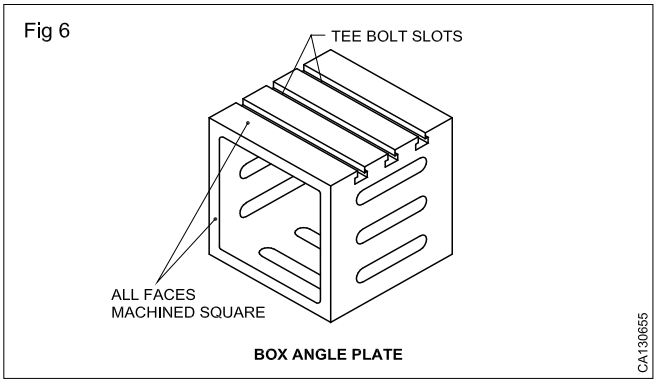
Box angle plates (Fig 6)

They have applications similar to those of other angle plates. After setting, the work can be turned over with the box enabling further marking out or machining. This is a significant advantage. This has all the faces machined square to each other.

Grades

Angle plates are available in two grades - Grade 1 and Grade 2. The Grade 1 angle plates are more accurate and are used for very accurate tool room type of work.

Fig 6



The Grade 2 angle plates are used for general machine shop work. In addition to the above two grades of angle plates, precision angle plates are also available for inspection work.

Sizes

Angle plates are available in different sizes. The sizes are indicated by numbers. Table 1 gives the number of the sizes and the corresponding size proportions of angle plates.

Specification of angle plates

a) Size 6 Grade 1

Box plate will be designated as box angle plate 6 Gr 1 BIS 623.

b) Size 2 - Grade 2 Angle plate will be designated as angle plate 2 Gr 2 B.I.S 623.

Size No.	L	B	H
1	125	75	100
2	175	100	125
3	250	150	175
4	350	200	250
5	450	300	350
6	600	400	450
7	700	420	700
8	600	600	1000
9	1500	900	1500
10	2800	900	2200
Grade 2 only			

Marking off and marking table

Objectives: At the end of this lesson you shall be able to state
- **why marking off is necessary**
- **the function of witness marks**
- **the features of marking tables**
- **the uses of marking tables**
- **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

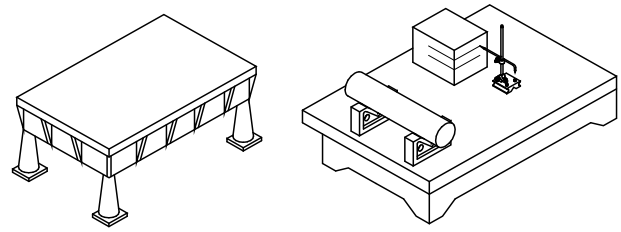
The line marked on metal surfaces is likely to be erased due to handling. To avoid this, permanent marks are made by placing punch marks at convenient intervals along the marked line. Punch marks act as a witness against inaccuracies in machining and hence, they are known as witness marks.

Marking 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 a rigid construction with accurately-finished top surfaces. The edges are also finished at right angles to the top surface.

Fig 1 Fig 2



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.

A marking table is very precise as an 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.

– – – – – – – – – –

Parallel blocks

Objectives: At the end of this lesson you shall be able to
- **name the different types of parallels**
- **state the constructional features of parallel blocks**
- **specify parallel blocks as per BIS recommended practice**
- **state the uses of parallel blocks.**

Parallel blocks of different types are used for setting workpieces for machining. The commonly used ones are of two types.

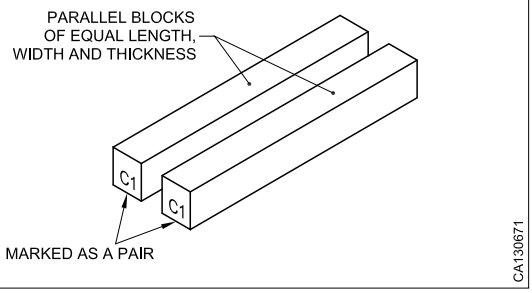
* Solid parallels
* Adjustable parallels

Solid parallels (Solid parallel blocks) (Fig 1)

This is the type of parallel which is very much used in machine shop work. They are made of steel pieces of rectangular cross-section, and are available in different lengths and cross-sectional sizes.

They are hardened and ground, and, sometimes, finished by lapping.

Fig 1



Parallels are machined to close limits, and are perfectly flat, square, and parallel throughout the length. These are made in pairs of identical dimensions.

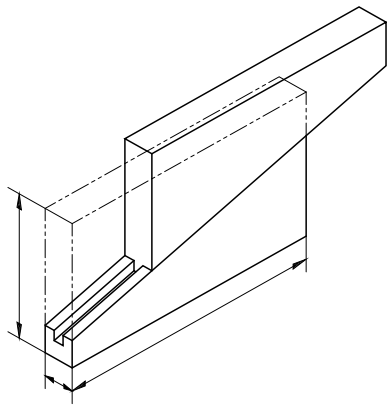
Grades

Parallels are made in two grades - Grade A and Grade B. Grade A is meant for fine tool-room type of work, and Grade B for general machine shop work.

Adjustable parallels (Fig 2)

These consist of two tapered blocks sliding one over the other in a tongue and groove assembly. These types of parallels can be adjusted and set to different heights.

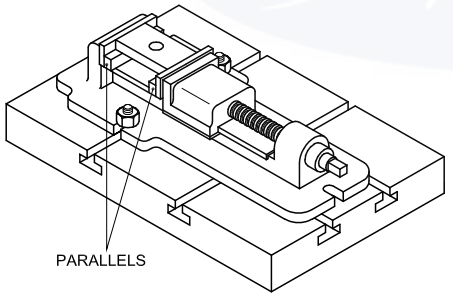
Fig 2



Uses

Solid and adjustable parallels are used for parallel setting of workpieces while machining. They are also useful for raising the workpieces held in vices or machine tables to provide better observation of the machining process. (Fig 3)

Fig 3



Parallels are made in pairs and should be used in matching pairs to ensure accuracy in the set-up.

Sizes of parallels

These are given in Table 1.

Fig 4

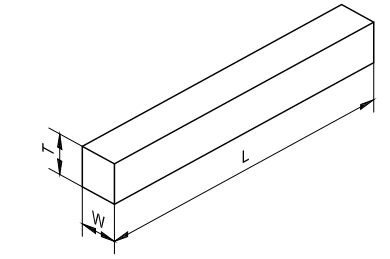


TABLE 1

Sizes of solid parallels

GRADE	SIZE T.W.L.
A & B	5 x 10 x 100
A & B	10 x 20 x 150
A & B	15 x 25 x 150
A & B	20 x 35 x 200
A & B	25 x 45 x 250
A & B	30 x 60 x 250
A & B	35 x 70 x 300
B	40 x 80 x 350
B	50 x 100 x 400

Designation of parallels

The parallels are designated by the type, grade (for solid parallels only) size, and the number of the standard.

Examples

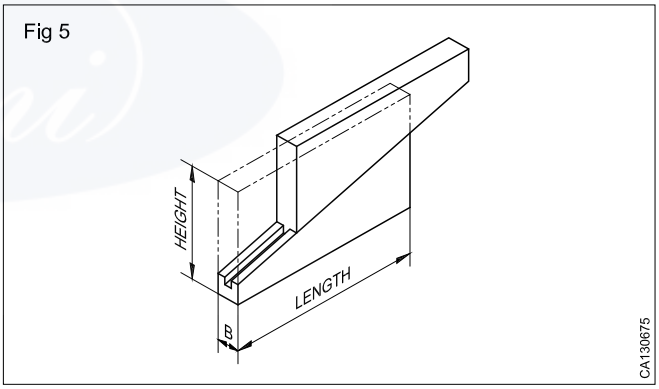
Solid parallel A5 x 10 x 100 IS: 4241

Adjustable parallel 10 x 13 IS:4241

TABLE 2

Range and size of adjustable parallels

Fig 5



HEIGHT RANGE	LENGTH
10 - 13	40
13 - 16	50
16 - 20	60
20 - 25	65
25 - 30	70
30 - 40	85
40 - 50	100

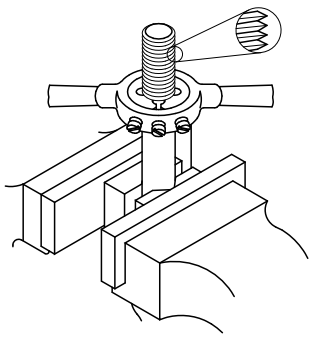
Die and Die stock

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 use 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 workpieces. (Fig 1)

Fig 1



CA130711

Types of dies

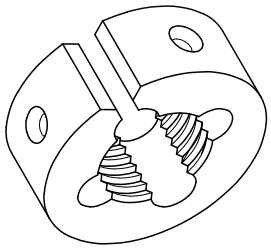
The following are the different types of dies.

* 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.

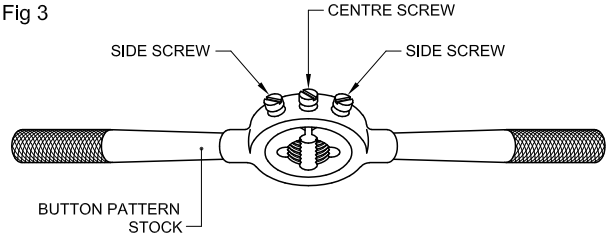
Fig 2



CA130712

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



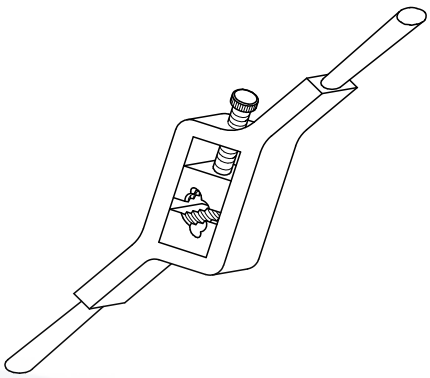
CA130713

For adjusting the depth of the cut, the centre screw is advanced and locked in the groove. This type of die stock is called button pattern stock.

Half die (Fig 4)

Half dies are stronger in construction.

Fig 4



CA130714

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.

When the guide plate is tightened after placing the die pieces in the collar, the die pieces are correctly located and rigidly held.

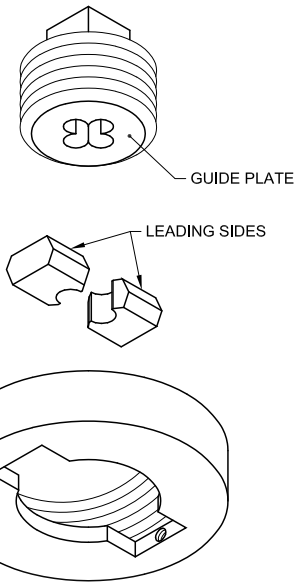
The die pieces can be adjusted, using the adjusting screws on the collar.

This type of die stock is called quick cut stock. (Fig 6)

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.

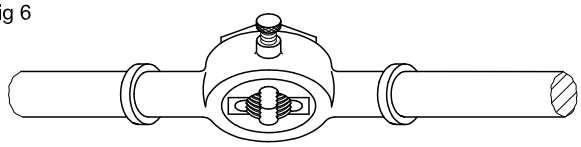
Both pieces should have the same serial numbers.

Fig 5



QUICK CUT STOCK

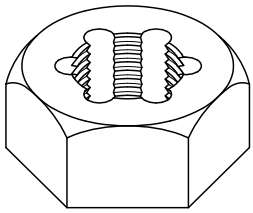
Fig 6



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.

Die nuts are available for different standards and sizes of threads.

The die nut is turned with a spanner.

Blank size for external threading

Objectives: At the end of this lesson you shall be able to
- **determine the diameter of blank for external thread cutting.**

Why should the blank size be less?

It has been observed from practice that the threaded diameters of steel blanks, show a slight increase in diameter. Such increase in diameter will make the assembly of external and internal threaded components very difficult. To overcome this, the diameter of the blank is slightly reduced before commencing the threading.

What should be the blank size?

The diameter of the blank should be less by 1/10th of the pitch of the thread.

Example

For cutting a thread of M12 with 1.75 mm pitch the diameter of the blank is 11.80.

Formula, D = d - p/10
= 12 mm - 0.175 mm
= 11.825 or 11.8 mm
d = diameter of bolt
D = the blank diameter
p = pitch of thread

Calculate the blank size for preparing a bolt of M16 x 1.5.

Answer

_____

_____

_____

Timber

Objectives: At the end of this lesson you shall be able to
- **describe the classification of timber**
- **describe the uses of timber**
- **explain the various Defects in Timber.**

- Timber is also a building materials.
- Timber also thus denotes as wood which is suitable for building and other various purposes.
- Timber is used in the manufacture of various products such as organic acids, paper, cardboard, resin cellulose etc.

Classification of Trees

Mainly trees are divided into two classifications.

- Exogeneous
- Endogeneous

Exogeneous

- These trees increase in bulk and growing outwards.
- In these trees rings are formed horizontally in section.
- These rings are called annual rings.
- In this type of trees are again divided into two ways.
- Conifers
- Deciduous

Conifers trees

- The conifers trees always ever-green leaves of these trees do not fall, till new eves are grown.
- Deciduous trees
- The deciduous trees are the broad leaves.
- These leaves fall in Autumn and new leaves appear in spring season.
- It is hard wood close grains strong, heavy weight and dark coloured.
- Endogeneous
- Endogeneous trees grow longitudinal in section.
- These trees used limited in construction fields.
- The examples of endogeneous trees are bamboo, palm casuarina etc
- In connection with the timber the following terms are to be noted.
- Standing Timber
- Rough Timber
- Converted Timber

Standing Timber

- This shows timber contained in a living trees.

Rough timber

- This timber indicates which is obtained after felling a tree

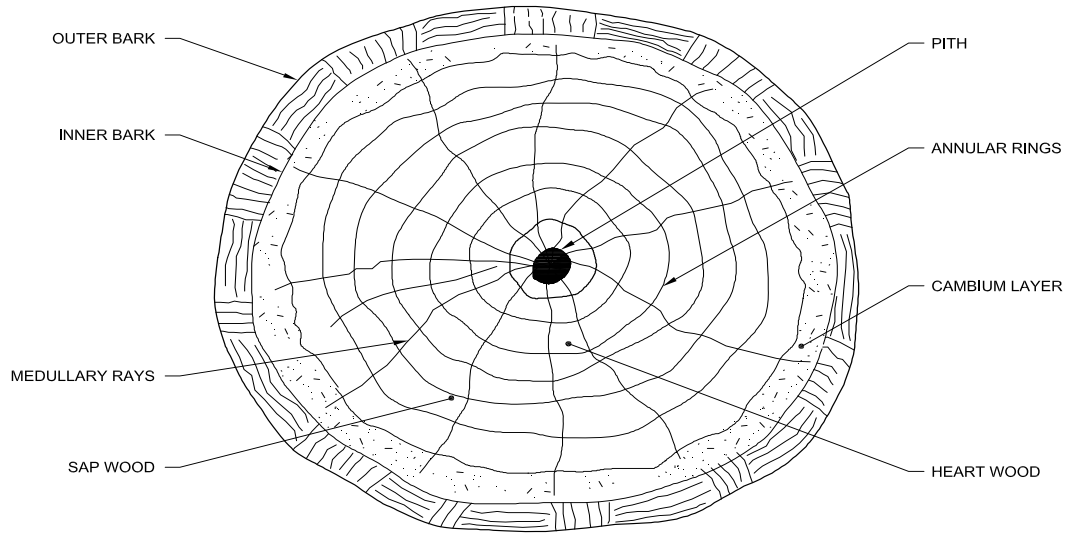
Converted Timber

- This type of timber which is sawn and cut into suitable required sizes.

Structure

- A tree basically consists of three parts, namely Trunk, crown and roots
- The function of trunk is to support the crown and to supply water and nutrients from the roots to the leaves through branches. and back to leaves.
- The cross section of an exogeneous tree as shown in (Fig 1).

Fig 1

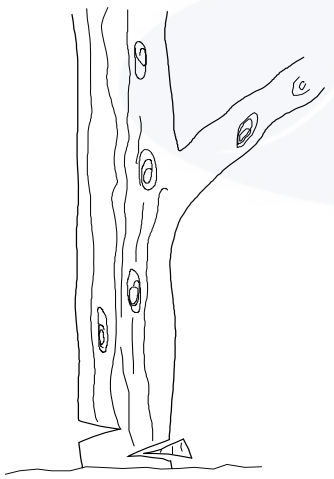


CROSS SECTION OF AN EXOGENEOUS TREE

Method of cutting and felling

- The tree should be cut from a place a little above its roots and very near to the ground level.
- Cut is made at the lowest portion of the trunk
- Cuts are made in opposite direction as shown in (Fig 2).

Fig 2



TREE FELLING

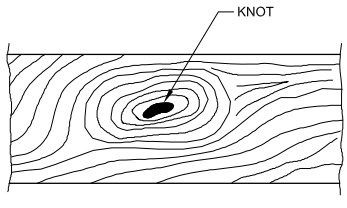
Defects in Timber

The timber causing defects mainly by abnormal growth and rupture of tissues.

Knots

The broken or cut off from the tree The portion from which has the branch is removed. Finally it results in the formation of dark hard rings are called knots. (Fig 3)

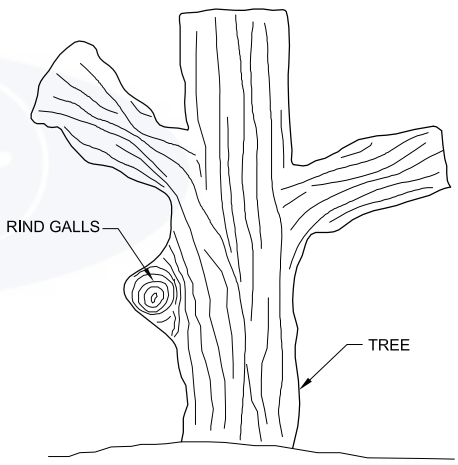
Fig 3



Rind galls

The rind means bark and gall means abnormal growth. A curved swelling found on the body of a tree are known as the Rind galls as shown in (Fig 4).

Fig 4



RIND GALLS

Shakes

These are the cracks which partly or completely separate the fibres of wood

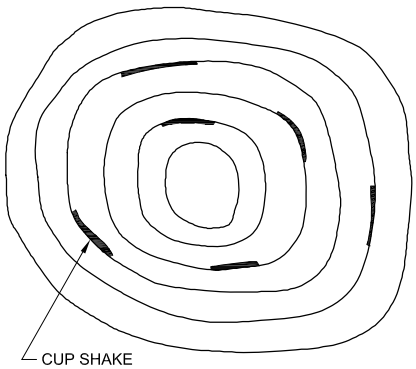
The following are the different types of shakes

- Cup shakes.
- Heart shakes
- Ring shakes
- Star shakes
- Radial shakes
- Wind cracks
- Twisted fibres
- Upset

Cup shakes

- These are caused by the rupture of tissue in a circular direction.
- It is curved crakes
- It develops due to non uniform growth. as shown in (Fig 5).

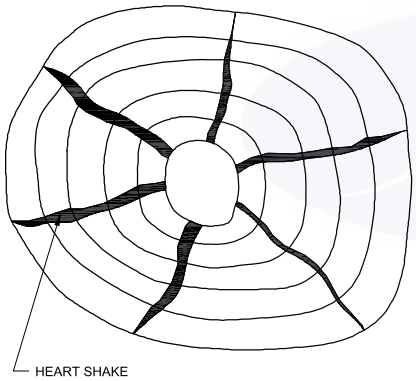
Fig 5



Heart shakes

These cracks occur in the centre of cross section of the tree and they extend from pith to sap wood in direction medullary rays as shown in (Fig 6).

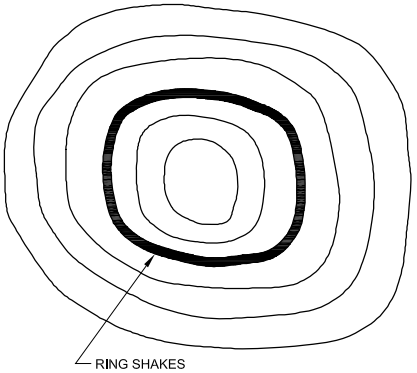
Fig 6



Ring shakes

- When cup shakes cover the entire ring
- They are known as the ring shakes as shown in (Fig 7)

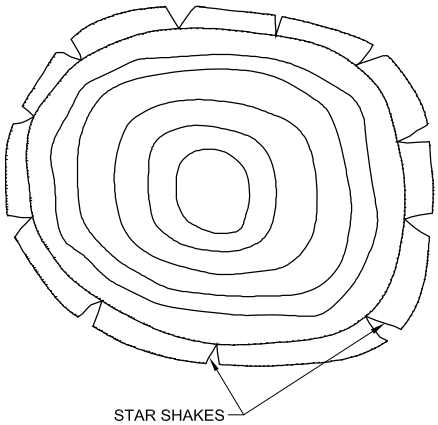
Fig 7



Star shakes

- These are crakes from bark towards the sap wood.
- The crackes form wider on the outer side endes
- and narrower on the inside ends.
- They are usually formed due to high heat or severe cold during the growth of the tree as shown in (Fig 8).

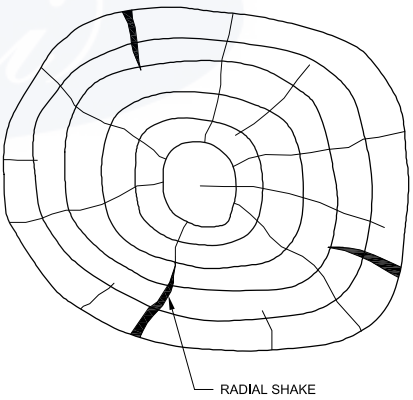
Fig 8



Radial shakes

- These are also similar to star shakes
- This is accur, tree is exposed to sun.
- They run for a short distance from bark towards the centre, finally run towards pifth. as shown in (Fig 9).

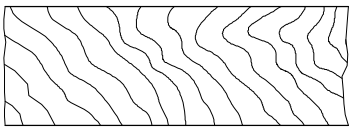
Fig 9



Twisted fibres

- This twisted fibres caused by twisting of young trees by fast blowing wind.
- The fibres of wood are twisted in one direction.
- The timber with twisted fibres is unsuitable for sawing. as shown in (Fig 10).

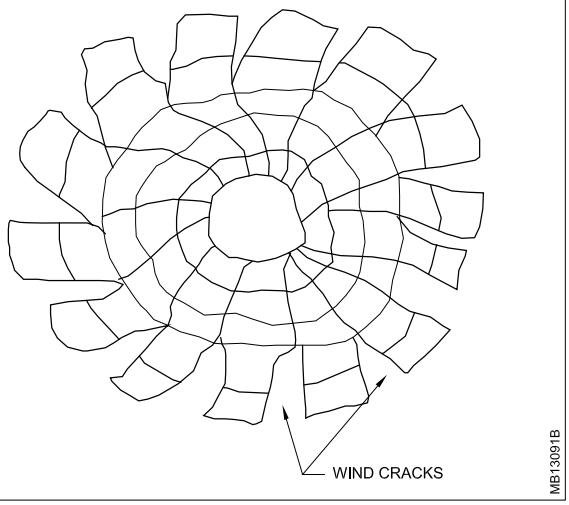
Fig 10



Wind cracks

The timber is exposed to atmospheric agencies it s exterior surface shrinks such as shrinkage results into cracks are called as the wind cracks as shown in (Fig 11).

Fig 11



Good qualities of Timber

- The colour of timber should prefarbly be dark.
- The light colour usually indicates timber with low strength
- A good timber should be free from defects such as knots, shakes etc
- A good timber should be durable
- A good timber should have straight fibres
- A good timber should be hard.
- A good timber should give out clear ringing sound
- A good timber should be strong for working as structural member such as joist, beam, rafter etc.

Uses of Timber

- It is used for door and window frames
- Shutters for doors and windows roofing materials etc.
- Timber is used for formwork of cement concrete
- It is used for centering of an arch and scaffolding
- It is used for making furniture
- It is used for making railway wagens and railway sleepers
- Timber is used for making wood carving and packing cases etc.
- Timber is used for temporary bridges and boat construction.

Plywood (Fig.12)

The meaning of term ply is a thin layer

The plywood are boards which are prepared from thin layers of wood or veneers.

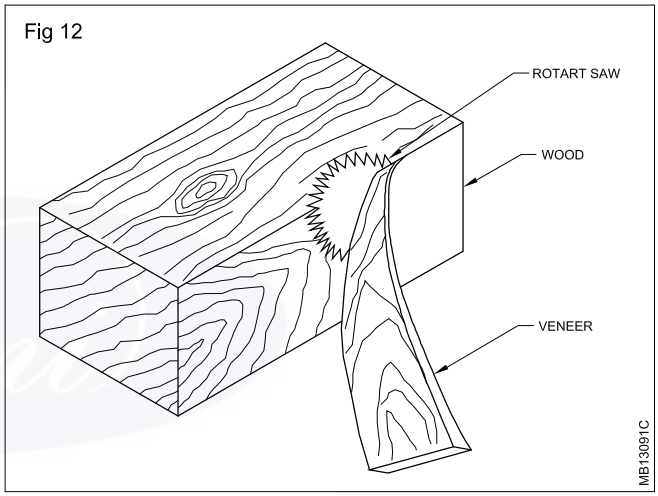
Uses of plywood

The plywoods are used for various purposes as follows

Plywood are used for ceilings, doors, furnitures, partitions panelling walls, packing cases etc.

Light in weight

Fig 12



Advantages of plywoods

- The expansion and shrinkage are comparatively very low.
- Because of piles are placed at right angles to each other.
- They are available in avariety of decorative appearance
- Plywoods are not easily affected by moisture
- They posses uniform tensile strength in all directions.

Door Frame

Objectives: At the end of this lesson you shall be able to
- **state the constructional details of door and door shutters**
- **state the technical terms used in door and door shutter construction**
- **state the types and uses of door shutters.**

- 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 x 2000	790 x 1990
2	8 DS 21	800 x 2100	790 x 2090
3	9 DS 20	900 x 2000	890 x 1990
4	9 DS 21	900 x 2100	890 x 2090
5	10 DS 20	1000 x 2000	990 x 1990
6	10 DT 21	1000 x 2100	990 x 2090
7	12 DT 20	1200 x 2000	1190 x 1990
8	12 DT 21	1200 x 2100	1190 x 2090

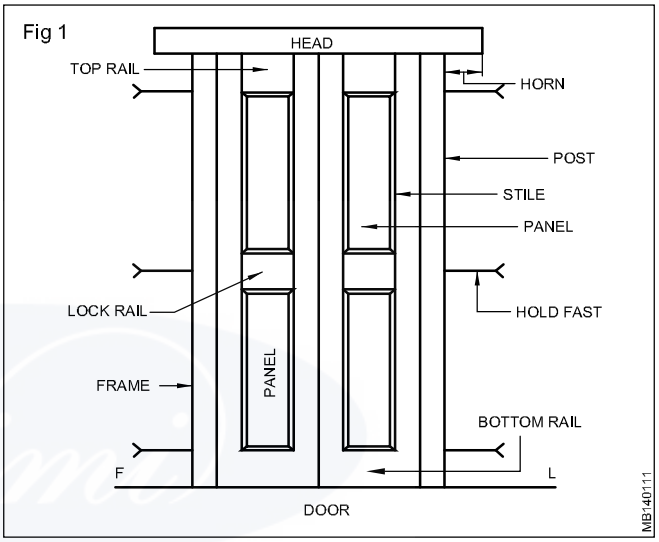
- A door may be defined as an openable barrier secured in an opening left in a wall for the purpose of providing access to the users of the structure.
- A door consist of two main parts called the frame and the shutter.
- The door shutter is held in position by the door frame which in turn is fixed in 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 shutter. (Fig.1)



The definition of technical terms used in connection with doors and windows are as follows.

Frame

A frame consists of horizontal and vertical members forming as an enclosure to which the shutters are fixed.

Stile

The out side 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

The lower most or bottom horizontal of window frame is called the sill (generally sills are not provided in door frame).

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.

A rail fixed between the top rail and lock rail is called Frieze rail

Shutter

The openable part of the door or window. This is the entire assembly of styles, 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.

Sash

This is a special type of frame to carry glass. A sash consist of two vertical styles 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.

Types of door

- Ledged door
- Ledged and Braced door
- Ledged and framed door
- Ledged, framed and braced door
- Framed and panelled door
- Glazed or sash door
- Louvered door
- Flush door

Ledged door (Fig 2)

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.

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 3)

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.

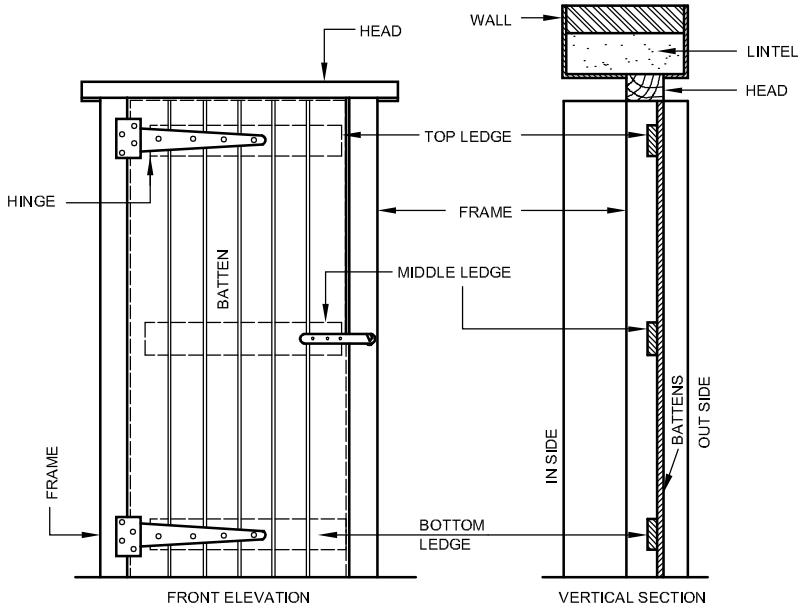
It is important that the braces must slope upwards from the hanging side, as they have to work in compression and not in tension.

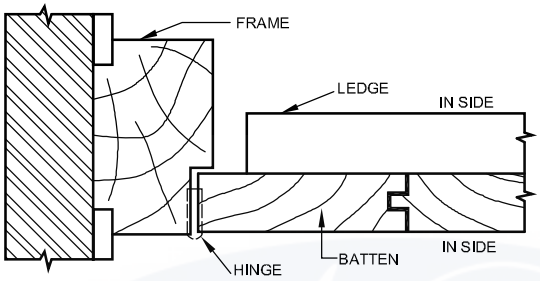
Ledged and framed door (Fig 4)

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 “STYLES” to make the door stronger and good in appearance.

Fig 2

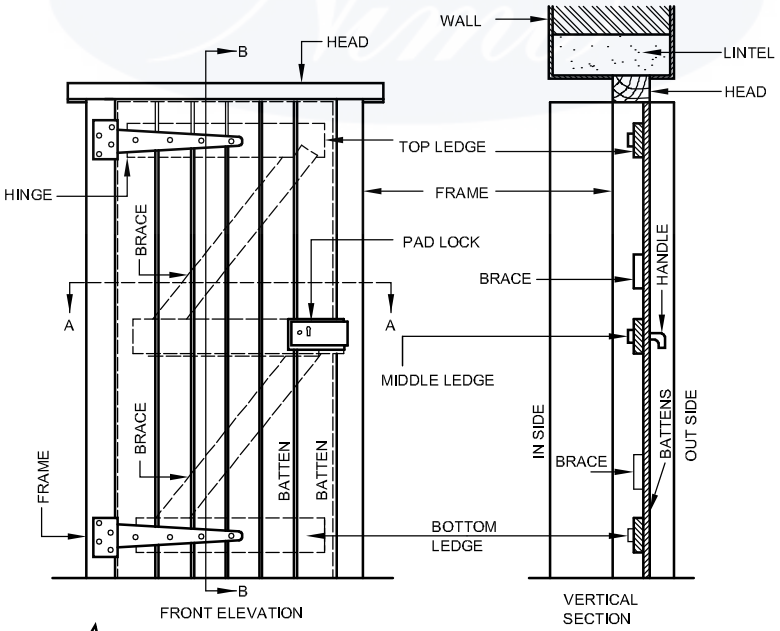


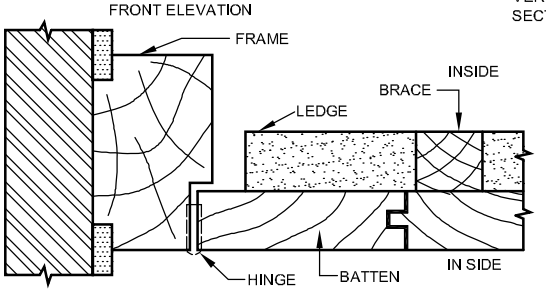


LEDGED DOOR

MB140112

Fig 3

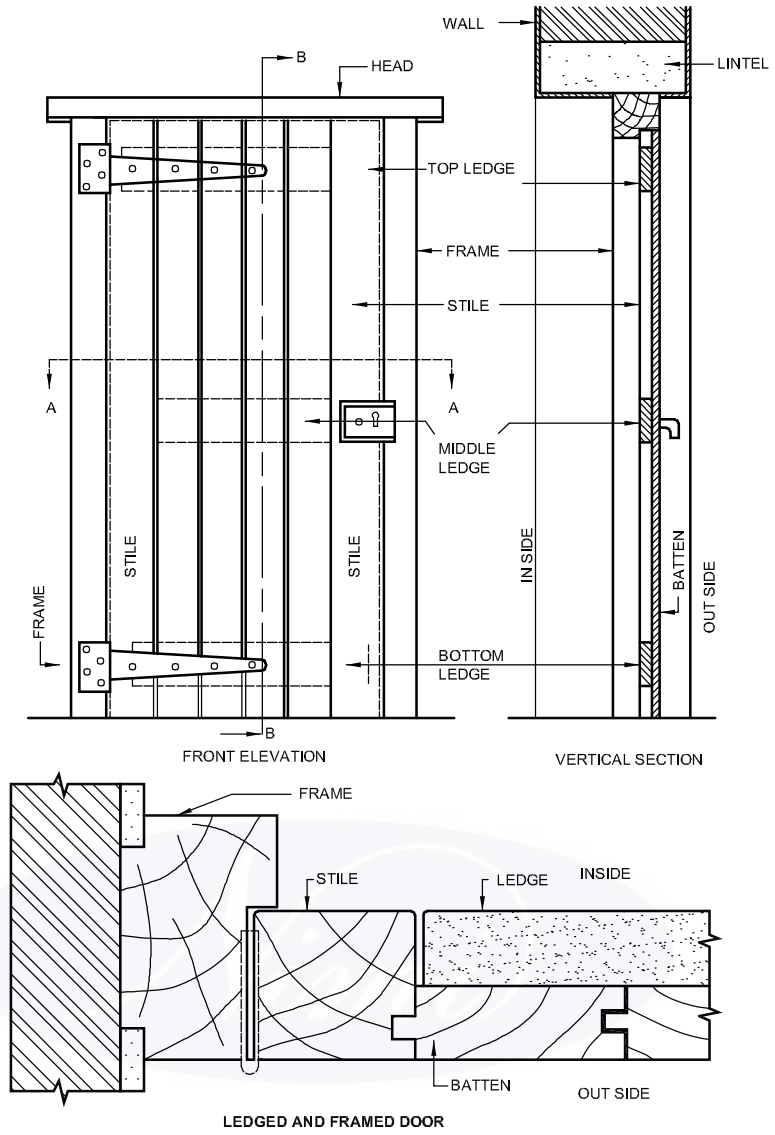




LEDGED AND BRACED DOOR

MB140113

Fig 4



- The stiles are generally 10 cm wide and 4 cm thick.
- The battens and three ledges are provided as usual.
- The thickness of styles are equal to the thickness of ledges and the thickness of battens.

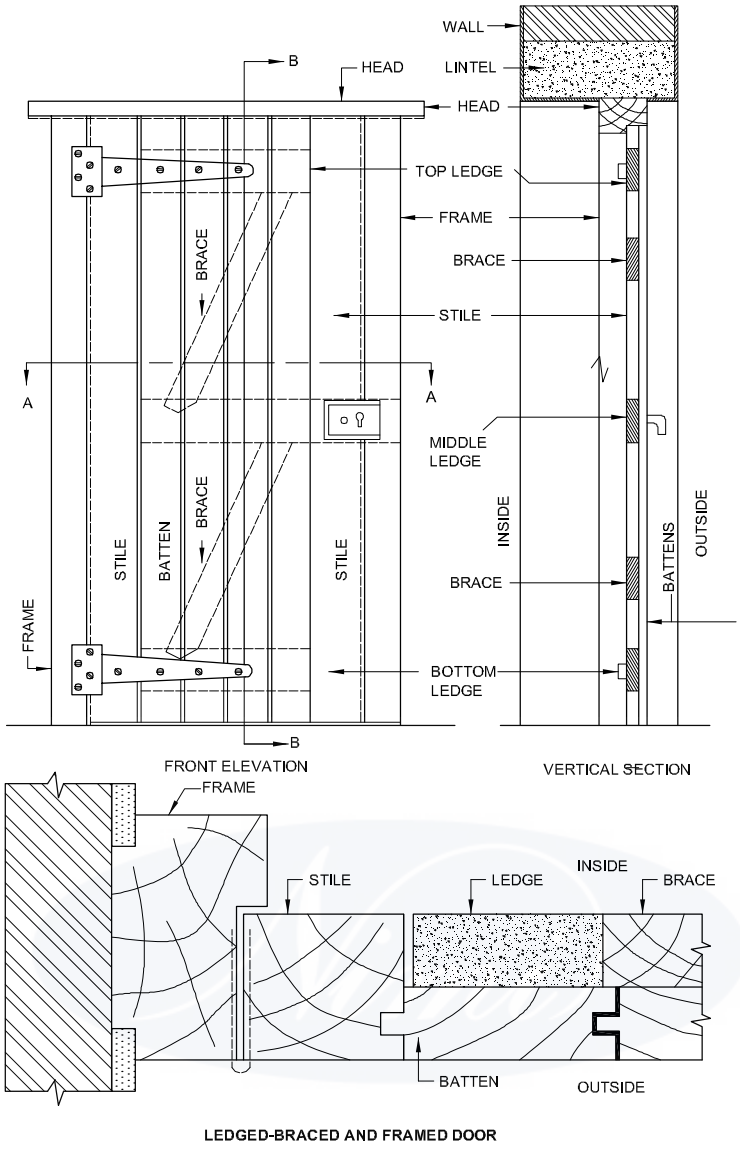
Ledged, braced and framed door (Fig 5)

- 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 styles, 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 styles of the door.

Framed and panelled door (Fig 6 & 7)

- This is the common type of door used in all kinds of buildings.
- This door consists of a frame work with vertical members called "STYLES" and the horizontal members called "RAILS".
- The styles 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"

Fig 5



LEDGED-BRACED AND FRAMED DOOR

- The styles 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 styles 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.

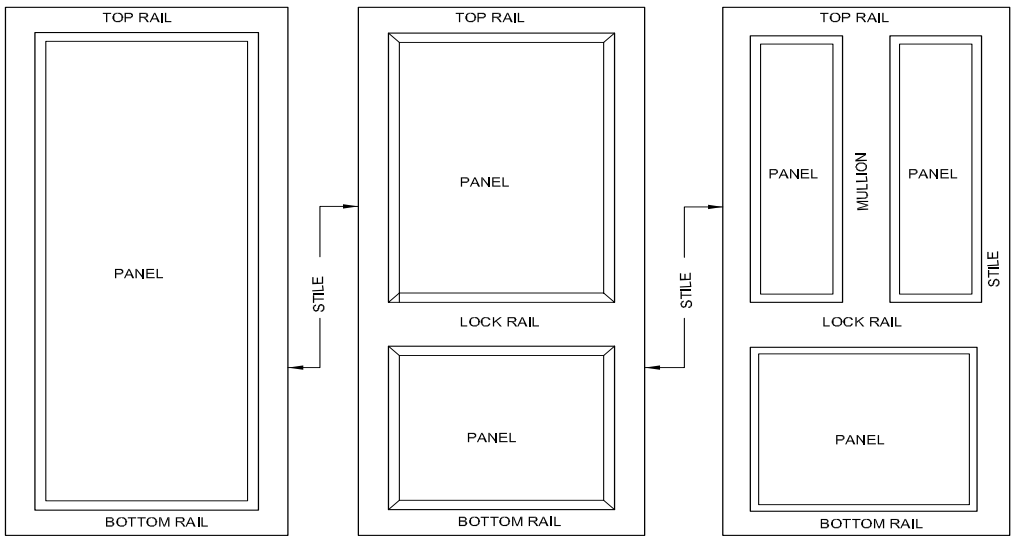
Glazed or sash door (Fig 8 a,b,c)

- 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 (Fig 9 & 10)

- The flush door consists of a frame work of stiles, rails and it is covered with plywood.

Fig 6

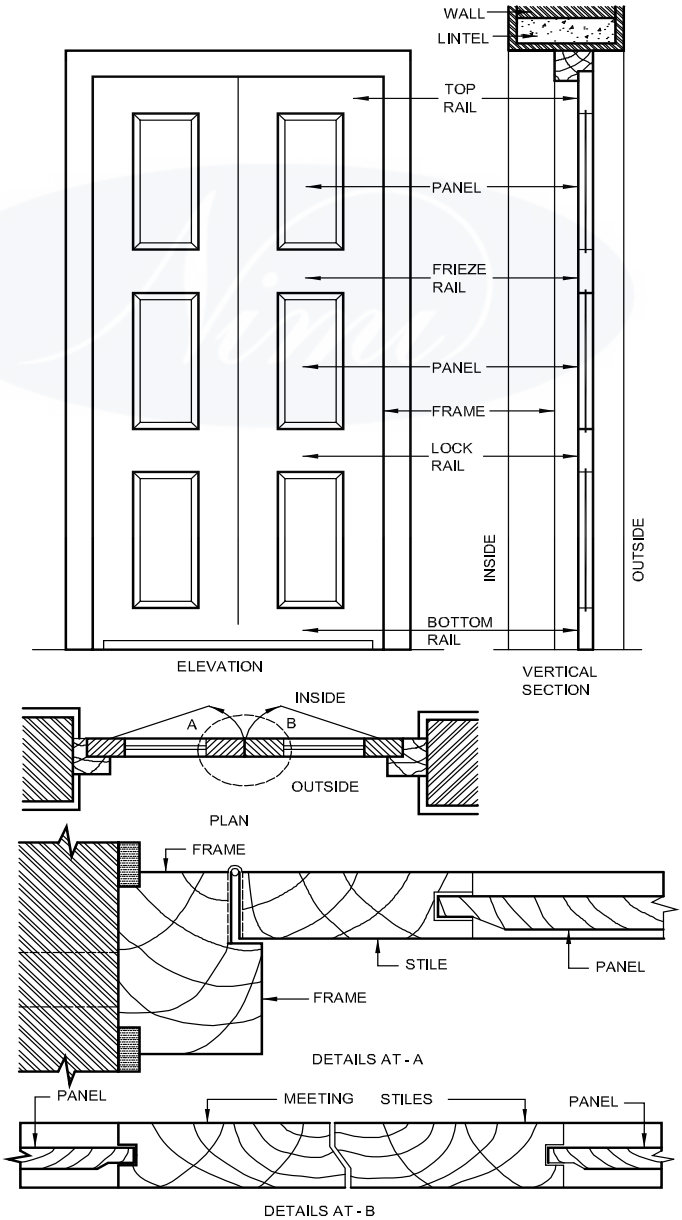


SINGAL PANEL DOOR | DOOR WITH TWO PANELS | DOOR WITH THREE PANELS

FRAMED AND PANELLED DOOR

MB140116

Fig 7



DOUBLE-LEAFED DOOR WITH SIX PANELS

MB140117

- The framed flush door consists of stiles, top rail, lock rail, bottom rail, horizontal ribs vertical ribs and ply-wood.
- 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.
- 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.

Louvered doors (Fig 11)

- In this types of doors the shutters are provided with Louvers.
- The doors may be louvered either to its full length or partially or partially with panelled.

Fig 8

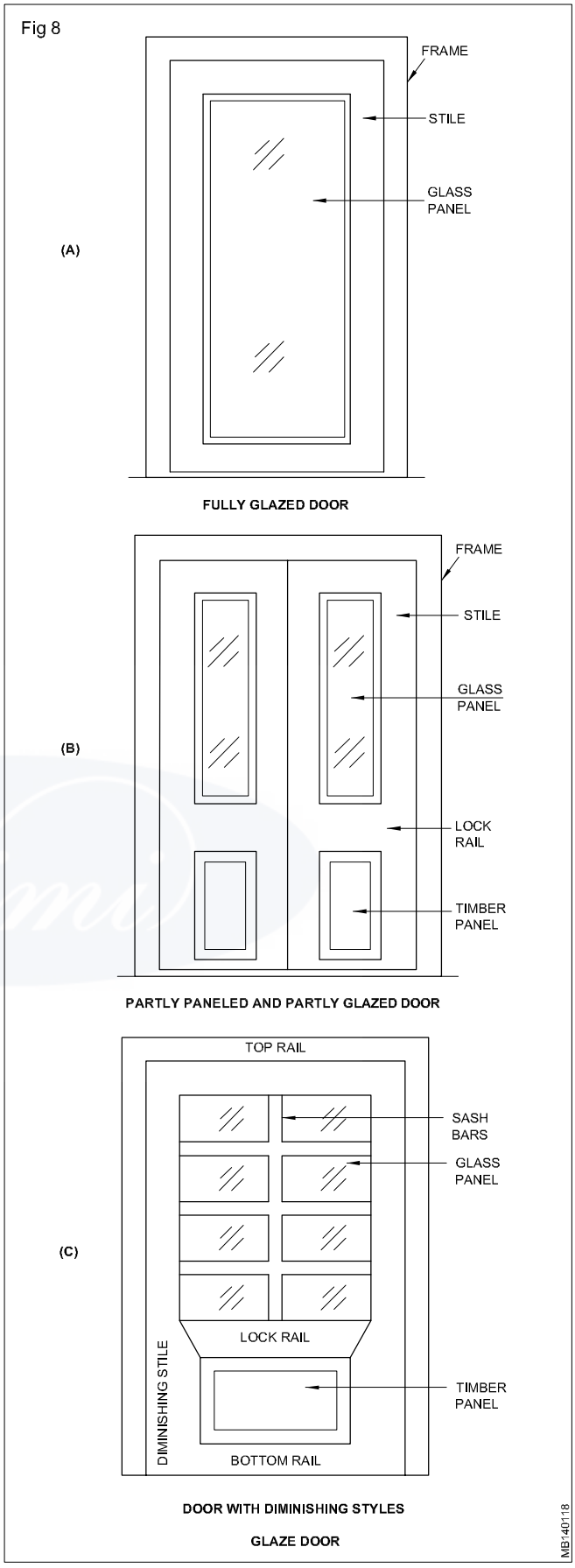


Fig 9

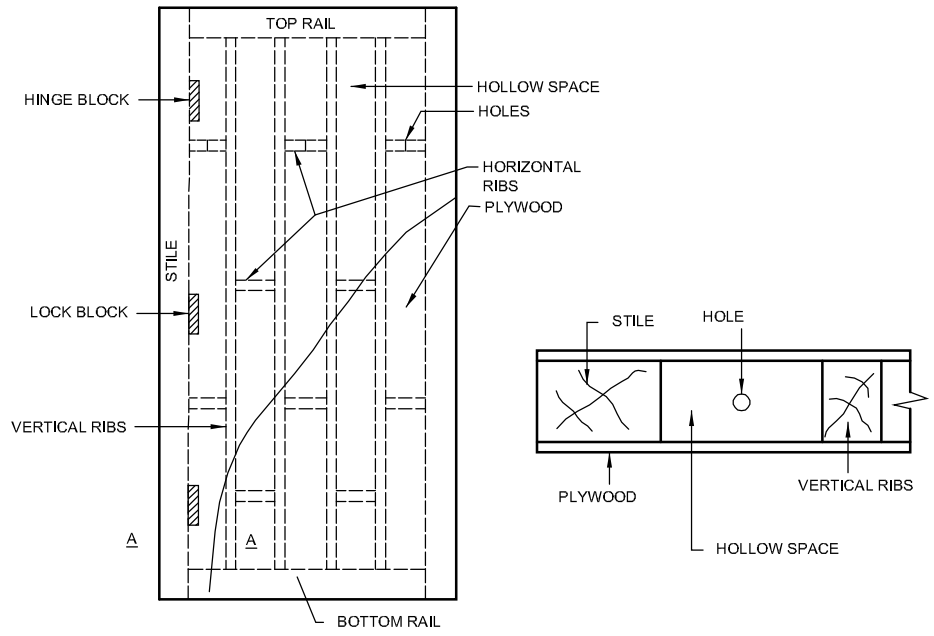
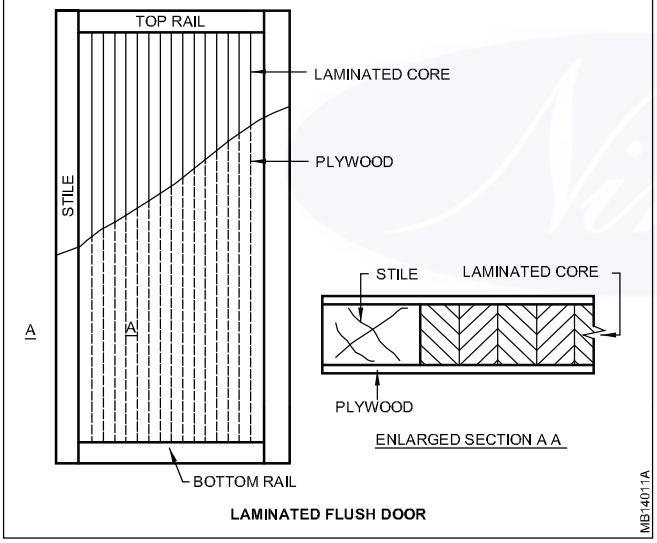
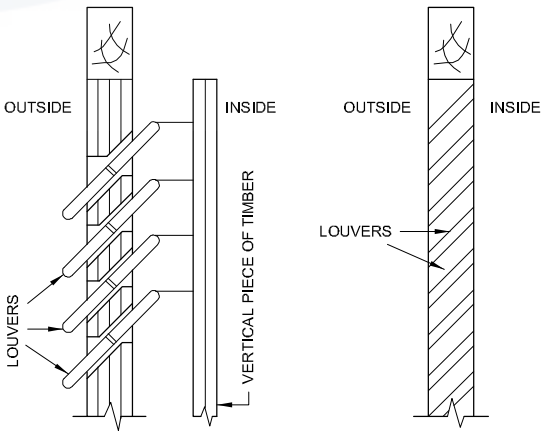


Fig 10



- 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.
- 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.

Fig 11

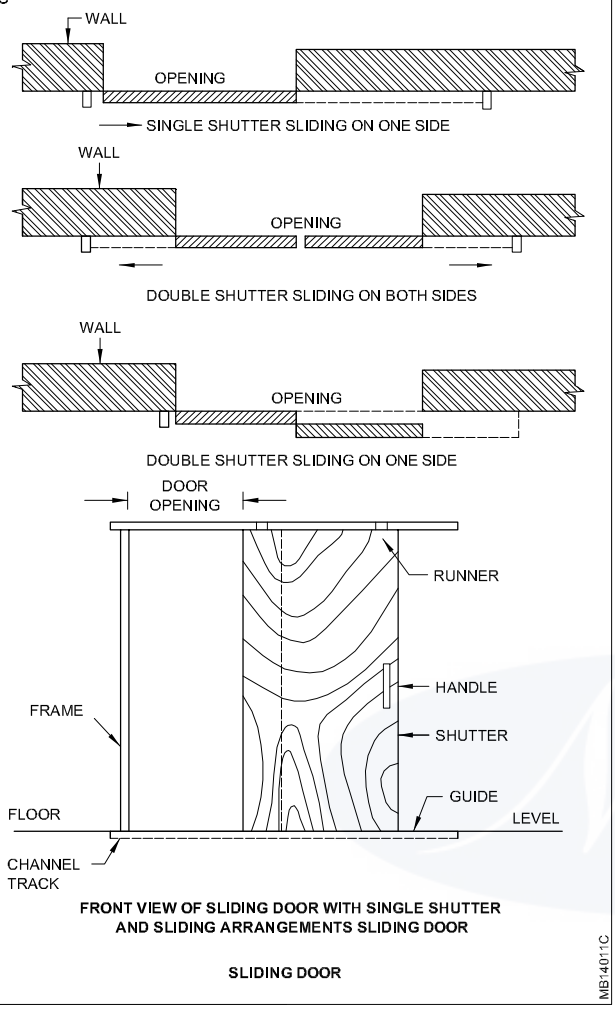


Sliding doors (Fig 12)

- 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.

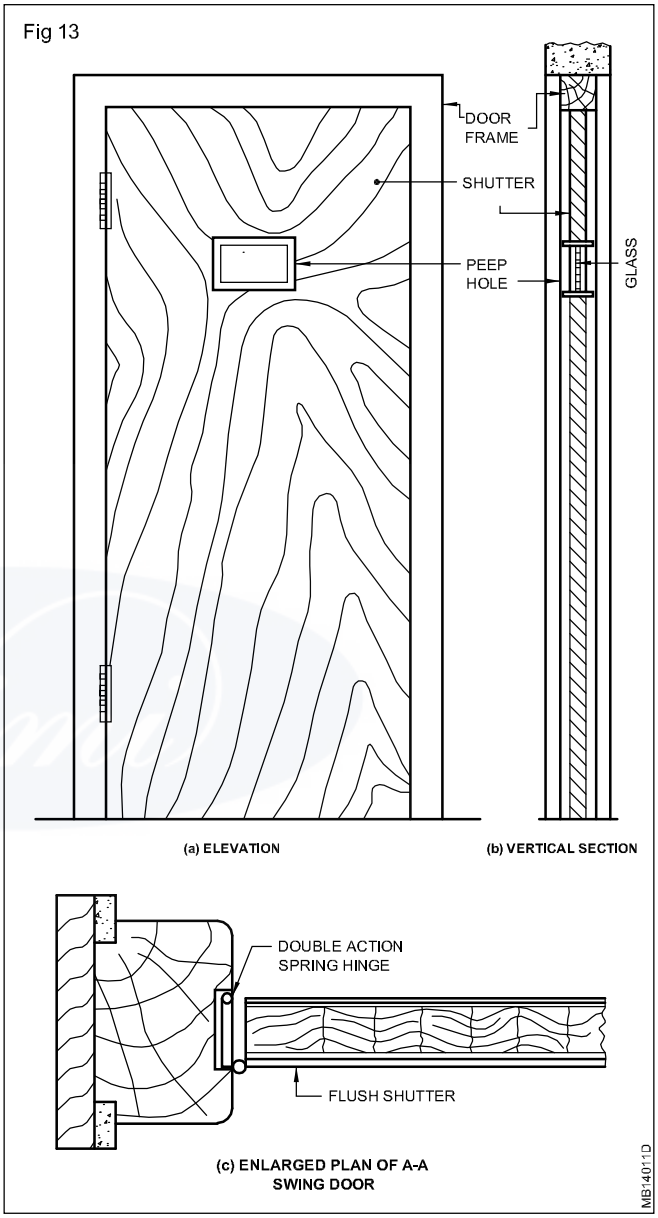
Fig 12



Swing door (Fig 13)

- 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 13



Roofs

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 structural elements are the beam, trusses, slabs, slates and portals.

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 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.

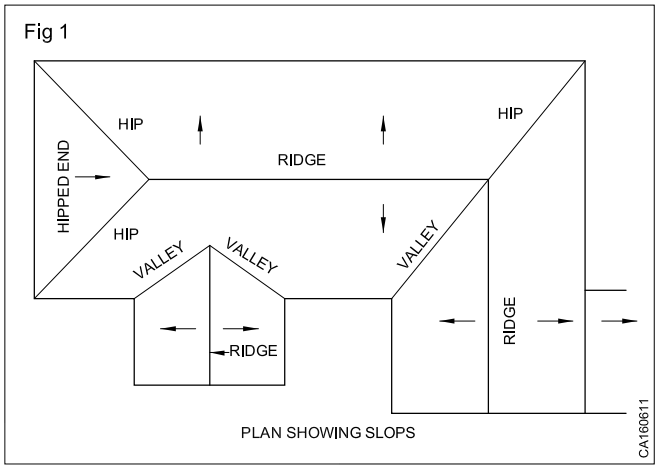
Pitch

The inclination of sides of a roof to the horizontal plane. The pitch can be expressed either in terms of degree or as ratios 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.

Fig 1



Hip

The angle formed at the intersections of two roof slopes are called the help

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
- Couple roof
- Couple closed roof
- Collar beam roof
- Collar and scissors roof

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.

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

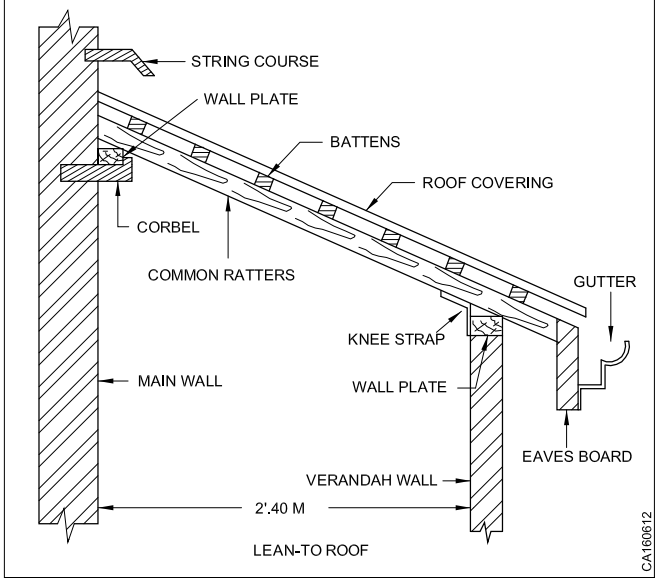
The common rafters are suitably secured on the wall plates. The eaves boards, batters and roof covering are provided on the common rafter.

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.

Fig 2



These roofs has the tendency of spreadout 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.

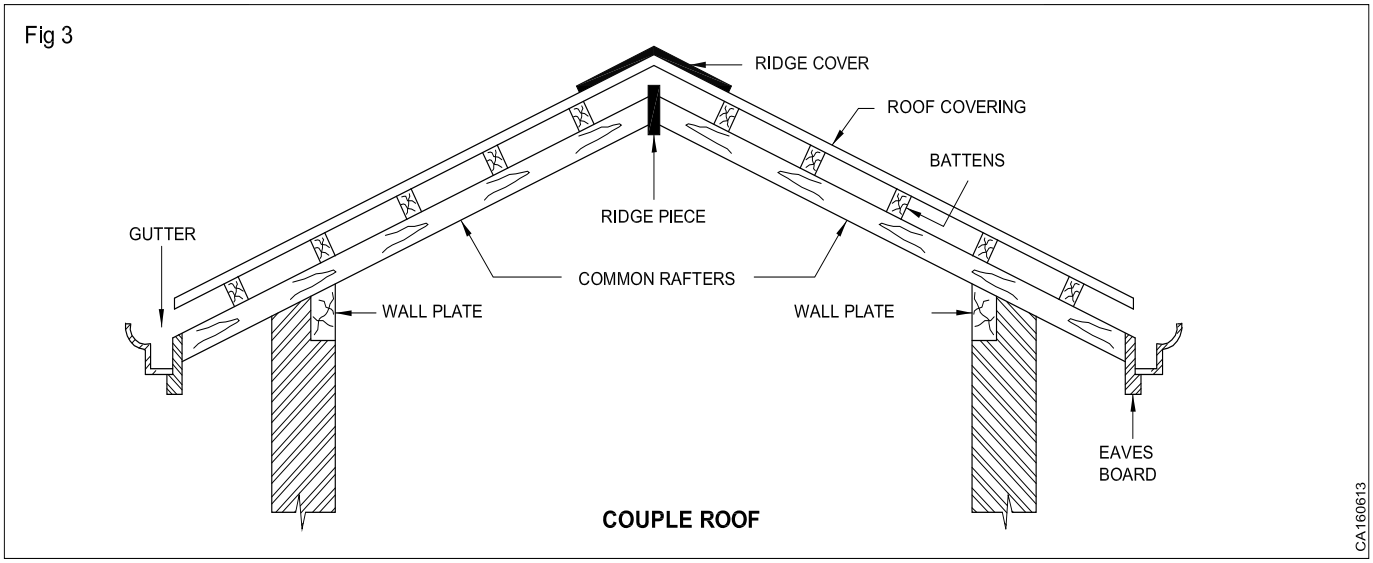
Coupled roof (Fig 3)

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.

Fig 3



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.

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 foxed at 1/3 rd to 1/2 the vertical height from the wall to the ridge.

The lower the collar 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 4

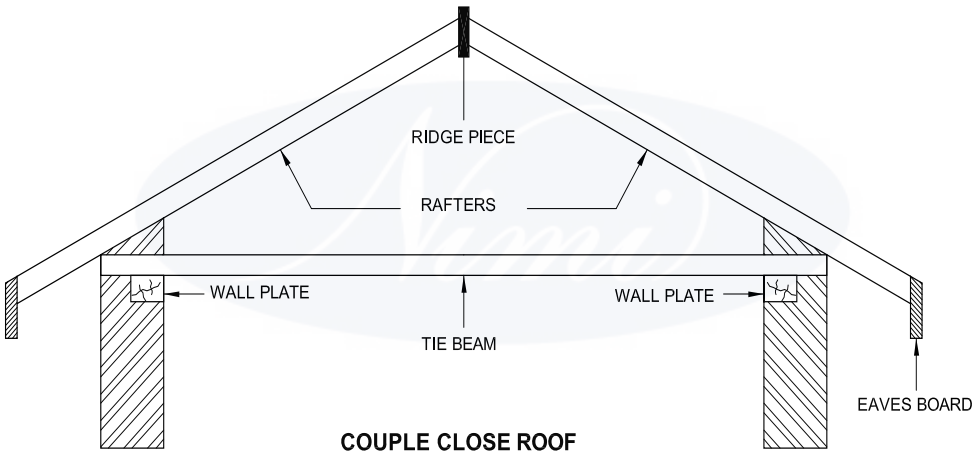
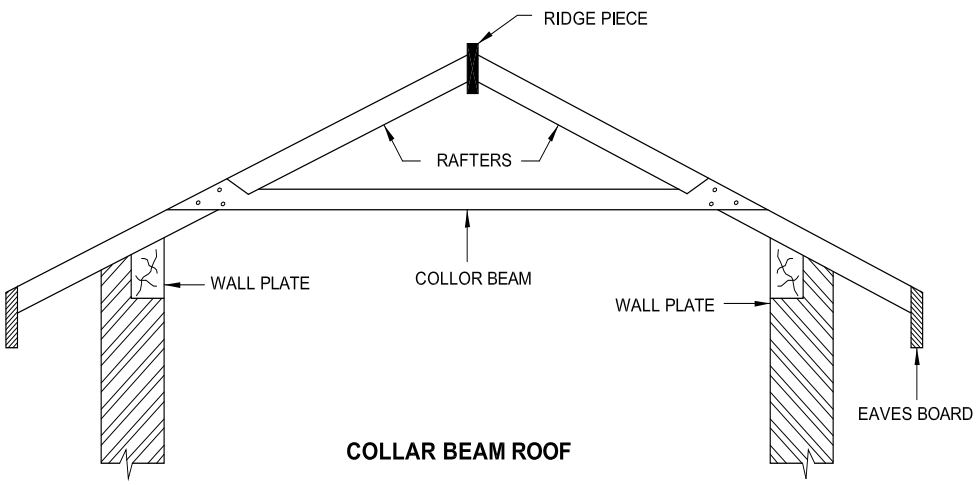


Fig 5



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.

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.

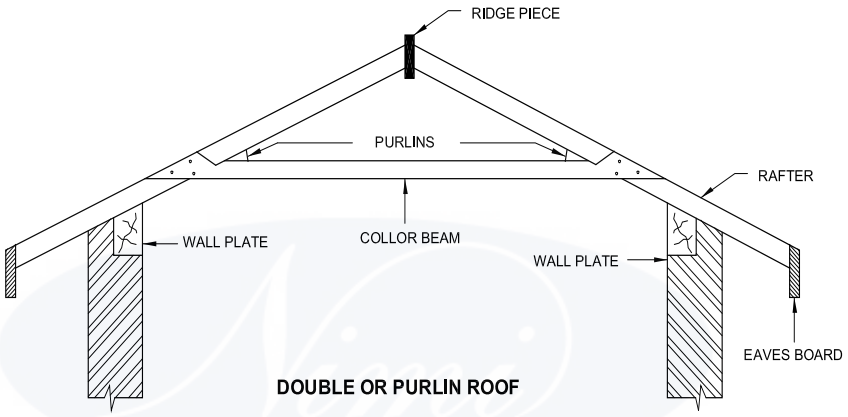
For larger roofs two or more purlins can be provided to support the each rafter.

The purlins can be adopted up to the span distance of 4.50 meters to 5.0 meters.

Collar and scissors roof (Fig 7)

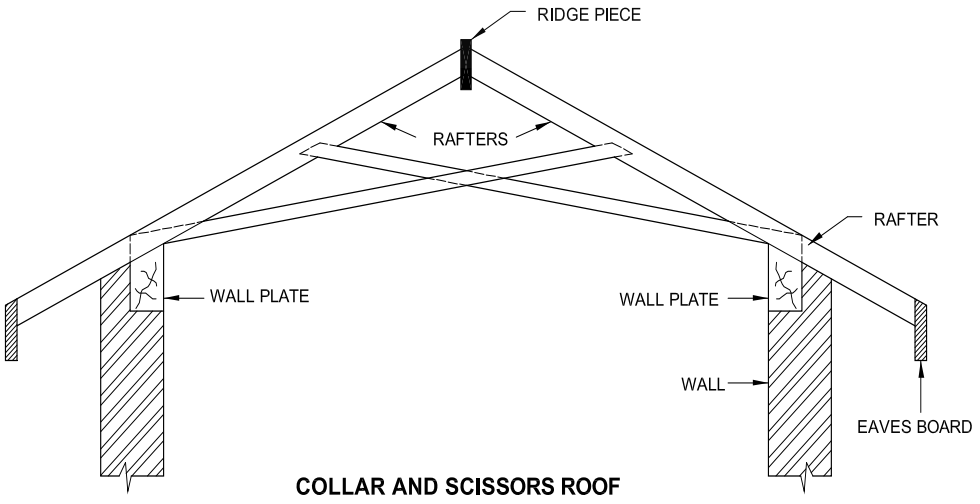
This roof is similar to the collar beam roof except that two collar beams which are crossing each other to present an appearance of a scissors.

Fig 6



DOUBLE OR PURLIN ROOF

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**
- **State the constructional details of king post trusses**
- **State the constructional details of queen port trusses.**

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)

The centre to centre spacing of the truss depends up on 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.

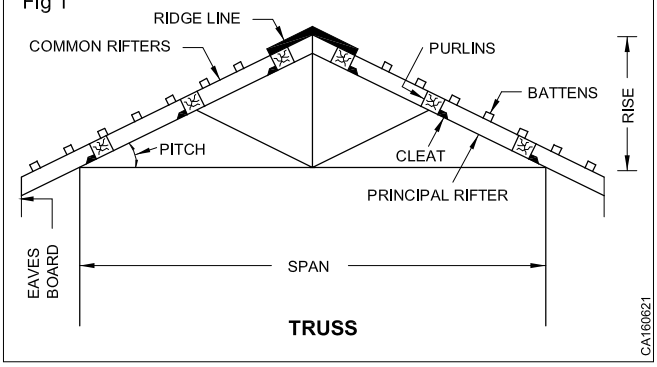
The king post truss (Fig 2)

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”.

Fig 1



TRUSS

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.

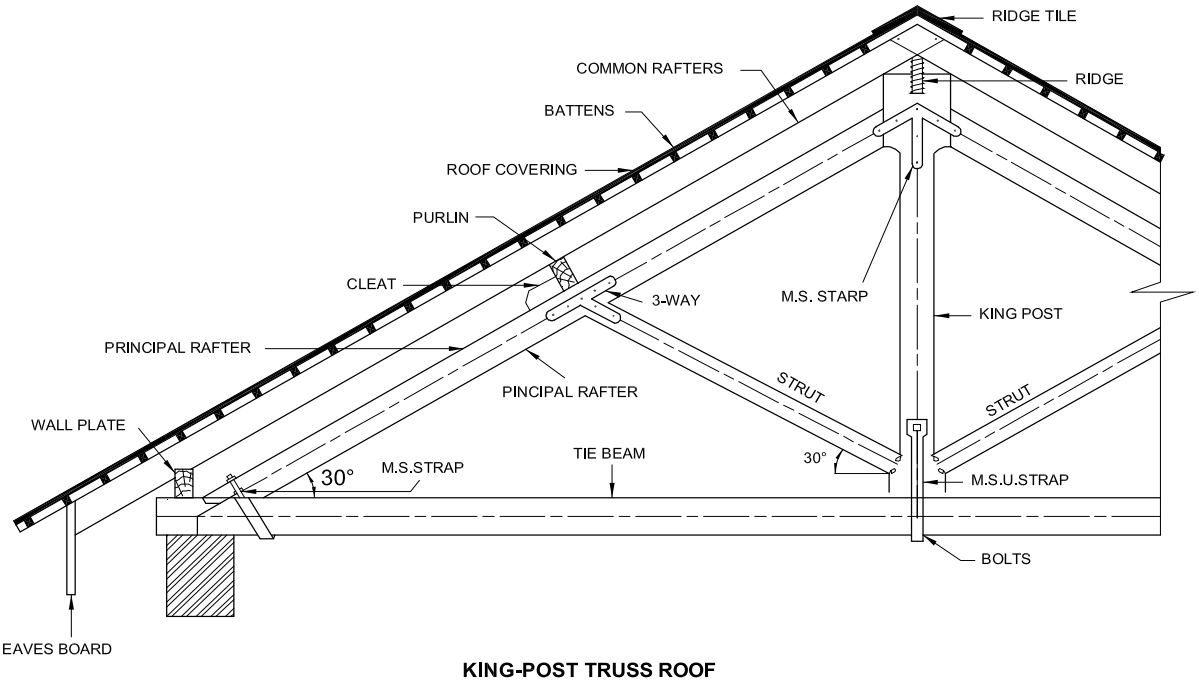
A king post roof truss is suitable for the span varying from 5m to 8m. The centre to centre spacing of the king post truss is up to 3 metres.

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.

Fig 2



KING-POST TRUSS ROOF

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 3)

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.

The queen post truss (Fig 4)

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.

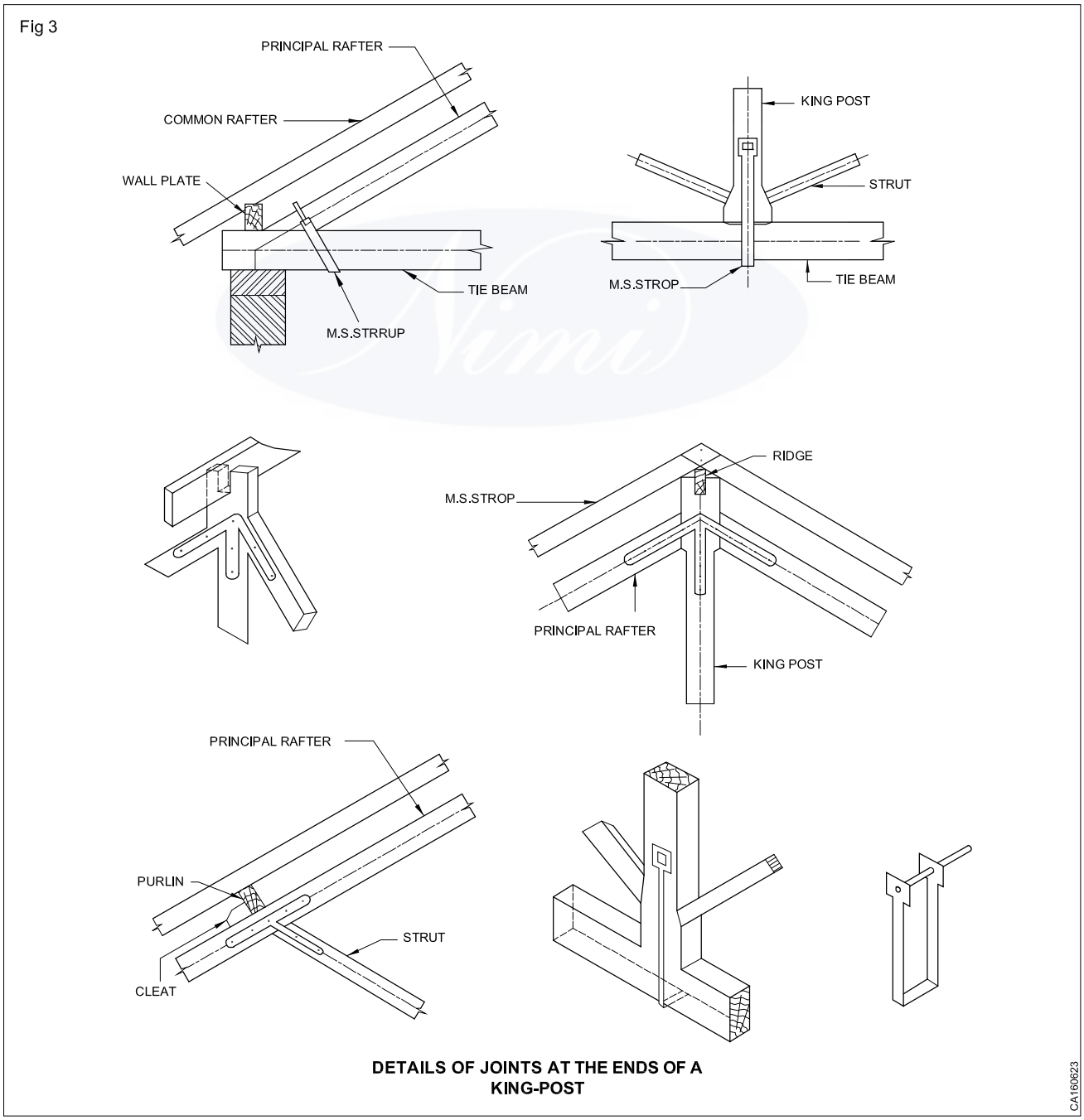
Two struts are used to join the feet of queen post to the principal rafter.

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.

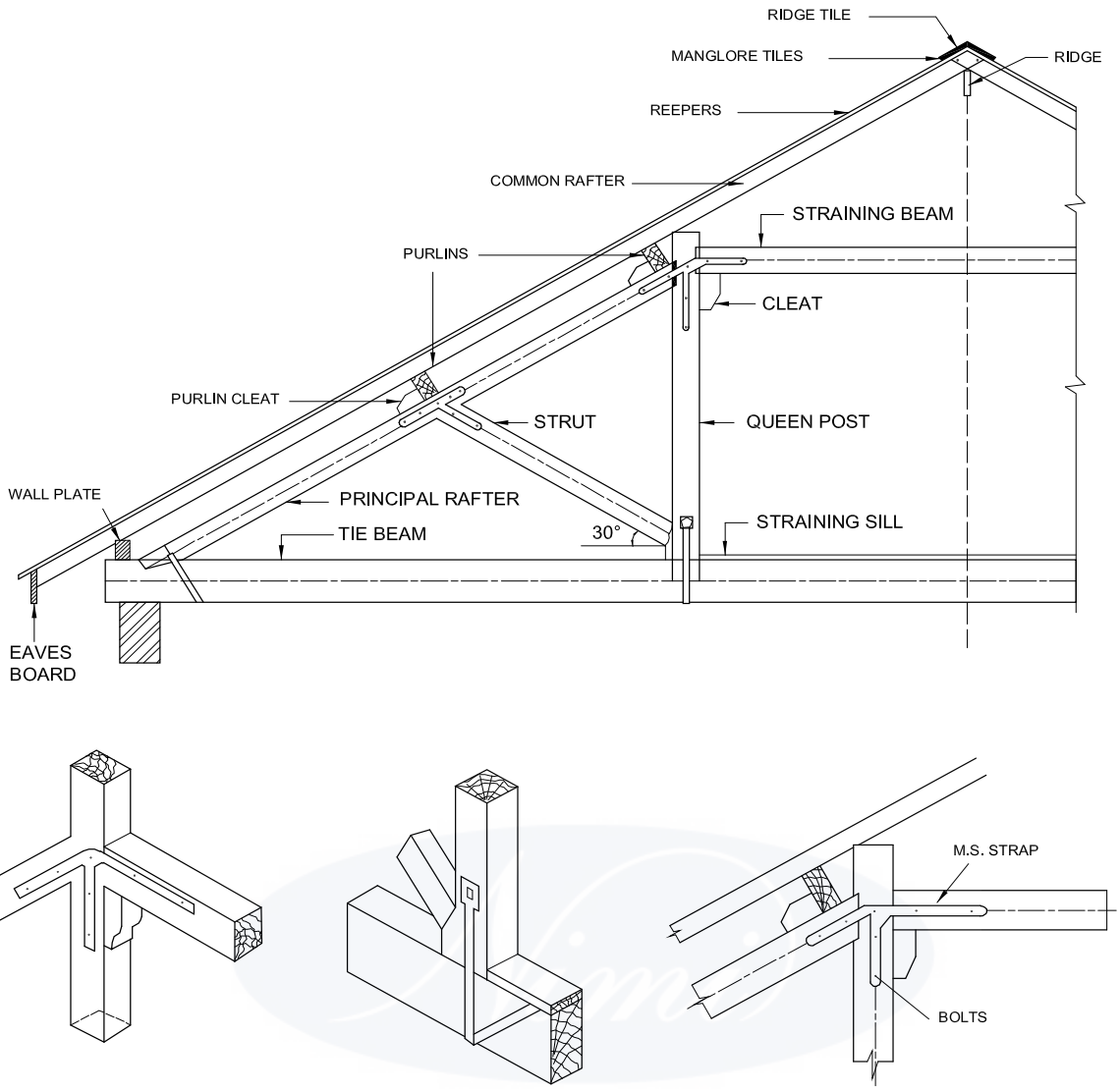
Fig 3



DETAILS OF JOINTS AT THE ENDS OF A KING-POST

CA160623

Fig 4



QUEEN-POST TRUSS

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	80	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	100	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

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)

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.

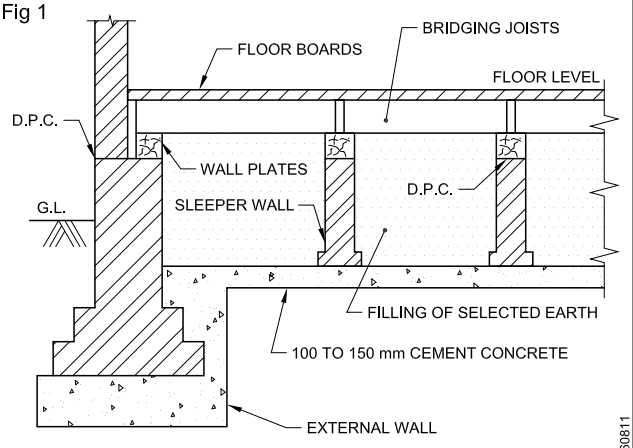
The ends of the bridging joist are usually provided at a centre distance of 30cm. The flooring boards are provided to finish the floor work.

Single joist floor (Fig 2)

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.

Fig 1



BASEMENT OR GROUND FLOOR OF TIMBER

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 joist by providing the HERRING BONE STRUTTING at the mid-span.

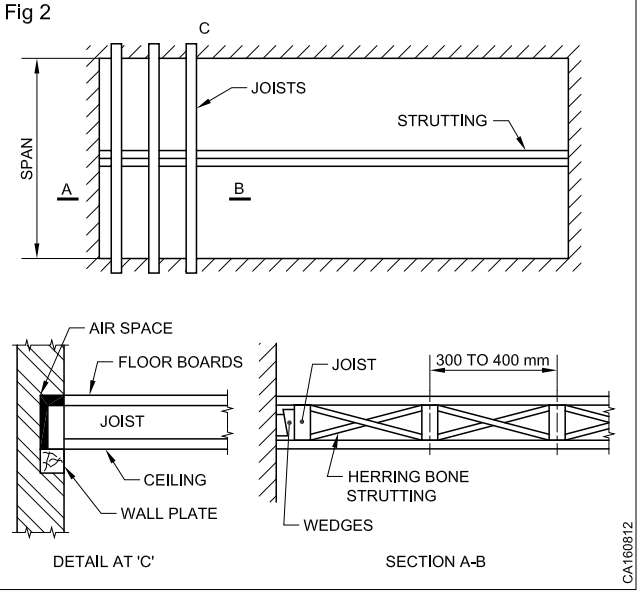
The size of the herring bone studding is 50 mm x 30 mm to 50 mm x 50 mm.

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.

Fig 2



Double joist wooden floors (Fig 3)

This type of flooring is stronger than single joist wooden floor.

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 betterway. 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)

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.

Fig 3

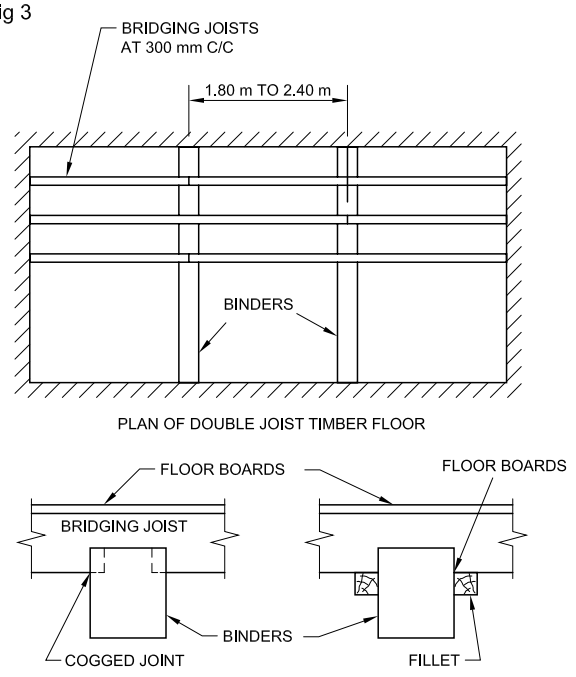
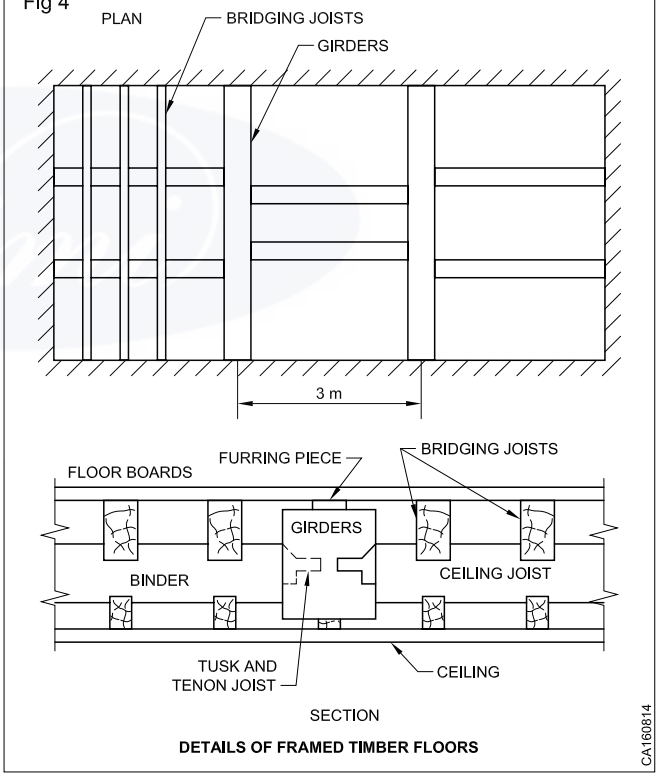


Fig 4



Nails

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

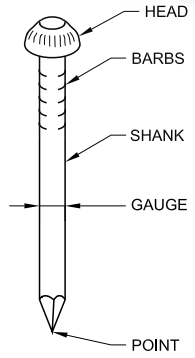
Shape of head

Shape of cross section

Their uses.

Diamond head nail (Fig 1)

Fig 1



DIAMOND HEAD

CA111511

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)

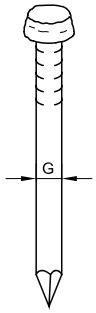
A round wire nail with a round head, which enters the timber cleanly leaving a smaller hole than the diamond head.

Used for same as diamond head.

Flat head round (Fig 3)

A round wire nail with a large round flat heads used for packing case construction (fruit cases) etc.,

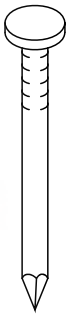
Fig 2



JOLT HEAD

CA111512

Fig 3



FLAT HEAD ROUND

CA111513

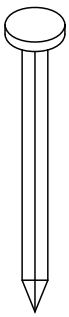
Flat head square (Fig 4)

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.

Fig 4



FLAT HEAD SQUARE

CA111514

Roofing nail (Fig 5)

Made of iron and galvanized to prevent rusting.

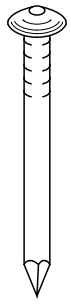
It has a large - dome - shaped head.

Sometimes it has square twisted shanks.

Size 45mm to 65mm.

Used for fixing corrugated galvanized roofing iron.

Fig 5



SPRING HEAD

CA111515

Panel pin (Fig 6)

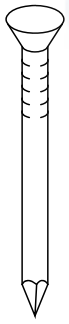
A thin wire nail with an inverted cone shaped head.

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.

Fig 6



PANEL PIN

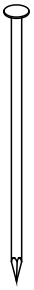
CA111516

Veneer pin (Fig 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.

Fig 7



VENEER PIN

CA111517

Finishing or cut nail (Fig 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.

Fig 8



FINISHING NAIL

CA111518

Clout head (Fig 9)

Similar to the flat head round nail, usually shorter in length

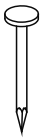
It is having large flat head

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.

Fig 9



CLOUT HEAD

CA111519

Upholstery nail (Fig 10)

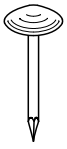
A thin nail with a dome-shaped head.

This nail usually made of brass or iron nickel plated or oxidized to suit the work.

For fixing materials such as resin, leather etc to wood as in chair, theatre seats and up holstery in trains and cars etc.,

Size 12mm to 40mm.

Fig 10



UPHOLSTERY NAIL

CA11151A

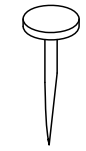
Cut tack (Fig 11)

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.

Fig 11



CUT TACK

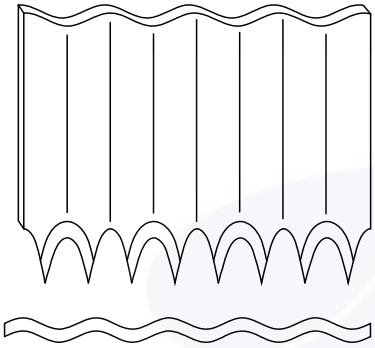
CA11151B

Corrugated fastener (Fig 12)

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.

Fig 12



139 CORRUGATED BOX FASTENER OR WIGGLE NAIL

CA11151C

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 coated there is greater holding power.

Miscellaneous hand tools

Objectives: At the end of this lesson you shall be able to
- **state the use of the crow bar**
- **state the fuction and use of awls**
- **state the function and use of butt gauge.**

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.

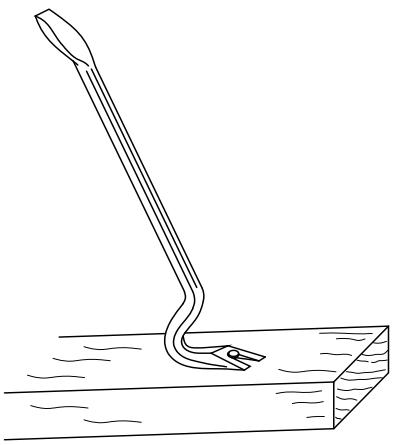
When a lot of force is needed to get out of a nail use a crow bar so as not to break the handle of your hammer.

For lifting very heavy jobs an iron bar should be used in plance of smaller crow bar.

Awl (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. The

Fig 1



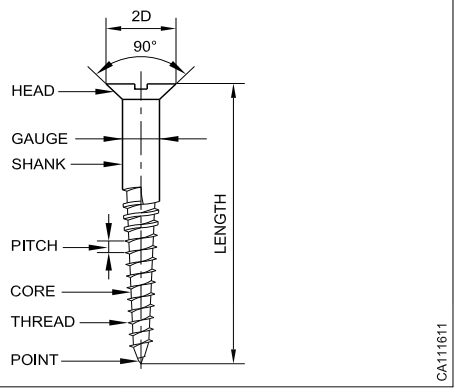
CA111521

Screws used in wood

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

Wood screws are mostly made of mild steel, copper, brass and aluminum. (Fig 1)

Fig 1



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 galvanised (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 and its uses

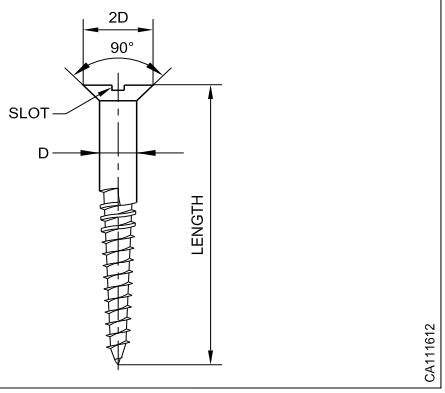
Counter sunk or flat head. (Fig 2)

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 galvanised or screws made of copper or brass.

Copper and brass screws must be driven carefully as they are easily broken.

Fig 2



Uses

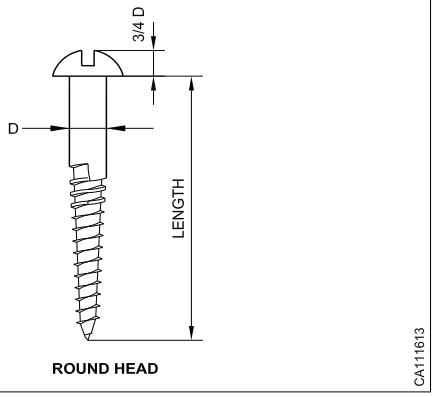
For general screwing purpose where it is necessary for the head to be flush with the surrounding surface.

Table top, chair seats, boxes and metal fitting to wood such as hinges.

Size: 12mm to 150mm length.

Round head (Fig 3)

Fig 3



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.

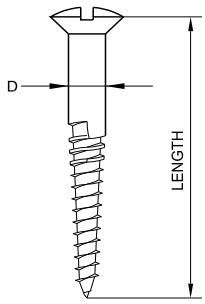
Uses

Where the head of the screw is visible as on ornament, or where the metal is too thin to allow counter sinking.

Galvanised steel round head screws with lead washer are sometimes used for fixing roofing iron.

Raised head or Oval head (Fig 4)

Fig 4



RAISED HEAD

CA111614

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.

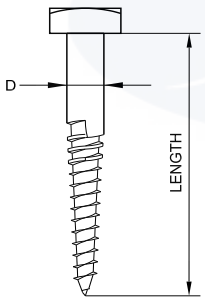
Uses

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 5)

Fig 5



COACH OR SQUARE HEAD

CA111615

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

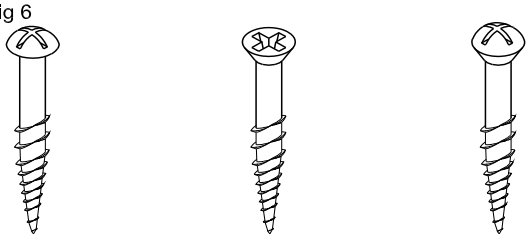
For rough work, bridge construction, fixing gate hinges, coach and carriage construction and for fixing machinery to bases etc.

Size 50mm to 150mm length.

Phillips or cross point head (Fig 6)

These screws have a flat, oval or round head with two slots at right angles each other.

Fig 6



PHILLIPS OR CROSS POINT SCREW HEAD

CA111616

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 7)

Fig 7

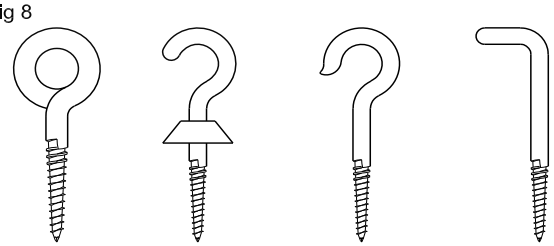


CA111617

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.

Screw eyes, screw hooks, square screw, hooks and cup hooks are made in many sizes. (Fig 8)

Fig 8



CA111618

They are made from steel, brass or of galvanised iron and are used from special purposes, such as for hanging pictures, curtains, kitchen utensils keys etc.,

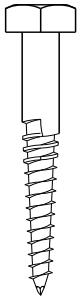
Large screws or wrench bolts (Fig 9)

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.

Fig 9



CA111619

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.

Scaffolding

Objectives: At the end of this lesson you shall be able to
- **state the pars and tormb used in scaffoloding**
- **study the types of scaffolding.**

A scaffolding is a temporary platform erected to enable building operations to gain easy and safe access to their work above ground level

Scaffolding can be classified in two ways

- by the material used for the scaffold. (ie) wood or steel
- by method of erection (ie) dependent or independent

parts and terms used in scaffolding

Standard

The upright members positional in alignment and parallel to wall face

Ledgers

The horizontal members which connect the row of standard

Putlog

shorter lengths with one end flattend to enter the wall joints as shown in (Fig 1).

Fig 1



PUTLOG

MB131611

Brace

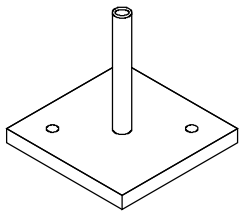
A ledger fixed diagonally across the standards for added rigidly

Base plate

A base plate is used at the foot of the standard to provide the stable footings.

The base is nailed to a base board as shown in (Fig 2)

Fig 2



BASE PLATE

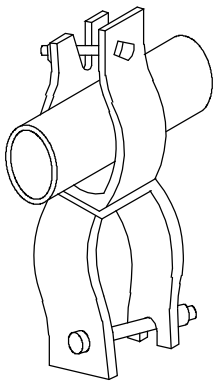
MB131612

Double coupler

This is used to tie ledgers to standards at right angles

The double coupler is shown in (Fig 3)

Fig 3



DOUBLE COUPLER

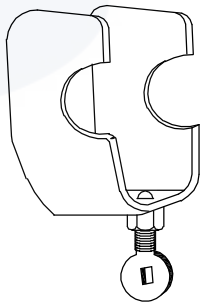
MB131613

Single coupler

Single coupler is used to tie a putlog to a ledger

Single coupler is also called putlog clip. as shown in (Fig 4)

Fig 4



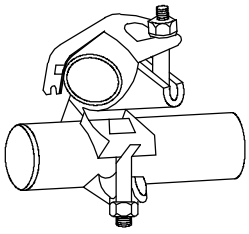
SINGLE COUPLER

MB131614

Swivel coupler

A rotating fitting used to tie a brace to the standard as shown in (Fig 5)

Fig 5



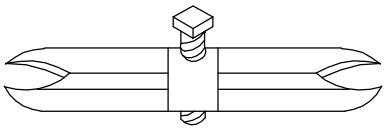
SWIVEL COUPLER

MB131615

Jointing pin

Used to join two lengths of tubing. The pin consists of split halves connected by a coach screw. as shown in (Fig 6)

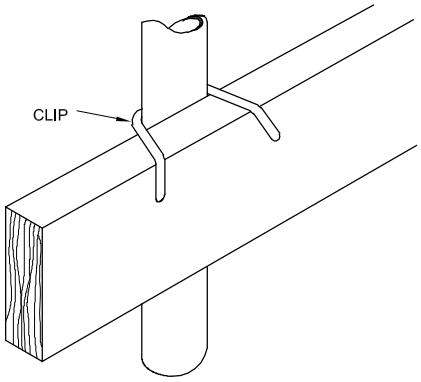
Fig 6



JOINTING PIN

MB131616

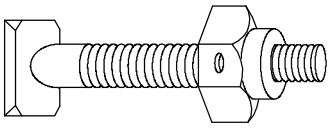
Fig 7



TOE BOARD CLIP

MB131617

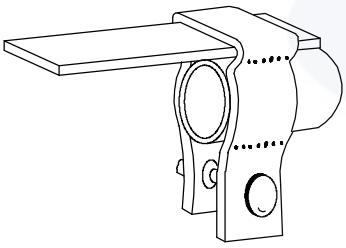
Fig 8



ADJUSTABLE REVEAL PIN

MB131618

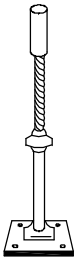
Fig 9



PUTLOG END

MB131619

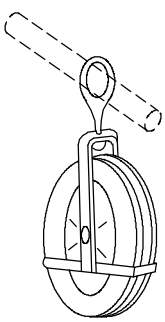
Fig 10



PLATE

MB13161A

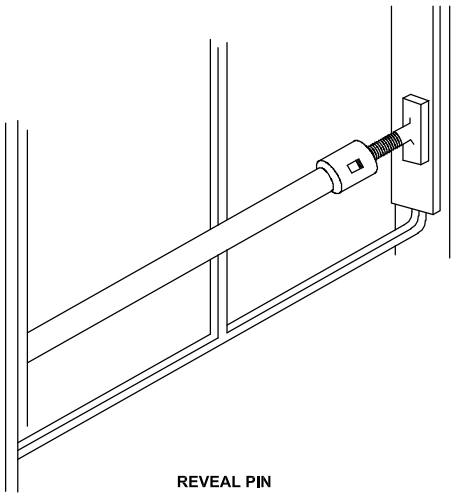
Fig 11



GIN WHEEL

MB13161B

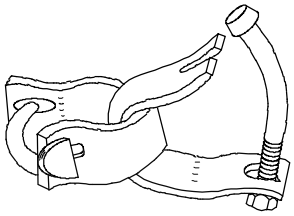
Fig 12



REVEAL PIN

MB13161C

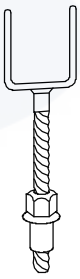
Fig 13



90° CLIP

MB13161D

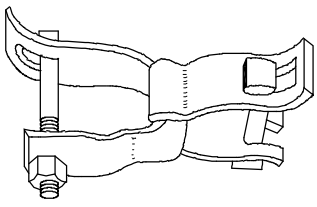
Fig 14



LIGHT DUTY ADJUSTABLE FORKHEAD

MB13161E

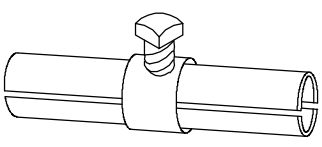
Fig 15



BRACING COUPLER

MB13161F

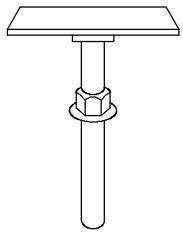
Fig 16



EXPANDING JOINT PIN

MB13161G

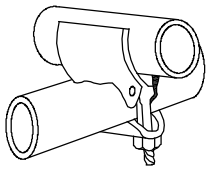
Fig 17



SHORING JACK

MB13161H

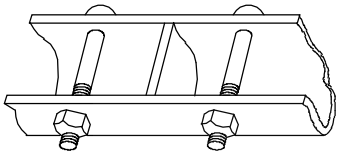
Fig 18



TRANSOM CLIP

MB13161I

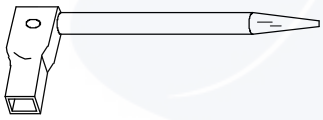
Fig 19



SLEEVE COUPLER

MB13161J

Fig 20



SWING-OVER BOX SPANNER

MB13161K

Classification by type of material

- Wood
- metal

Wooden scaffolding

- Wood is commonly for scaffolding
- For single story building wooden scaffolds are used.

Advantages of wooden scaffolds

- In areas where wood is available plenty and cheap
- No fittings used
- No extra maintenance costs
- Easily cut to size
- Wastage and old logs can be sold as fine wood.
- Required length of log may cut accordingly
- Large holes are left in the wall after use and these need to be patched.
- Regular replacement is essential old logs must be removed and new added to avoid failure.

Tubular scaffolding

- Steel and light alloy tubes are used commonly
- This scaffolds needs a lot of fittings hence it costy and to maintain

Advantages of tubular scaffolding

- Less deteriorate than wooden scaffolding
- This can be erected rapidly and dismantled
- More convenient for internal work
- Takes up less space for storing the materials after use
- Tubular scaffolding is mostly used for multi story buildings
- Quickly transported from one side to another side
- These scaffoldings do not require holes in the walls as in the case of other types of wooden or timber scaffolding

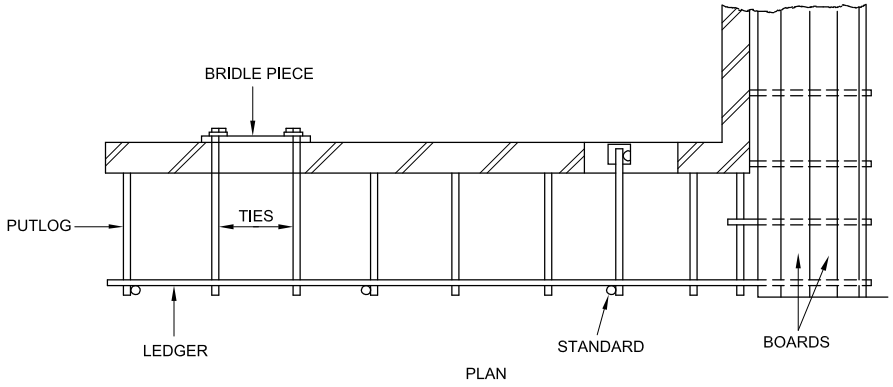
Method of Erection

- Dependent scaffolding (Fig.21, 22, 23)
- Independent Scaffolding

Dependent scaffolding

- This scaffolding commonly termed as bricklayer's scaffolding or putlog scaffolding
- The vertical members called as standards are firmly embeded in ground as shown in (Fig 23)
- The diameter of this standards is about 10 to 15mm and placed in 1.5m away from the building in a row with 2m centre to centre spacing
- These standards are connected with ledgers.
- Putlogs are then placed with their one end onthe ledgers and the other end in the holes kept in the wall as shown in Fig 23
- Over the putlogs wooden planks are placed to keep materials and tools platform at different levels as shown in Fig 22
- In the case high buildings diagonal members known as braces are fixed, to the standards and ledgers for giving more strength.

Fig 21

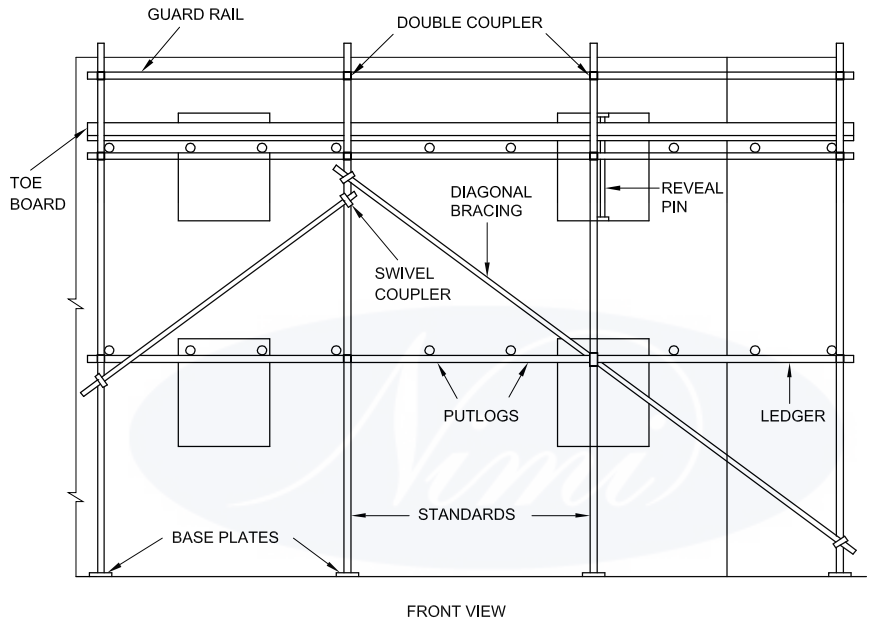


PLAN

DEPENDENT SCAFFOLD

MB13161L

Fig 22

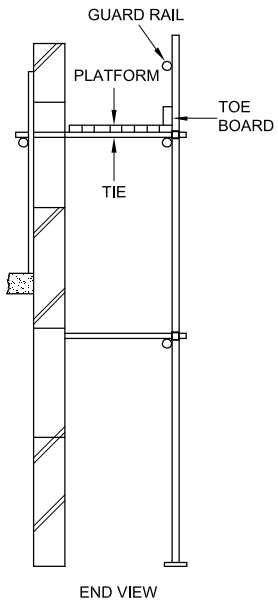


FRONT VIEW

DEPENDENT SCAFFOLD

MB13161M

Fig 23



END VIEW

DEPENDENT SCAFFOLD

MB13161N

Tubular scaffolding

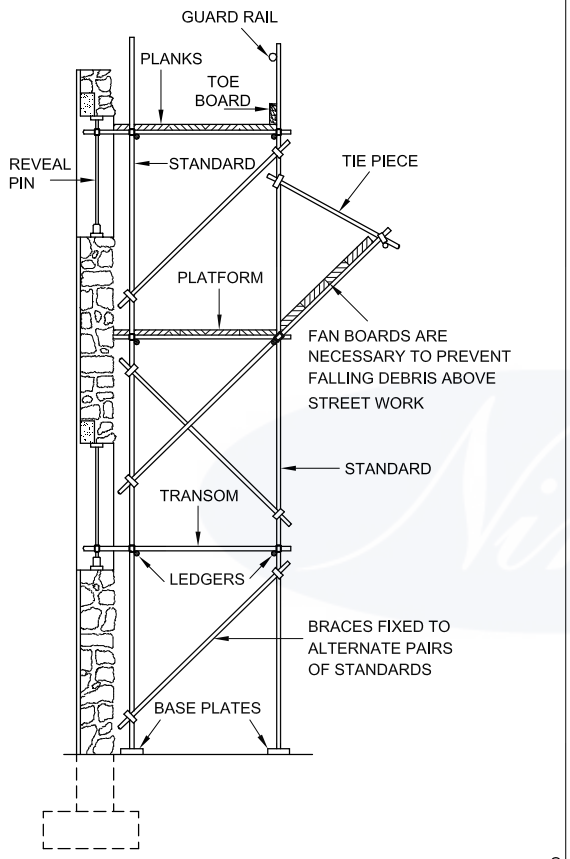
- Tubular or steel scaffoldings are being more popular over bamboos or timber scaffoldings
- Tubular scaffolding consists of 40mm to 60mm diameter weldless tube pipes are used.
- These are connected together by means of couplers.
- Tubular scaffolding can be easily erected in position and dismantled quickly and transported to one site to another

Independent Scaffolding

- This type of scaffolding is called as mason's scaffolding
- It has two rows of standards
- One close to the building structure and another at a distance equal to the required platform width

- Independent scaffolding is very stronger and is used for heavy operations such as masonry work as shown in (Fig 24)
- Procedure for erecting a tubular scaffolding
- The scaffolding units have been brought to the site
- Sort out their various lengths, fittings , oiled Place the base plates for standards
- With the aid of an assistant stand the standards on the base plate
- Connect the ledger using double coupler as shown in the (Fig 24)

Fig 24



MASON'S OR INDEPENDENT SCAFFOLD

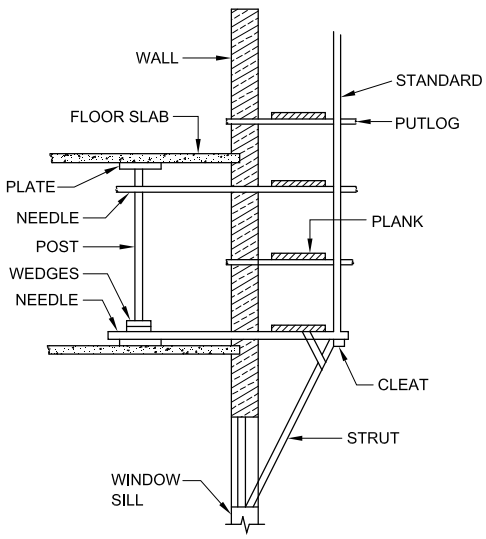
- The ledger should be sighted for level
- The bolts of the coupler should be placed uppermost
- Put logs can be fixed by using single coupler or put log clips as shown in Fig 4
- After fixing standards in position connect ledgers by using jointing pin at the ends
- Use the double couplers to fix put logs and standards after correct alignment
- Use the standards for diagonal braces for firm rigidity
- Repeat the procedure until the required length of scaffold is obtained.

"Some other types of scaffoldings"

Needle scaffolding

This is generally used for repairing purposes and for adding further stories in the existing building as shown in (Fig25)

Fig 25

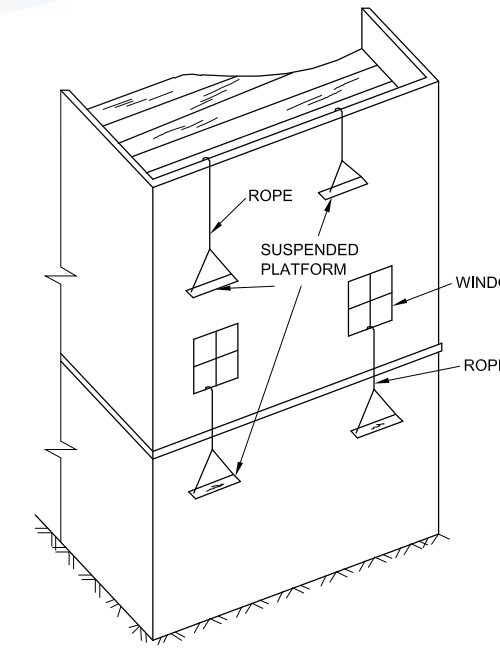


NEEDLE SCAFFOLDING

Suspended scaffolding

- For repair cleaning painting and erection of buildings various types of working platforms are required at various levels
- It can be easily provided and removed from time to time such platform can be easily suspended as shown in (Fig 26)

Fig 26



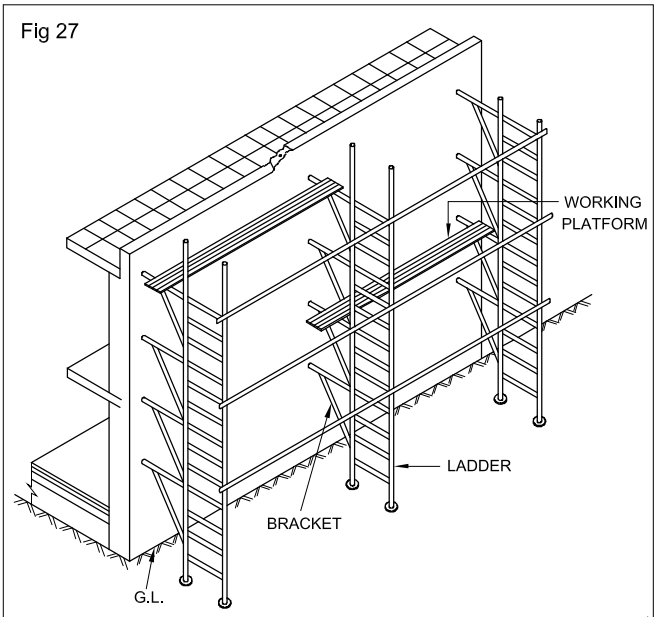
SUSPENDED SCAFFOLDING

Ladder scaffolding

- painting work of the multistorey building ladders are not suitable due to their limited length

- In such places ladder scaffoldings are provided as shown in (Fig 27)

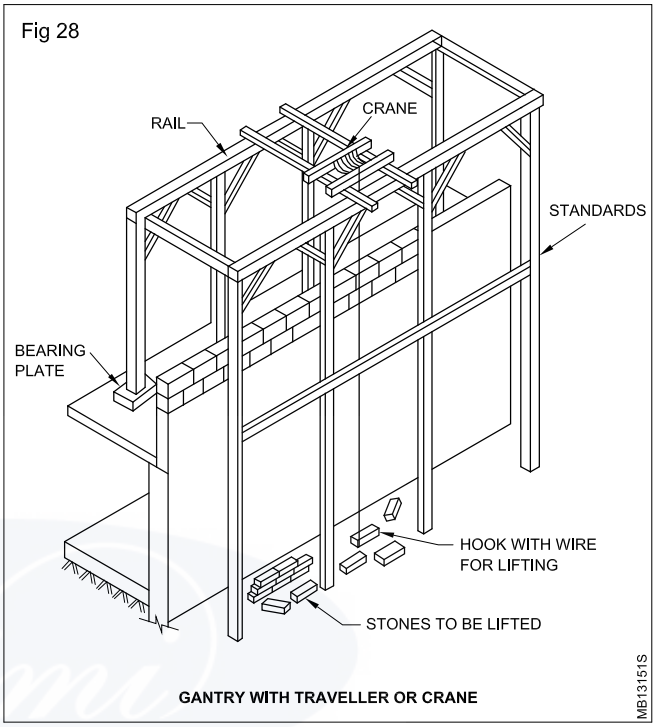
Fig 27



LADDER SCAFFOLDING

- Gantry with traveller or crane
- This type of Gantry consists of wooden standards generally square in section and erected vertically
- Longitudinal member called runners are fixed at the top of standards on which rails are fixed. The lifting tackles move on the rails
- The tackles can also move perpendicular to the wall as shown in (Fig 28)

Fig 28



GANTRY WITH TRAVELLER OR CRANE

Investigation and site Clearence

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

- **describe the investigation of the site**
- **describe the advantage of site investigation**
- **describe site clearance and site levelling.**

Investigation of Site

The investigation of the site involving the soil, type of terrain, obstructions and proximity to existing properties etc is carried out at the design stage by the design group.

For the purpose of tendering, for such a contract, the contractor in his own interest also carries out these aspects of site investigation.

Most building are not large enough to necessitate elaborate site investigation However, essential, and advisable on the part of the builder to examine the proposed site before building operation start in order to ensure that some statutory regulations are not contravened.

Every contrator should take appropriate steps on the award of the contract to satisfy himself of the following.

There are no local authority restrictions on method of work with in the area.

Site does not slope steeply.

If there are existing structure to be removed.

The building is set out correctly.

Advantages of site investigation

It saves the builder or contractor from future legal tussles with the local authority

The type of problem to be expected during the operation and enables him to take steps in advance to solve them.

It prevents unnecessary danger to workman.

All the above points kept in mind at the time of site investigation and examination.

Site clearance

Site clearance is necessary for all types of buildings.

Before the earth work is started, the area coming under cutting and filling shall be cleared.

Debris, vegitation, grass, trees and saplings of girth upto 30cm measured at a height should be cleared.

The roots of trees and saplings shall be removed.

Site clearance used to be carried out using manual labour with pick axes and spades.

Site levelling

After clearance the site has to be levelled

Many building sites were originally parcels of land used for cultivation of farm crops

Certain mounds and ridges have to be levelled before the setting out of the building.

Setting out and Fixing levels

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

- **describe three methods of seeting out.**

- Setting out of the building demands careful consideration right from the earliest stage of construction.
- Correct the setting out should ensure that
- The building faces in the right direction.
- The building is erected on the correct plot of land.
- The overall, sizes length and breadth are according to those shown on the sketch or plan.
- Setting out is the one of the operation for a simple buildings.
- Contineous works or operation will take place for more complicated building.
- It is essential to establish a level on the site.
- Fix any reference point near by the site and may and Transfered by using the level of instrument as datum peg. which is also called Bench mark.

Three method of setting out

Setting out simple buildings we may use one of the three methods.

1 The 3,4,5 method

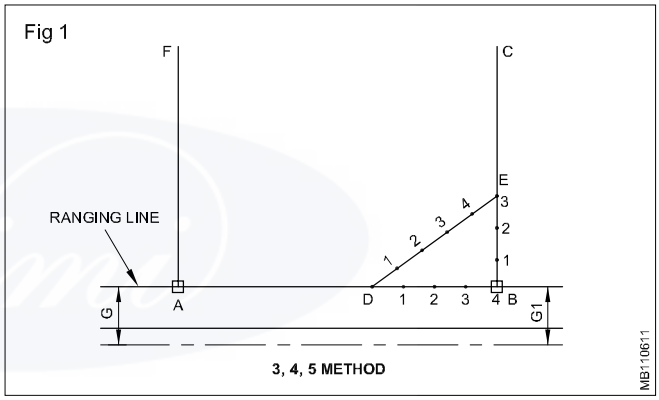
2 The Builder's square method

3 Levelling instruments

The 3,4,5 method

- Markout the building line from the road by measuring the required distance from the centre of the road.
- By streching a line along an existing building to the proposed site.
- The building line is then represented by a line known as the Ranging line, which also marks the front wall of the building as shown in (Fig 1)
- Mark out the overall length of the building by fix wooden pegs at 'A' and 'B' along the ranging line.
- Obtain two steel tape measures markout four equal distances on the ranging line starting from the corner wooden peg at 'B'
- These distance may be in any unit of measurement iemm, metres etc
- Pull a tape measure from point B to C and ask an assistant to hold it. Ready with a hammer and peg.
- Pull the second tape from the fourth mark at 'D' on the ranging line to point 'E' on the first tape.
- The distance 5m, if using metres tape 'DE' should coincide with the point 3m on tape BEC. then the angle B is 90^0.
- Repeat the same procedures to obtain the right angle for "BAF" and mark out the overall widths of the buildings.
- Fix corner pegs and erect profiles.
- Mark the position of cross walls on the profiles with either nails or saw cuts.

Fig 1



3, 4, 5 METHOD

The Builder's square method (Fig 2)

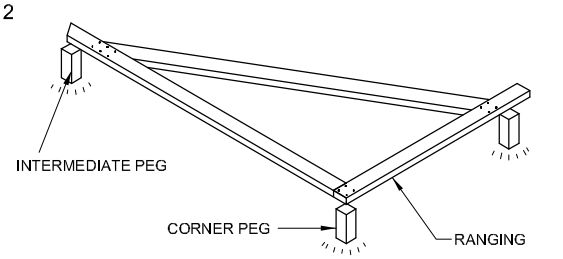
- Setout the front of building line in the usual manner with pegs or marks at the required distances.
- Place Builder's square so that the front line touches one side the square right through its length.
- Stretch a line from the corner peg so that it is parallel to the second side of square and fix the third peg
- And a corner of angle 90^0 is thus obtained.
- By using the steel measuring tape, measure mark out the length and breadth of the proposed building.
- Transferring the builder's square to the other corners and repeating the above operations.
- The Builder's square method

Advantages

- Simple to use
- Does not require any calculation.
- Can be very accurate when used for small rectangular buildings.

- Quick in application.

Fig 2

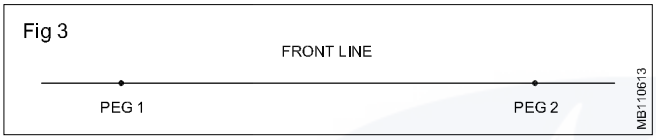


THE BUILDER'S SQUARE

The site square method.(Levelling instrumenty)

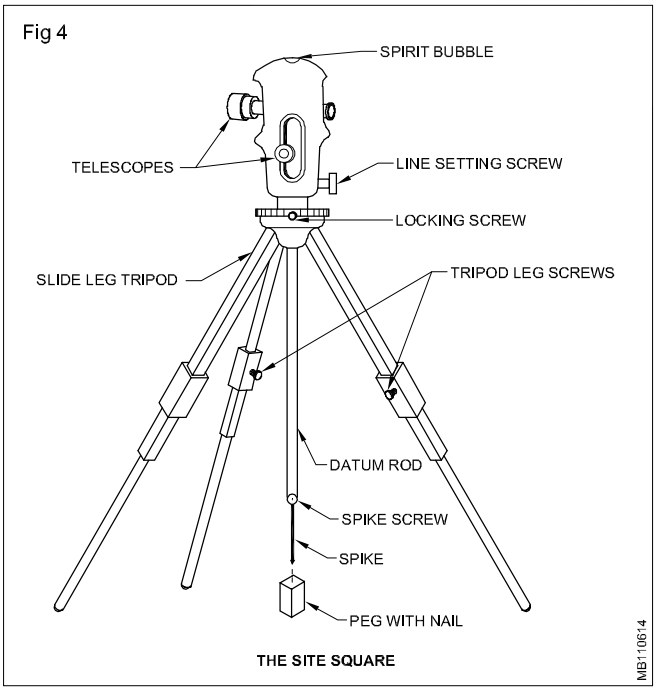
- When a right angle is to be set out, the corner of the angle and oneside of the corner are always known.
- One has only to find the position of the second side.
- The site square solves this problem in a very simple, quick and reliable way.
- Setout the front or building line in the usual manner with pegs or marks at the required distance as shown in (Fig.3)

Fig 3



- Setup the tripod at peg 1 so that the datum rod is directly over the peg mark which represents the corner point.
- Make sure that the legs are firm on the ground.(Fig.4)

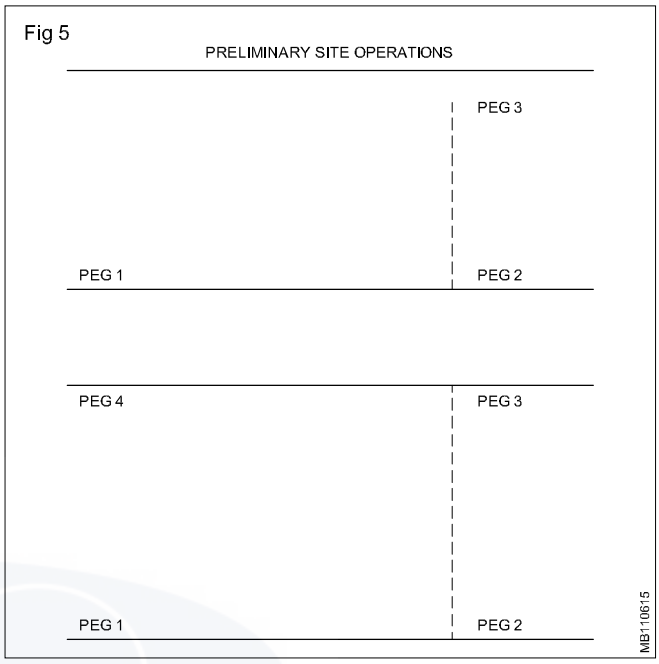
Fig 4



THE SITE SQUARE

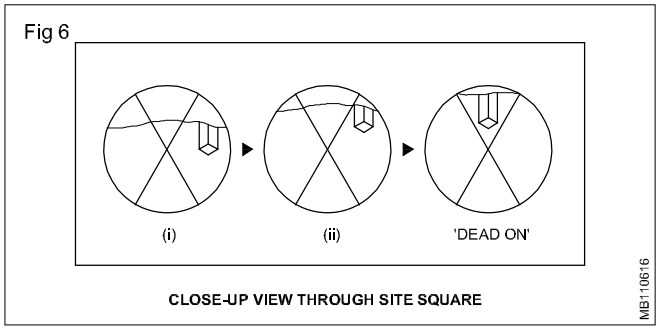
- Release the spike screw and extend the spike so that it sits firmly on the nail mark. Tighten the screw
- Mount the instrument on to the tripod and the locking screws are tightened.
- Check the circular bubble over the top of the instrument.
- Measure the distance required peg 3 (Fig 5)

Fig 5



- By moving the site square to peg 3 and lining up on peg 2, the remaining corner peg 4 can be set out using the above already given.
- Profile can be marked easily by tilting the telescope upwards having sighted on to the peg and placing a nail in the and position on the profile board .
- Sight on to peg 1 through the lower telescope to obtain the “dead on” position by means of the fine setting screw which moves the telescope to the right or to the left and by tilting the telescope up or down as shown in Fig Close up view through site square. (Fig 6)

Fig 6



CLOSE-UP VIEW THROUGH SITE SQUARE

Setting out of Building foundation

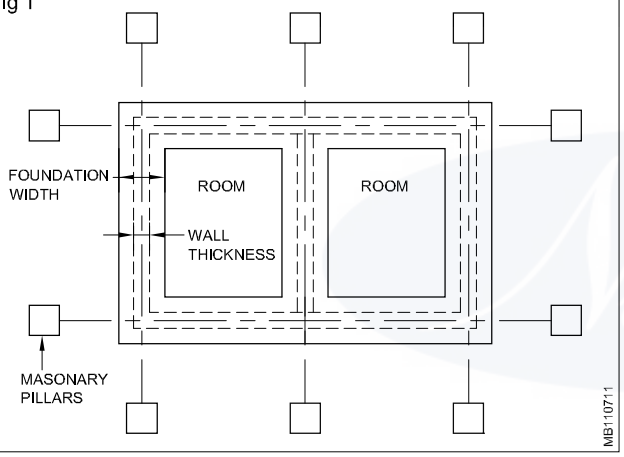
Objectives : At the end of this lesson you shall be able to

- **describe setting out of building foundation**
- **describe temporary site bench mark.**

Setting out of Building foundation

- Setting out or layout of foundation means to layout the details of the foundation trenches to be excavated.
- In other words we can say that layout is nothing but transfering the details from the paper to the ground.
- The first essential before the layout of foundation is to prepare a foundation plan to a convenient scale showing all centre lines and all measurements as shown in (Fig. 1)

Fig 1



- To start with centre line of the longest wall passing through that corner which has been located with help of a fixed point or object is marked on the ground.
- Stretch a string or Thread between two wooden pegs
- Take measurements accurately as per the drawing for first line, because all other lines will be located with respect of this line.
- After setting this line, other lines are similarly located by using centre lines as shown in (Fig. 2)
- Steel tape is used for measuring the distances.
- For setting out perpendicular lines a right angled triangle is formed by measuring the lengths in 3,4,5 method as shown in (Fig. 3)

Fig 3

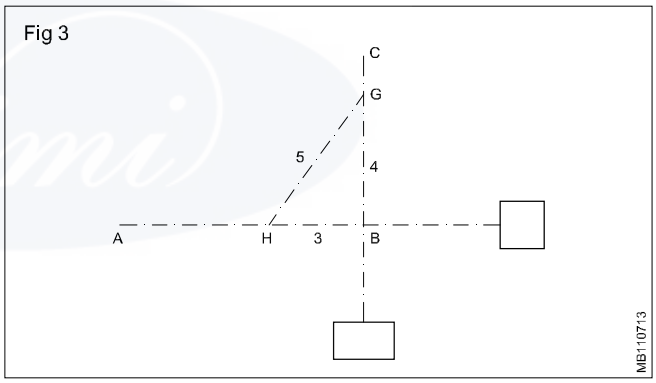
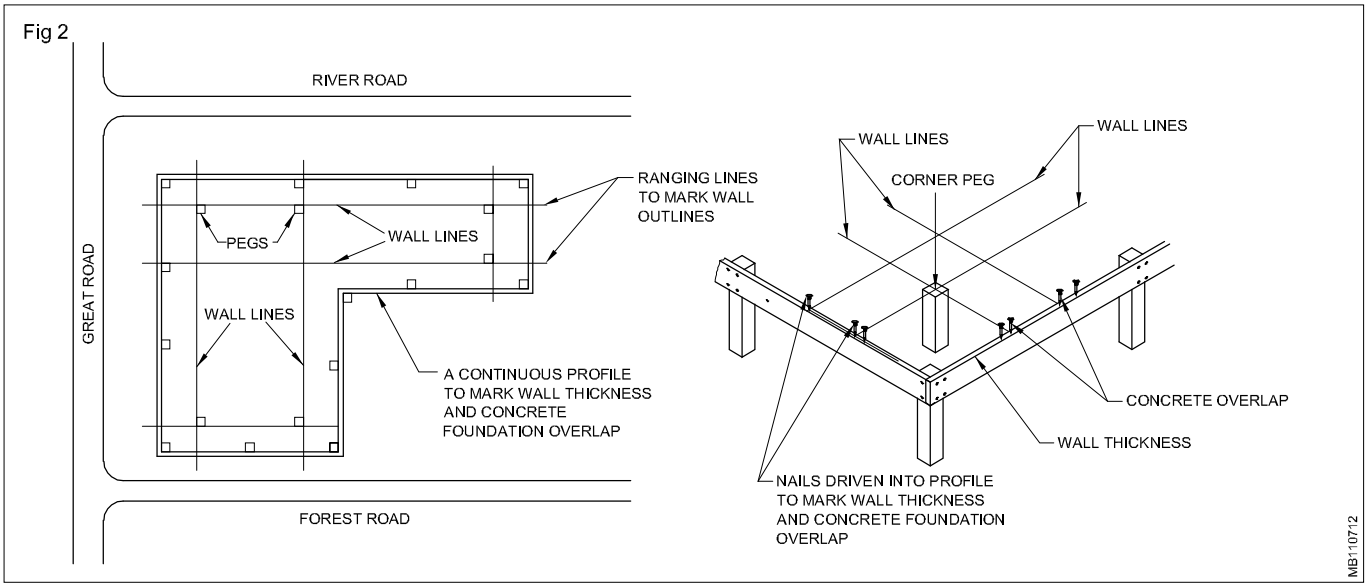


Fig 2



Setting of perpendicular lines for layout out of plan.

List of Tools required for setting out.

Levelling Instrument

100mm diameter Ballipieces 500 to 600mm long.

35mm long nail.

Hammer

Right angle (or) Builder's square

steel tape 30 meter long.

Steel tape 3 meter long.

Pencil

Thin cotton Thread (Line dori)

Materials required for setting out

Bricks

Cement

Lime powder

Screened sand

Paint (if necessary)

Preliminary works

- The following preliminary works will have to be executed before the actual work of setting out is taken up.
- Site should be cleared of all grass, bushes, trees etc.
- Spot levels of ground should be recorded
- A permanent bench mark is to be constructed in the vicinity.

Baseline and Centre lines

- While setting out most important factor is to establish a base line.
- This is done as per the site plan requirements and offsets are taken from the existing road or existing building.

Caution

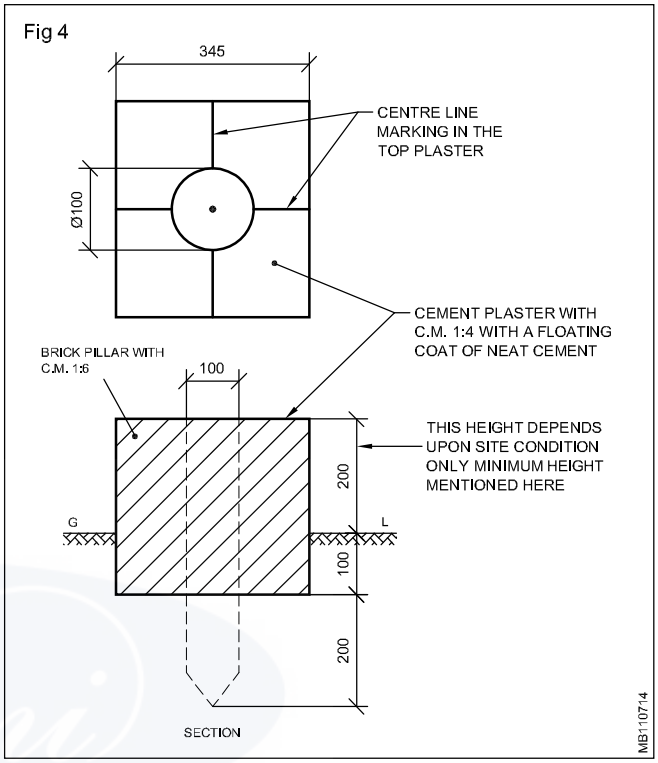
The setting out of a structure is takenup in a systematic manner. The mistakes that may crop up in the initial stages and which are very difficult to rectify at latter stages.

On important works a theodolite should be used.

Details of brick pillars.

- At the end of each centre line masonry pillars of 20 x 20cm size having a height equal to the height plinth are constructed.
- The height of all brick pillars as far as possible should be kept at a same height.
- The top of the pillars are plastered with cement mortar 1:4 finished with floating coat of neat cement.
- The position of centre lines are marked on the top of a plastered surface of the brick pillars or imprinted for future guidance as shown in (Fig 4)

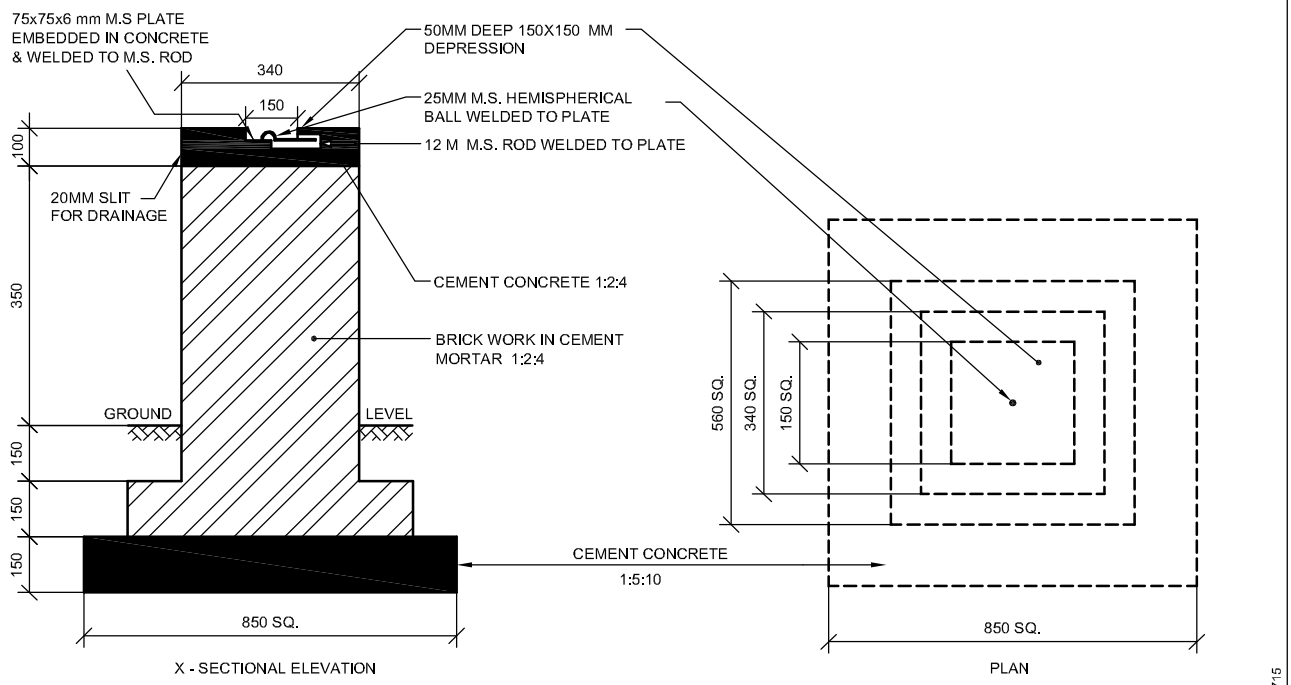
Fig 4



Temporary site Bench mark (Fig 5)

- Before starting the actual setting out of the building, it is essential to establish a level on the site, to which references pertaining to levels, of elements of work, may be made in the course of executing the work.
- In planned cities and towns ordinary Bench mark are established and points marked along streets in permanent position or cut into the plinth of walls and gate posts or other reasonably permanent fixtures whenever possible ordinary Bench marks should be used.
- In connection with establishing the levels of land and surface water drains floors etc.
- If the bench march is far from the proposed site a levelling instrument can be used to transfer the datum level to site.

Fig 5



THE DESIGN FOR TEMPORARY SITE BENCH MARK

Building materials SAND

Objectives: At the end of this lesson you shall be able to
- **state types of sand**
- **state classification of sand**
- **describe bulking of sand.**

Types of Sand

The sand particles consists of small grians of silica. (Sio2) It is formed by the decomposition of sand stone due to various effects of weather.

According to the natural sources from which the sand is obtainted It is the following three types.

- Pit sand
- River sand
- Sea sand.

Pit Sand

- This sand is found as deposits in soil and it is obtained by forming pits into soils.
- It is excavated from a depth of about 1m to 2m from ground level.
- The pit sand consists of sharp angular grains
- It is free from salt and other organic matters.
- It proves to be excellent materials for mortar or concrete work.

River sand

- This sand is obtained from banks or beds of rivers.
- The river sand consists of fine rounded grains.
- The colour of river sand is almost white
- The river sand is usually available in clean condition.
- It is usually used for all works in Civil Engineering construction.

Sea sand

- This sand is obtained from sea shores.
- It is also consists of fine rounded grains
- The colour of sea sand is light brown
- The sand contains salts.
- Hence, it is not generally used in construction purposes.
- It mainly used for filling basements works.

Qualities of good sand

- Sand should be clean, sharp angular hard and durable.
- Sand should be free from clay, mica and soft flaky pieces.
- Mostly River sand and pit sand used for all construction works.
- All sand must be well washed and cleaned before use.
- Generally 4 to 6 percent of clay and silt are premitted in sand.
- well graded sand should be used for cement work as it adds to the density of the mortars and concrete.

Classification of sand

According to the size of the grains, the sand is classified as

- Fine sand
- Coarse sand
- gravelly sand

Fine sand

- The sand passing through a screen with clear openings of I - 5875 mm is known as the fine sand.
- It is mainly used for pointing and plastering works.

Coarse sand

- The sand passing through a screen with clear openings of 3.175mm is known as the coarse sand.
- It is generally used for masonry work.

Gravelly sand

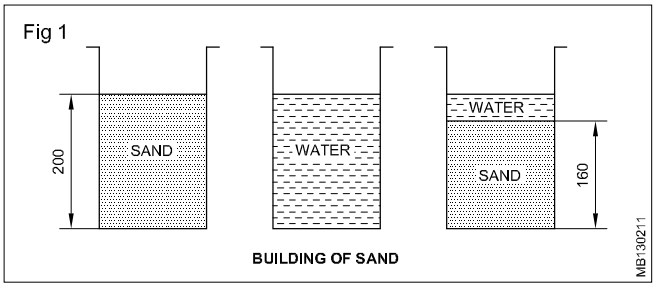
- The sand passing through a screen with clear openings of 7.62 mm is known as the gravelly sand.
- It is generally used for concrete work.

Object of mixing sand in mortar is

- The prevent excessive shrinkage and cracking of mortars in setting, especially in the case of the fat limes which shrink very much while drying cement also shrink to some extent.
- To improve the setting power of fat limes.

- To improve the strength of a mortar as sand has greater crushing strength
- To increase the bulk and reduce the cost, especially in the case of cement mortar.

Fig 1



BUILDING OF SAND

Bulking of sand

- A very simple test may be carried out to decide the percentage of Bulking of sand.
- The following procedure is adopted
- A glass container is taken and it is filled two -third with the sample of sand which is to be tested.
- Measure the height of sand filled, say it is 200mm
- The sand is removed out from the container, there is no less of sand during this transcation.
- The container is filled with water.
- Sand is then slowly dropped in the container and it is throughly stirred by means of a rod.
- The height of sand is measured say it is 160mm

$$\text{Bulking of sand} = \frac{(200 - 160)}{160} = \frac{40}{160} = \frac{1}{4} \text{ (or) } 25\%$$

Bulking of sand is 25%

Building Materials (BRICKS)

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

- **define constituents of good brick earth**
- **describe manufacturing of bricks**
- **describe qualities of good bricks.**

Bricks are artificially manufactured building materials.

It is a rectangular in shape and Brick is in uniform size and standard measurements

Bricks can be easily handled by hand as they are light in weight.

Composition of good brick earth:

The following are the constitutents of good brick earth

- Alumina - 20 - 30%
- Silica - 50 - 60%
- Lime - 5%
- Oxide of Iron - 5 to 6%
- Magnesia - 1%

Alumina

- A good brick earths hould contain 20% to 30% of Alumina.
- It gives good plasticity to the earth for moulding.

Caution

If Alumina is present in excess raw bricks shrink and warp during drying and burning.

Sillica

- A good brick earth should contain about 50% to 60% of silica
- It prevents cracking, shrinking and warping of raw bricks.

Caution

The excess of silica destroys the particles and the bricks become brittle.

Lime

- A small quantity of lime about 5%
- The lime prevents shrinkage of raw bricks
- The excess of lime causes the brick to melt and hence it shape is lost.

Oxide of iron

- A little quantity of oxide of iron to the extent of about 5 to 6% in good brick earth
- Oxide of iron gives red colour to the bricks.
- The excess of oxide or iron makes the bricks dark, blue or blackish.
- If oxide of iron is less, the bricks will be Yellowish in colour.

Magnesia

- A small quantity of magnesia in brick earth imparts yellow tint to the bricks and decreases shrinkage
- But excess of magnesia leads to the decay of bricks.

Caution

Excess of magnesia leads to the decay of bricks.

The process of manufacturing bricks

The following operations are involved.

- Preparation of clay
- Moulding
- Drying
- Burning.

Preparation of Clay

- The top layer of soil, about 20cm in depth is taken out and thrown away.
- The clay is then dug out from the ground.
- It is spread on the levelled ground
- The clay as obtained in the process of digging should be cleaned of stones, pebbles, vegetable matter, etc.
- The clay is then exposed to atmosphere for softening.
- The clay is made loose and any particles to be added to it is spread out at its top and mixed well up and down.
- The water is added in required quantity in clay and the whole mass is kneaded or pressed under the feet of men.

Moulding

The clay which is prepared is then for next operation of moulding.

- Hand moulding
- Machine moulding

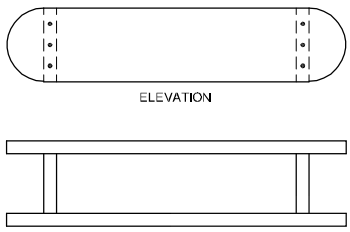
Hand moulding

- The bricks are moulded by hand or manually
- The moulds are rectangular boxes, which are open at top and bottom.
- They may be wood or steel.

Wooden mould

- It is prepared with well seasoned wood.
- Longer sides are kept slightly projecting to serve as handles.
- The strips of brass or steel are sometimes fixed on the edges of wooden moulds to make them more durable as shown in (Fig 1).

Fig 1



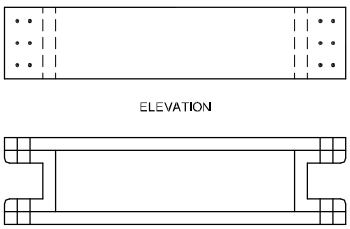
WOODEN MOULD

MB130411

Steel mould

- Steel mould is prepared from the combination of chan nels and steel plates
- It maybe prepared from steel angles and plates.
- The thickness of steel mould is generally 6mm.
- The steel mould is more stronger than wooden moulds.

Fig 2



STEEL MOULD

MB130412

Bricks prepared by hand moulding are of two types

1 Ground moulded bricks.

2 Table moulded bricks

Ground moulded bricks

- The ground is first levelled uniformly.
- Fine sand or ash is sprinkled over it
- The mould is dipped in water and placed over ground.
- The lump of tempered clay is taken and it is dashed in the mould.
- The clay is pressed in the mould
- Take care that all the corners fills well
- The extra surplus clay is removed.
- The mould is then lifted up and raw brick is left on the ground.

Table moulded bricks

- The process of moulding these bricks is just similar to hand moulding.
- The brick moulder stands near a table of size about 3m x 2m The tempered clay, mould, water pots, stocks board are placed on this table.
- The bricks are moulded on the table and send for drying.

Drying

- For drying the bricks are laid and stacked longitudinally of width equal to 2 to 3 Bricks.
- The stack consists of eight to ten tiers.
- The bricks are laid along and across the stack in alternate layers
- All bricks are placed on edge
- The bricks should be allowed to dry till they become hard.

Period of drying

- For drying purpose, the time required by moulded bricks to dry depends on prevailing weather condition. Usually drying takes about 3 to 10 days.
- The bricks in stacks a way that sufficient air space is left in between them for free circulation of air.

Burning

- Burning is the one of the most important operation in the manufacture of Bricks.
- By burning bricks gets hardness, and strength and makes them dense and durable.
- The bricks should be burnt properly.

Caution

If bricks are overburnt, they will be brittle and hence break easily

If they are underburnt, they will be soft and hence cannot carry loads.

The burning of brick is done either in

- Clamp
- Kiln

Clamp

- The clamps are temporary structures and they used to manufacture bricks in small quantity to serve a local demand.
- A piece of ground is selected, and it should be slightly sloping ground at an angle of 15^0 from ground level
- The Brick wall is constructed with mud mortar at one end.
- And a layer of fuel is laid on the sloping ground.
- The fuel may consist of grass, cow dug, ground nuts and Husk of rice, etc.
- Each thickness of layer is about 70cm to 90cm The wood and coal dust also may be used as fuel.
- A layer of 4 to 5 courses of raw bricks is putup over fuel already laid.
- The raw bricks are laid on its edge, for free circulation of air.
- A second layer of fuel is then putup over the raw bricks.
- And another layer of 4 to 5 courses of raw bricks are again laid.
- Alternate layers of fuel and raw bricks are placed.
- The total height of a clamp may vary from 4 metre to 5 metre
- After clamp is completed. it is plastered with mud on sides. including top.
- Then clamp is fixed at bottom. and it is allowed to burn for a period of about 2 to 3months.
- The clamp is allowed to cool for another 2 to 3months.
- The burnt bricks are then takenup from the clamp.

Kilns

- The kilns are permanent structures and they are used to manufacture bricks on a larger scale.
- A kiln is a large oven which is used to burn bricks.

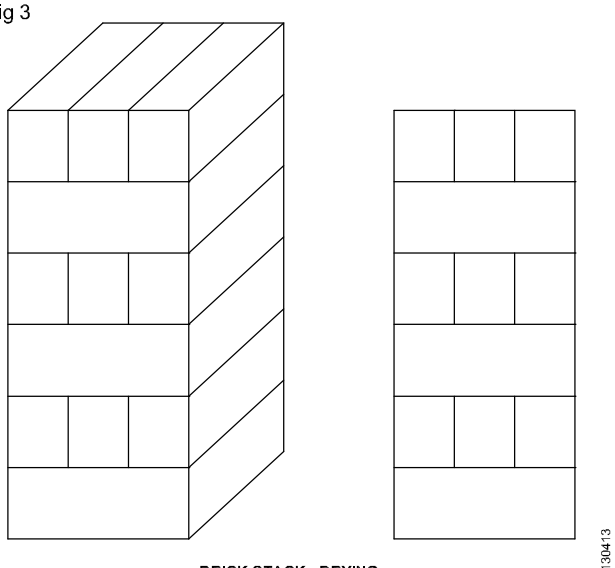
The kiln has the following two types.

- Intermittent kilns
- Continous kilns

Intermittent kilns (Fig 3)

- Intermittent kilns are in operation which means that they are loaded, fixed cooled and unloaded.
- These kilns may be either rectangular or circular in plan.
- The raw bricks are laid in rows of thickness equal to 2 to 3 bricks and height equal to 6 to 8 Bricks.

Fig 3



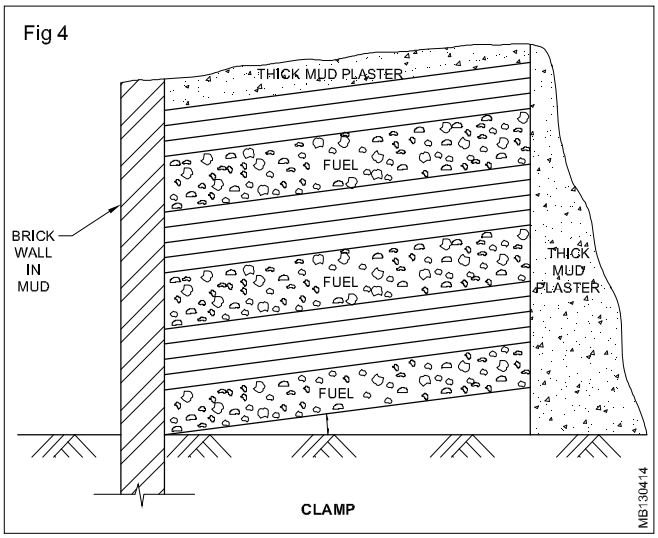
BRICK STACK - DRYING

MB1304113

- A space of about 2 bricks is left between adjacent rows.This space is used for placing fuel.
- The fuels are filled with brush wood which takes up a fire easily.
- An arch like opening is formed by projecting 5 to 6 rows of bricks.
- The loading of kiln with raw bricks is then carried out.
- The doors are covered with dry bricks and with mud clay and kiln is then fixed.
- The fire can be regulated by opening or closing the iron sheet doors of the fire holes and by controlling the supply of fuel.
- After burning of Bricks kiln is allowed to cool down gradually for atleast seven days.
- The bricks are then taken out
- The procedure is then repeated for the next burning of Bricks.

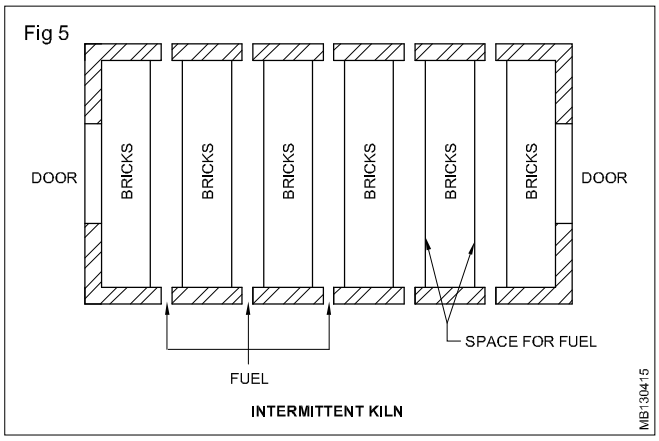
Contineous kilns (Fig. 4)

Fig 4



CLAMP

MB1304114



These kilns are contineous in operation. This means that loading, firing cooling and unloading are carried out simultaneously in these kilns.

The following three types of contineous kilns.

- Bull's trench kiln
- Hoffman's kiln
- Tunnel kiln

In above all kilns are working as all the operations

- Loading
- Burning
- Cooling and
- Unloading are carried out simultaneously the manufacturing of Bricks contineously.

Qualities of Good bricks

- All bricks should be uniform in shape and size
- Bricks should be well burnt
- A good brick should be in reddish colour
- A good brick should have rectangular in shape and all the edges are in sharpe and right angle
- The bricks should give ringing mettalic sound when struck with each other
- The good brick should not absorb not more than 20% of its own weight.
- The bricks should not break into pieces when dropped flat on the ground.
- When brick is scratched with finger nail, no impression should be marked on the brick.
- A good brick should have the crushing strength not below 5 N/mm^2
- A good brick should have sufficiently hard and durable

Tests for Bricks

A brick is generally tested follows

- Shape and size
- Soundness
- Hardness
- Structure
- Absorption.

Shape and size

- In this test a brick should be of standard size, shape should be rectangular with sharpe edges.

Soundness

- In this test bricks are taken by both hand and struck each other. The brick should give mettalic ringing sound and also bricks should not break.

Hardness

- In this test, no impression should be marked, when scratch by finger nail

Structure

- In this test the structure of a broken Brick is examined well.
- It should be homogeneous and free from any defects such as holes, lumps etc.

Absorption

- In this test a well burnt brick is taken and its is weighed dry
- It is then immersed in water for a period of 24 hours.
- Then it is taken out and weighed again
- The difference in weight shows the amount of water absorbed by the brick
- In any case, a brick should not absorb not more than 20percent of its own weight.

Method of cutting bricks by using of bolster and hammer

Objectives: At the end of this lesson you shall be able to
• method of cutting bricks by using of bolster and hammer.

- Set one brick face up on an off cut of timber or fibre board.
- Mark the face of the brick for cutting. Using the width another brick as a guide
- Hold the blade of the bolster on the face of the brick and vertical to it
- Strick the bolster with a firm hard blow with the lumb hammer.
- Use the bolster and Lump hammer to trim any excess remaining on the half brick
- Mark the line of cut for the closer on each header face an the brick to be cut
- Stand the brick an one header face on a fobre board pad and Place the bolster along the cutting line.
- Strike a medium blow with a lump hammer, turn the brick to the other header face and repeat the cut with are medium blow.
- Continue alternating between each header face untill the brick is cut.

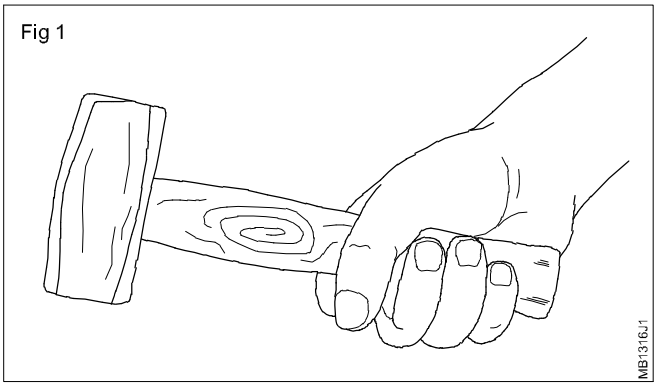
Caution

- Keep away fingers from the chisel head.
- Care should be taken while blow with hammer. Other wise may spoil the fingers.(Fig.1)

Lump hammer

- 1 kg hammer used in conjunction with a bolster for cutting (Fig 1)

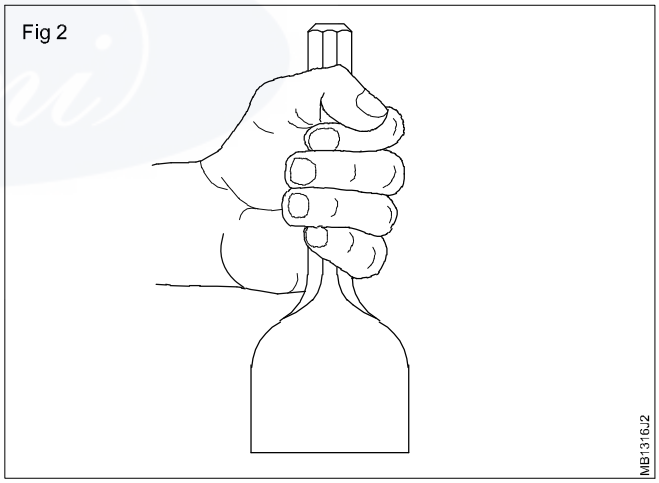
Fig 1



Bolster (Fig.2)

- 100 mm wide chisel, when cutting or trimming the bricks The brick should rest on a fibre of soft wood Pad to reduce unnecessary fractures. For final cutting the bolster should be given a sharp heavy blow with lump hammer or club hammer.

Fig 2



Masonry Tools

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

- **define laying tools**
- **define wall straightening tools**
- **define cutting and trimming tools**
- **define finishing tools.**

Block laying and concreting tools consists of tools normally used by the brick layer plus a few additional tools which have been developed to meet the specific demend of the work involved.

The Block layer and concrete is often also a plasterer, a tiler and drain layer.

we shall discuss some of the most important tools under the headings that follow.

Laying tools

Wall straightening tools

Cutting and Trimming tools

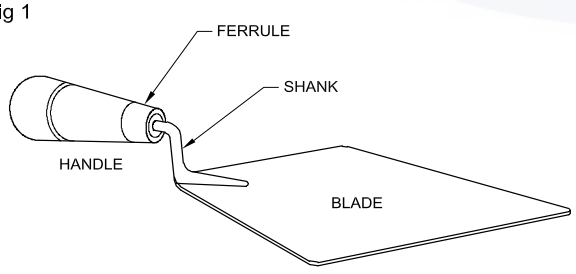
Finishing tools.

Laying tools

Block Trowel (Fig.1)

This is a tool which every block layer and concreter must possess used for picking up mortar from the mortar board, spreading it on the wall for bed joints, forming cross joints on blocks, cutting of excess mortar and consolidating cross joints. It is also used for tapping down laid blocks and for rough cutting of blocks.

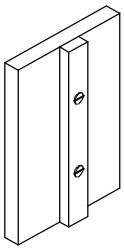
Fig 1



BLOCKLAYING TROWEL

Jointing Board (Fig.2)

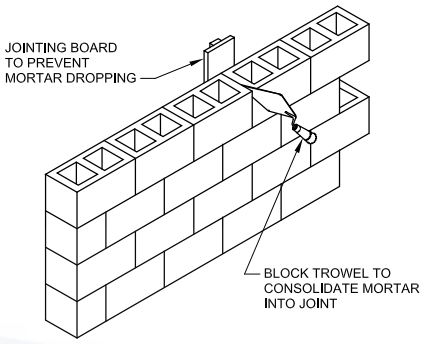
Fig 2



JOINTING BOARD

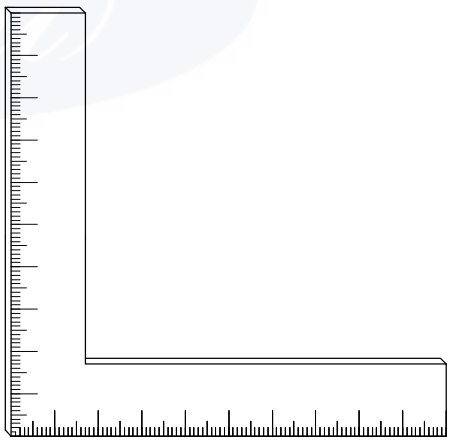
The jointing board can be made quite easily from either a 25mm thick piece of wood or a 19mm thick piece of plywood. It measures 300mm long by 75mm side. with a 25mm gripping piece screwed to the back. Its use as a tool is to facilitate the filling of cross joints to prevent mortar dropping (Fig.3)

Fig 3



Steel square (Fig.4)

Fig 4



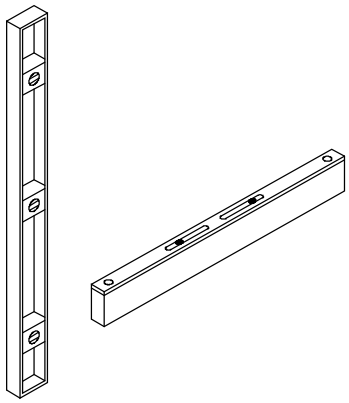
This tool is used in checking whether or not the angle formed by two walls meeting one another is 90^0. It is marked inmillimeters and measures 600mm by 450mm.

WALL STRAIGHTENING TOOLS

Spirit level (Fig.5)

The spirit level or plumb level as it is sometimes called is a very useful tool in the Brick layer or Block layer's toolkit. It may be made of wood or metal with straight edges. It is fitted with 3 spirit tubes for levelling and plumbing These spirit tubes are fitted one at each end with single tubes used for checking the plumb of the wall. and other two tubes fitted at the centre for checking levels, The most common type is 1 metre long.

Fig 5



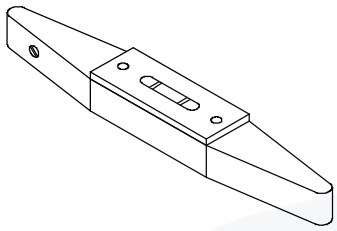
SPIRIT LEVELS

MB130115

Boat level Spirit level (Fig.6)

This level performs the same functions as the spirit level or plumb level. But is used mainly at small openings Boat levels measure from 225 mm to 300mm

Fig 6



BOAT LEVEL

MB130116

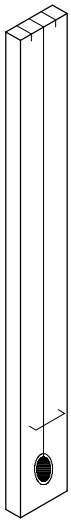
Plumb rule

This is a straight edge with a cut line running down the centre from the top to with in about 150mm from the bottom edge where a hole is made slightly larger than the plumb bob.

The plumb bob is an egg shaped angle piece of steel or lead held in position by a plumbline.

This tool ensures a very accurate vertical check as shown in (Fig 7).

Fig 7



PLUMB RULE

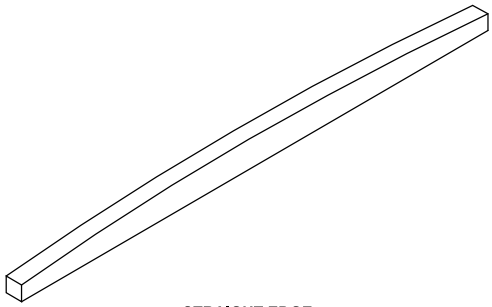
MB130117

Straight edge (Fig.8)

This is a piece of timber or Aluminium hollow piece of a length to suit its purpose, a convenient length for the brick layer or Block layer being 2 metres. It is bevelled at both ends to reduce the overall weight in the case timber.

The straight edge is used to check the flatness of a newly laid piece of wall and ensure that all blocks or bricks are laid to the same level in each course.

Fig 8



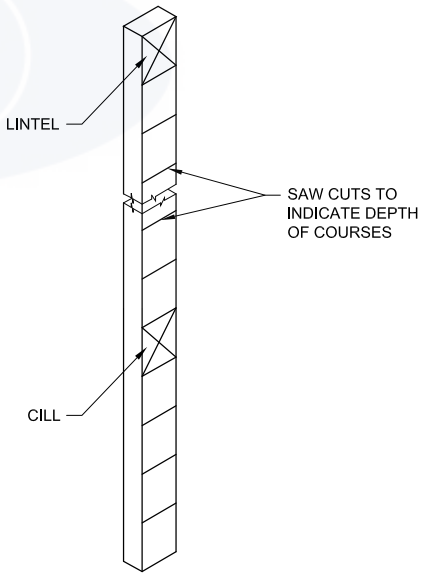
STRAIGHT EDGE

MB130118

Gauge Rod or Rule (Fig.9)

The Gauge rule should be sufficiently long. It has the depth of Block courses or Brick courses including mortar joints thickness marked on it. In addition to the courses of Bricks or Blocks, various important levels such as sill level, springing level are marked on it.

Fig 9



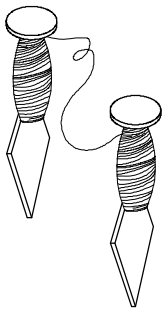
GAUGE RULE

MB130119

Line and Pins (Fig.10)

The line is usually made of hemp or nylen. It is wound round the spear like steel pins. To use this tool, the pins are each pushed into a joint at each end or Quion of the wall to hold the line tant. Each course is then laid using the line as a guide. The blocks or bricks being laid to leave just a strip of daylight between their edges and the lines so that they do not actually touch it.

Fig 10



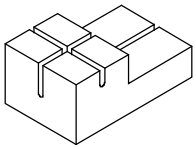
LINE AND PINS

MB13011A

CORNER BLOCKS

Where glazed work is involved and the joints are so tight that pins cannot be inserted into them, corner blocks are used instead of pins to hold the line tant. as shown in (Fig.11)

Fig 11



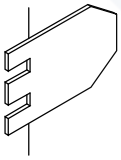
ENLARGED VIEW OF CORNER BLOCK

MB13011B

Tingle plate

This is a small metal plate with three fingers at one end used to take up the sag of the line. A common size is 100mm long as shown in (Fig.12)

Fig 12



TINGLE PLATE

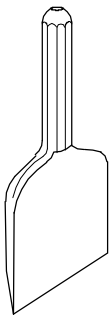
MB13011C

CUTTING AND TRIMMING TOOLS

Bolster (Fig.13)

The bolster is used for the clean cutting of Blocks and concrete components. It has a blade whose cutting edges ranges from 75mm to 125mm wide with a slight convex curve. It is hardened for cutting. The stock or striking end is left unhardened to prevent pieces of metal braking and flying off when struck with hammer.

Fig 13



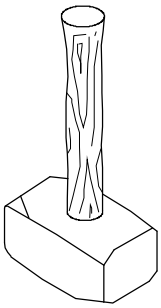
BOLSTER

MB13011D

Club Hammer (Fig.14,15)

The club Hammer is made in two ranges those with the steel head weighing 1.135Kg and those with 1.81kg head. It is fixed to a handle about 225mm long. This tool is used together with the bolster for cutting purposes.

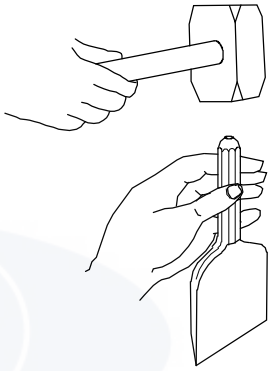
Fig 14



CLUB HAMMER

MB13011E

Fig 15



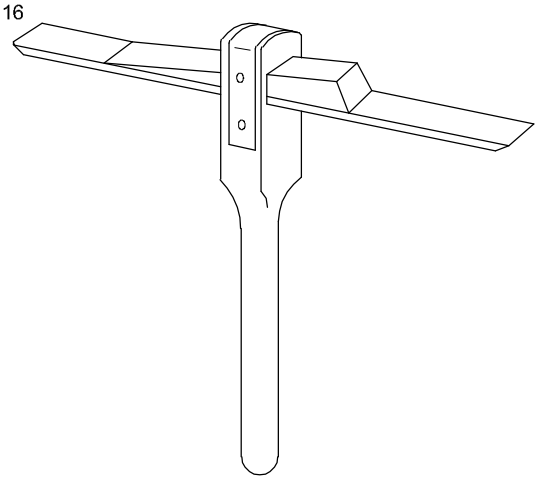
CUTTING WITH BOLSTER AND HAMMER

MB13011F

Scutch

The sketch consists of a stock wedge and reversible blade. It is used for trimming a block when cut. as shown in the (Fig.16)

Fig 16



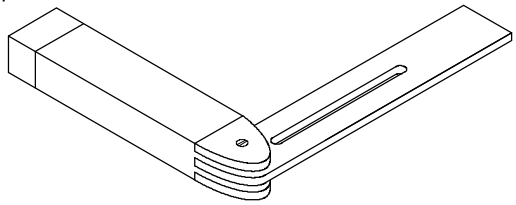
SCUTCH

MB13011G

Square and bevel(Fig.17)

The square and bevel are used for marking splayed cuttings.

Fig 17



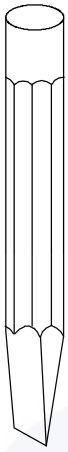
SQUARE AND BEVEL

MB13011H

Cold chisel (Fig.18)

The cold chisel is made in varying lengths and thickness from 6.25mm x 400mm to 25mm x 450mm They aremade of steel with the cutting edge and the stock treated in a similar manner to those of a bolster.

Fig 18



COLD CHISEL

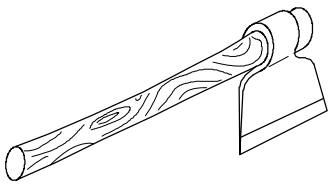
MB13011I

Block Axe(Fig19)

The block axe is very popular among block layers. It is used for cutting blocks into required diamensions and for cleaning the cut edges in much same way as a scutch is used.

Hollow blocks are difficult to cut with the success using a bolster and Hammer, because of the thickness of the ribs bounding the holes.

Fig 19



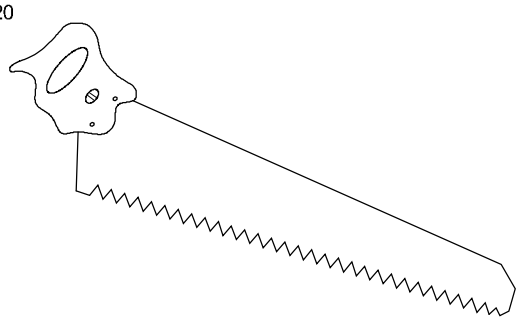
BLOCK AXE

MB13011J

Mason's hand saw (Fig 20)

The hand saw with 12mm teeth is used for cutting soft stones and sandcrete blocks. The saw is similar in all respects to the carpenter's hand saw except that the mason's hand saw is set with chisel shapped teeth of the necessary clearance for the saw cut. When cutting a block with saw, the block is first soaked with water and kept wet throughtout cutting operation. The water acts as a lubricant to minimise fricition between the saw and the block.

Fig 20



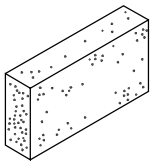
MASON'S JAW

MB13011K

Carborundam stone (Fig.21)

A carborundam stone is used for rubbing down the cut edges of blocks.

Fig 21



CARBORUNDUM STONE

MB13011L

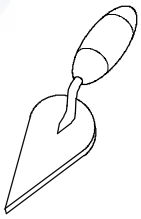
Finishing Tools

Pointing Trowel (Fig 22)

This is smaller in shape and lighter than the laying Trowel.

It is used for filling in the joints of a Brick or Block wall during the pointing operation.

Fig 22



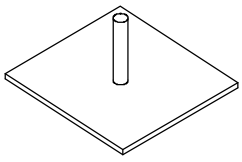
POINTING TROWEL

MB13011M

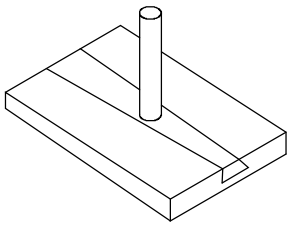
Hawk (Fig 23)

The Hawk is a hand board made from wood, steel or aluminium and is used to carry mortar while pointing or plastering.

Fig 23



STEEL HAWK



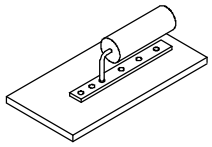
WOODEN HAWK

MB13011N

Plastering Trowel (Fig 24)

Made of steel with a rectangular face of about 275mm by 125mm The plastering Trowel is used for laying mortar on the wall surface and when final coat is applied it is used as finishing tool to give a very smooth surface to the walls.

Fig 24



PLASTERING TROWEL

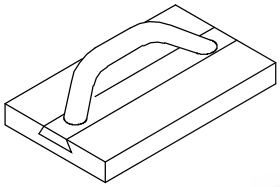
MB13011O

Wooden float (Fig 25)

The cross grained wooden float, as the name implies, has grains running across the sole.

It is used for scouring of excess mortar on the surface of the wall finishing coats and making angles square and clean.

Fig 25



WOODEN FLOAT

MB13011P

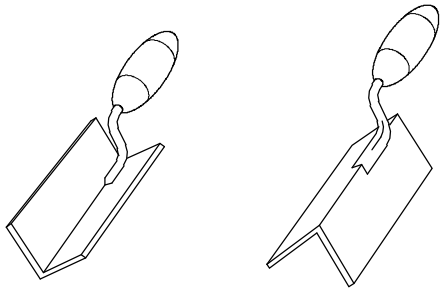
Angle tool (Fig 26)

These are made with either wooden or steel plate bent into angle of 900. It is used for finishing angles in neat and square form.

A Internal angle Tool

B External angle Tool

Fig 26



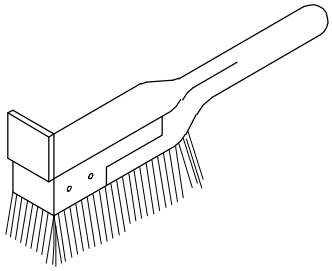
INTERNAL ANGLE TOOL EXTERNAL ANGLE TOOL

MB13011Q

Wire brush (Fig 27)

Used for multi purposes such as cleaning the joints of Brick work or block work, before pointing operations removing dirt from plastered surfaces before a painting operation and cleaning tiled work etc. (Fig 28)

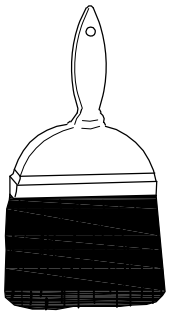
Fig 27



WIRE BRUSH

MB13011R

Fig 28



MB13011S

Joint cluster

The job of pointing in brick work and jointing block wall is much improved by finally using a joint cluster.

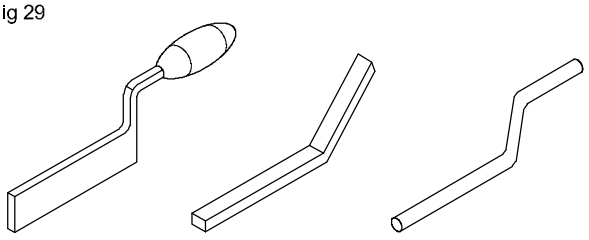
It is used to remove the excess mortar pieces from the finished work.

It is a convenient tool to use in wetting the joints before and as the work proceeds.

Jointing tools

These are popularly called jointers. They are of three main shapes as shown in the (Fig.29)

Fig 29



JOINTERS

MB13011T

Brick masonry Technical terms used

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

• define and explain the different technical terms used in brick masonry, necessity of bonding BRICK

Masonry is the art of construction in brick or stone

- From the very early ages of civilization new know the art of construction though the method were crude.
- But the advancement of age the technique of construction have appriciably developed.

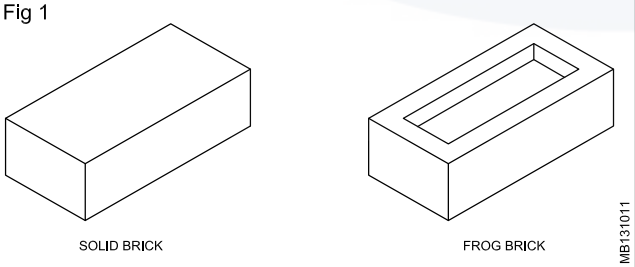
Masonry broadly divided into two parts

- Stone masonry
- Brick masonry
- Stone masonry is that in which stone is used as a construction material
- Brick masonry is that in which brick is used as a construction material.
- Technical terms used in Brick masonry

Brick

- Brick is the artifically manufactured It is in rectangular shape and size is 230 mm x 110mm x 70mm as shown in (Fig 1) (in ISI 200x100x100mm)

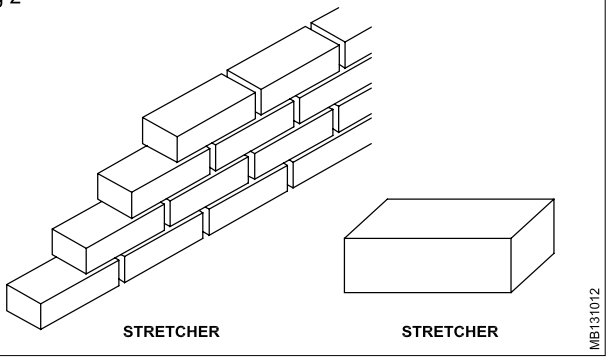
Fig 1



Stretcher

These are the bricks or stones laid long in a wall as shown in (Fig 2)

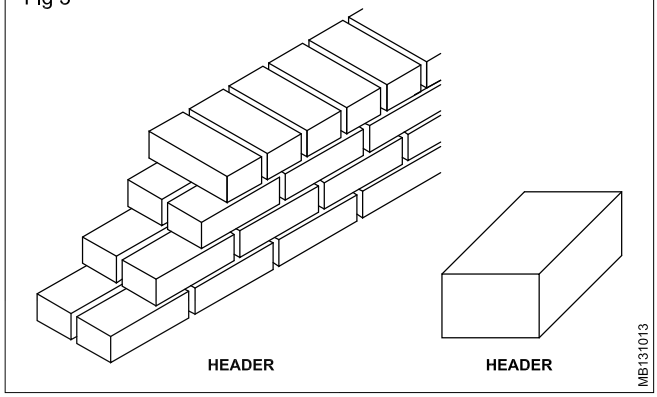
Fig 2



Header

These are bricks or stone blocks laid breadth wise or thier headers length of the wall as shown in (Fig 3)

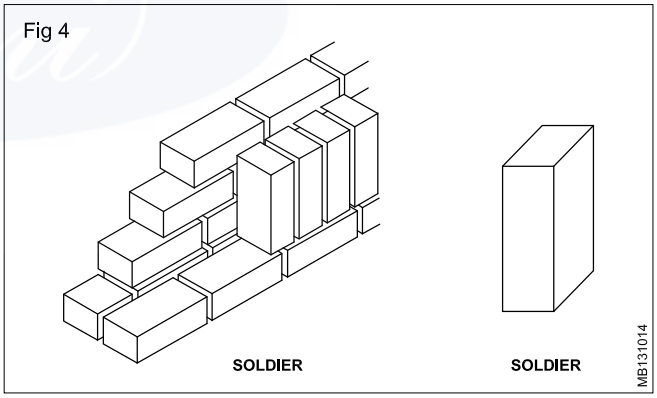
Fig 3



Soldier

These are bricks, laid stretcher face in vertical position as shown in (Fig 4)

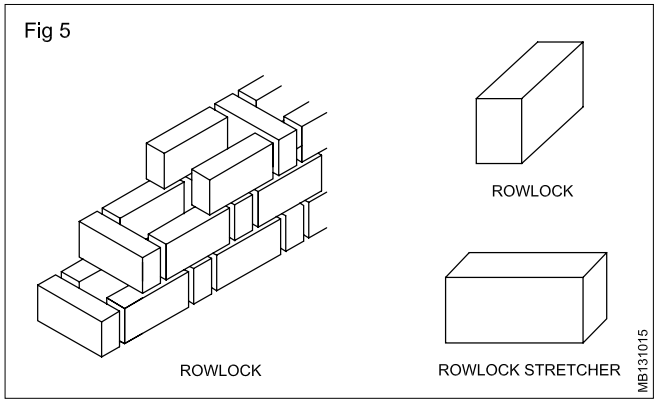
Fig 4



Row lock

These are bricks which are laid on its edge as shown in figure. This is also called Brick -on edge as shown in (Fig 5)

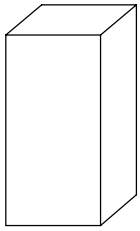
Fig 5



Sailor

These are bricks which are laid vertical position with bed of the brick is placed in elevation shown in(Fig 6)

Fig 6



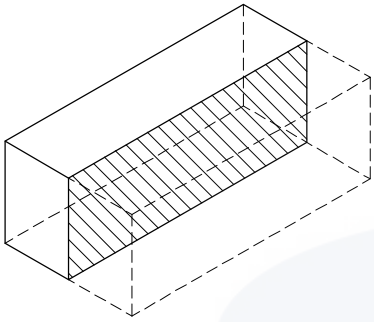
SAILOR

MB131016

Queen closer

These are half bricks cut length wise. It is used along the length of a quoin for staggering joints of alternate course see (Fig 7)

Fig 7



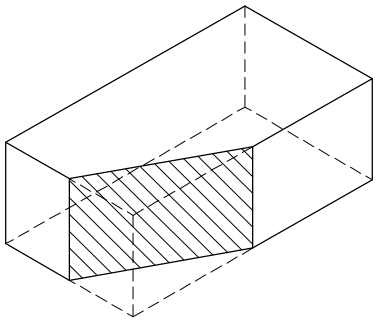
QUEEN CLOSER

MB131017

King closer

It is a brick which is cut in such a manner that the width of one of its ends is half a full brick. It is formed by cutting a triangular portion trans one of the corner ofa brick between the centre of one end of the centre of the other end as shown in (Fig 8)

Fig 8



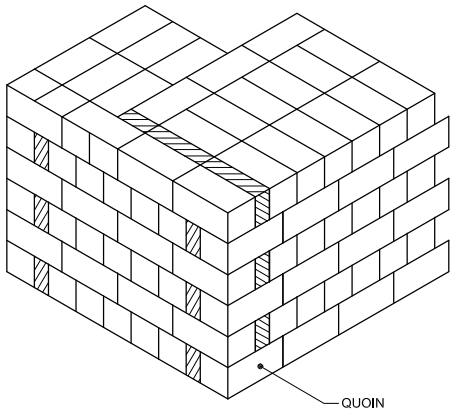
KING CLOSER

MB131018

Quoin (or) Quoin header

It is the brick or block of stone used at the corner of two walls. This bricks or block of stone will look as header from one side and stretcher from the other side as shown in (Fig 9).

Fig 9



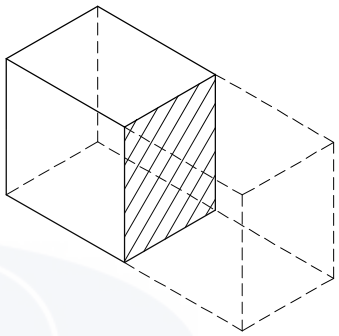
QUOIN

MB131019

Bats

These are bricks which are cut length wise into two half bats, which are known as half brick as shown in (Fig 10)

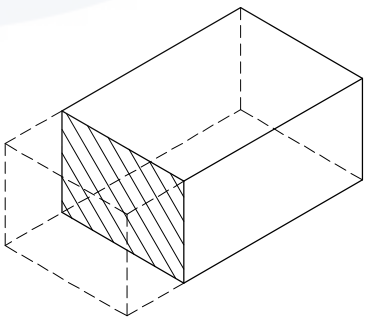
Fig 10



MB13101A

If the full brick is cut into 3/4 then it is called as 3/4th bat as shown in (Fig 11)

Fig 11

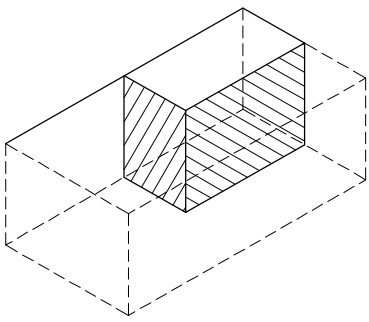


¾ TH BRICK

MB13101B

If the full brick is cut length wise into two half portion is queen closer, and again cut into two half is known as 1/4 brick. as shown in(Fig 12)

Fig 12



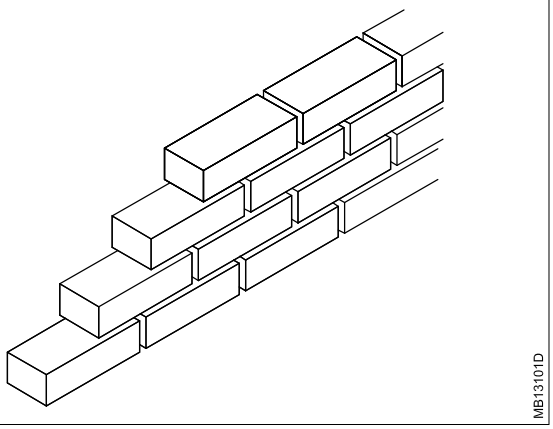
¼ BRICK

MB13101C

Course:

A horizontal layer of Bricks or stones laid in mortar or without mortar in a systematic way is called as course. see (Fig 13)

Fig 13

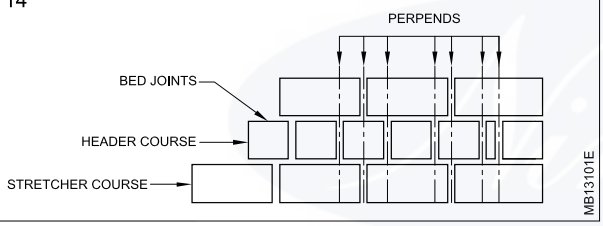


Bed joints

These are horizontal joints of a brick or stone masonry

Perpends These are imaginary vertical lines, containing the vertical joints of masonry (Fig 14)

Fig 14



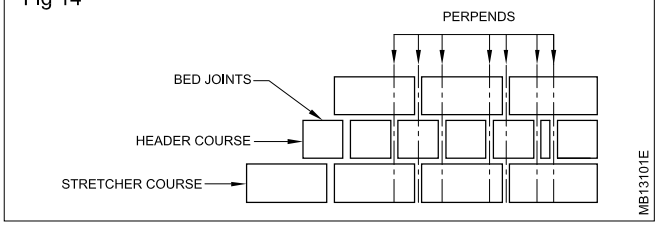
Jambs

These are vertical sides of a door or window openings on the backside These may be squared or splayed and are provided with recess to receive the door or window frame

Reveal

These are exposed vertical surface of walls on the outside of an opening of a door or window. The function of a reveal is to protect the frame and to keep privacy of the room as shown in (Fig 15)

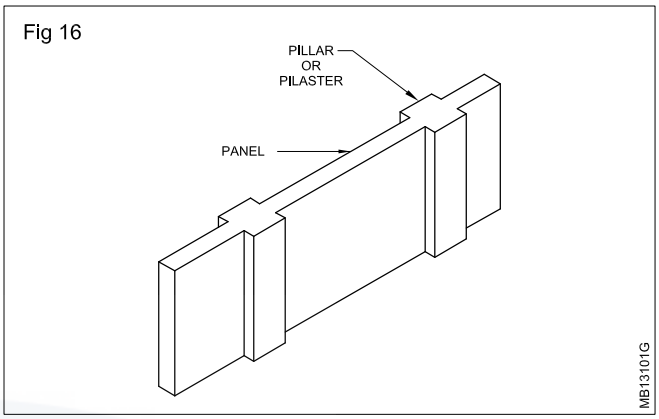
Fig 14



Panel and Pilaster wall

These are boundary walls consisting of pillars at regular intervals and thin partition walls. The function of a panel and pilaster wall is to increase the transverse strength of the long boundary wall.

Fig 16



Necessity of bonding bricks

Occording to their uniform size and shape the bricks are arranged various pattern

Bonding is essential to eliminate continuous vertical joints both in the body as well as in the face of the wall to give the strength to masonry.

A wall having continuous vertical joints does not act as a homogeneous mass to distribute the supermpost load.

Building materials MORTAR

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

- **state the properties of good mortars mix**
- **state the properties of good mortert**
- **state the types of mortert and its uses.**

The term mortar is used to indicate a paste prepared by adding required quantity of water to a mixture of binding materials like cement or lime and fine aggregate like sand.

The above two components of mortar, namely the binding materials and fine aggregate sometimes refered to as the matrix and adulterant respectively.

The properties of good mortar mix and mortar

The important properties of a good mortar mix are mobility, placeability, and water retension.

Mobility

The term mobility is used to indicate the consistency of mortar mix depends on the composition of mortar and the mortar mixed to be used for masonry work, finishing work etc.

Placeability

The placeability of mortar mix should be such that a strong bond is developed with the surface of the bed.

Water retension

- A good mortar mix should possess the ability of retaining adequate humidity during the transportation and laying over the porus bed.
- If water retention power of mortar mix is low, it breaks into pieces.

Properties of good mortar

- It should be cheap
- It should be durable
- It should be easily workable
- It should be capable of developing good adhesion withthe building units such as brick, stones etc.
- It should be capableof developing the designed stresses.
- It should be capable of resisting penetration of rain water
- It should set quickly
- It should not affect the durability of materials.
- The joints formed by mortar should not develop cracks.

Preparation of mortar

For preparing mortar, the water is added to an intimate mixture of binding material and sand. The water which is good and fit for drinking should only be used for preparing mortar.

Mortar is usually of the following types

- mud mortar
- Lime mortar
- Cement mortar
- Cement lime mortar

Mud mortar

This type of mortar commonly used for small works in villages.

- Clay and potable water mixed together to get a paste and stiffness.

Lime mortar

- The lime mortar is prepared by pounding or grinding
- The pounding is adopted for preparing small quantities.
- The grinding is adopted for preparing large of mortar.
- The lime mortar is used in brick works and also for plastering the surface of wall both external and internal walls.

Cement mortar

The cement and sand are mixed in required proportions in dry state on a water light platform or steel trough

The mixing in dry state is done twice or thrice up and down.

The potable water is then added and the binding materials and sand are again throughly mixed until good plasitsity workability.

Fig 1

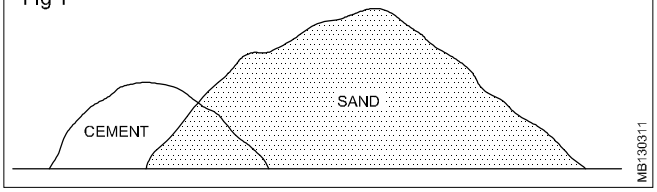
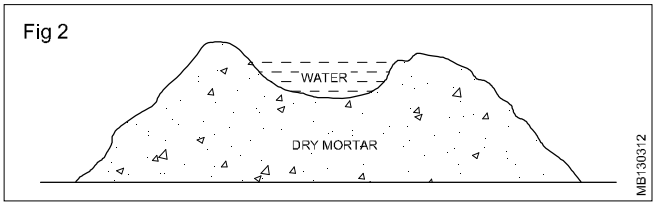


Fig 2



Uses of mortar

- To bind the building units such as bricks, blocks,stones, etc into a solid mass
- To carry out pointing and plastering work on exposed surfaces of masonry
- To form an even and soft bedding layer for building uints.
- To prepare moulds for coping, carbels cornice etc
- To improve the general appearance of structure.
- To form joints of pipes
- To distribute uniformly the super imposed loads from upper layer to lower layer of bricks or blocks or stones.
- To hide and close the open joints of brickwork and stone work.
- To fillup the cracks detected in the structure.

Selection of mortar

In civil Engineering works, suitable type of mortar shall be selected or recommended as follows.

No.	Type of mortar	Nature of work
1	Cement or lime mortar 1:3 lime being eminently hydraulic lime.	Construction work in water logged areas and exposed positions.
2	Cement mortar 1:2	Damp-proof courses and cement concrete roads
3	General R.C.C works such as Lintels, pillars slabs, stains etc	Cement mortar 1:3 the concrete mixing 1:2:4
4	Partition walls and parapet walls.	Cement mortar 1:3 or lime mortar 1:1
5	Plaster work	Cement mortar 1:3 or 1:4 or lime mortar 1:2
6	Pointing work	Cement mortar 1:1 or 1:2
7	Brickwork, foundations stone masonry, Block masonry work etc	Lime mortar 1:2 Cement mortar 1:6
8	Thin joints in Brick work	Limemortar 1:3 Cement mortar 1:2

Tests for mortar

The following are the usual Tests for mortar

- Adhesiveness to building units
- Crushing strength
- Tensile strength

Types of bonds

Objectives: At the end of this lesson you shall be able to
• state different types of bonds.

Bricks can be arranged in different fashions and patterns.

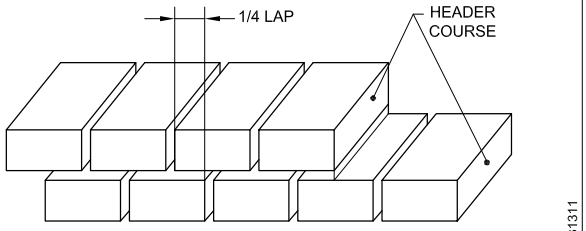
The following arrangements are mostly used for different types of work and for different situations.

- Header Bond
- Stretcher Bond
- English Bond
- flemish bond
  - a) single Flemish bond
  - b) Double Flemish bond
- Raking bond
  - a) Herring bone bond
  - b) Diagonal bond
- Garden wall Bond
  - a) English garden wall Bond
  - b) Flemish garden wall Bond.
- Dutch Bond
- Facing Bond
- English cross Bond
- Monk Bond and so on

Header bond

- This is simple type of bond consists of headers in every courses.
- All the bricks are laid cross wise with 5cm lap in each course.
- The bond is used in foundation footings, curved walls, in corbles and overhanging courses as shown in(Fig 1).

Fig 1

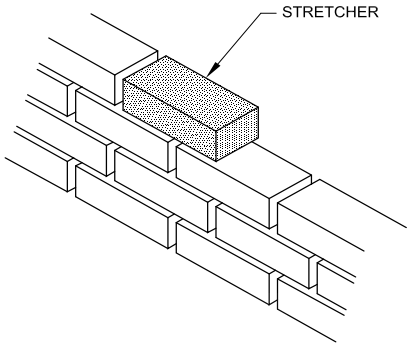


HEADER BOND

Stretcher Bond

- This type of bond consists of bricks laid length wise or as stretchers with a overlap of 10cm in each course.
- When the thickness wall is 20cm or more, the transverse strength of the wall reduces.
- It is only recommended for walls having a thickness of only half brick 10cm s shown in (Fig 2)

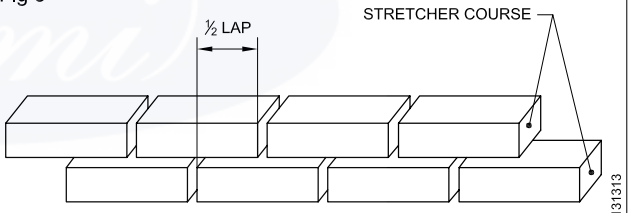
Fig 2



STRETCHER BOND

- All the bricks are laid lengthwise half Brick lap as shown in (Fig 3)

Fig 3

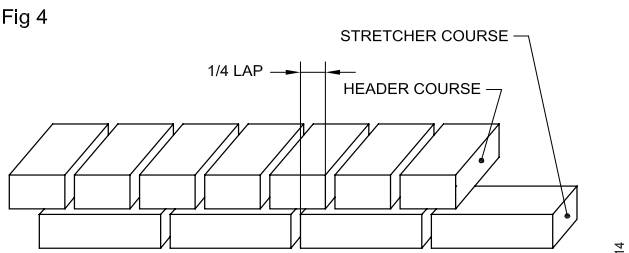


STRETCHED BOND

English Bond

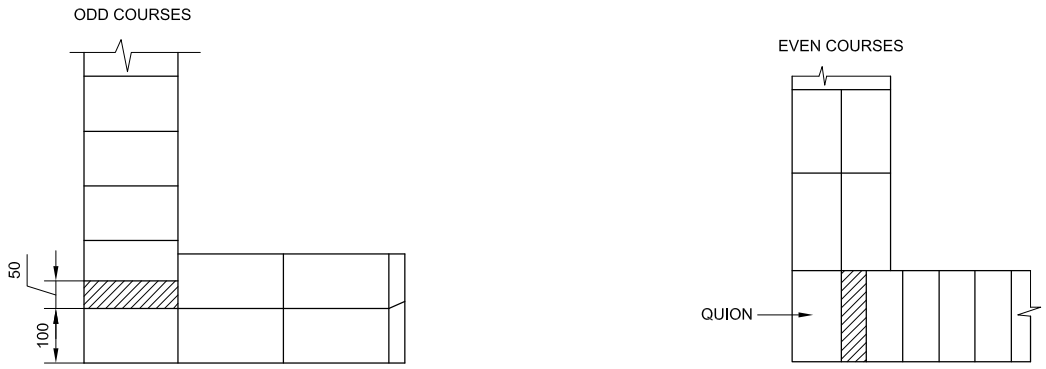
- This is most common and popular bond and is chiefly used for walls varying thickness ranging 20cm and above.
- It consists of equal balancing of header and stretchers in the wall.
- Headers and stretchers are arranged in alternate courses as shown in (Fig 4).
- English bond commences from the quote and along the length of the quoin, Queen closer is placed as shown in (Fig 5).

Fig 4



A HEADER COURSE WITH 1/4 LAP OVER A STRETCHER COURSE

Fig 5

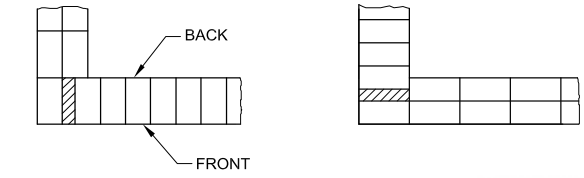


1 BRICK WALL IN ENGLISH CORNER

MB131315

- If the wall is one brick, two brick and so on there will be headers on the face and headers on back of the wall in the same course as shown in (Fig 6)

Fig 6

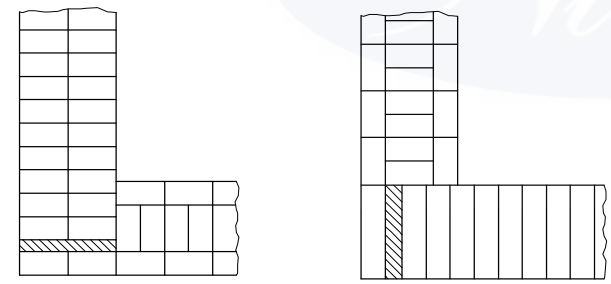


ONE BRICK WALL IN ENGLISH BOND

MB131316

- Similarly stretchers on the face and stretchers on the back of the wall in the same course as shown in (Fig 7)

Fig 7

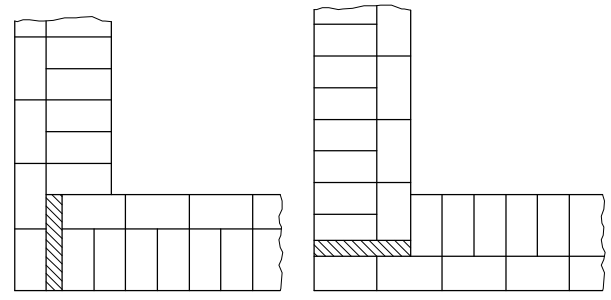


2 BRICK WALL IN ENGLISH BOND

MB131317

- On the other hand if in the thickness of wall one and a half brick (11/2 Brick) and two and a half brick and so on there will be stretchers on the face and headers on the back refer drawing No 8 and viceversa in the same course also in 21/2 Brick wall as shown in (Fig 8)

Fig 8



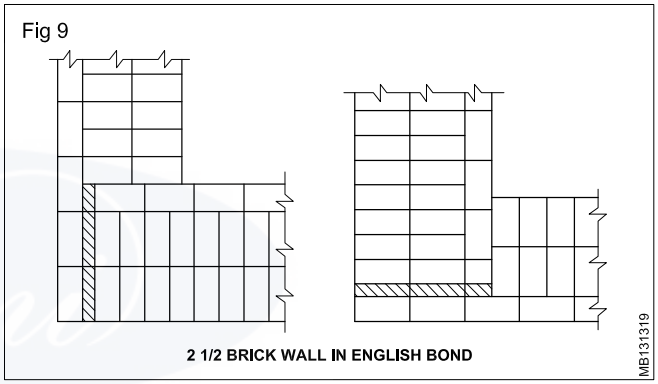
1 1/2 BRICK WALL IN ENGLISH CORNER

MB131318

Corner Junction

- It is also some times reffered as “L” junction
- Here the two walls meet each other in right angles in corner (Fig 9)

Fig 9

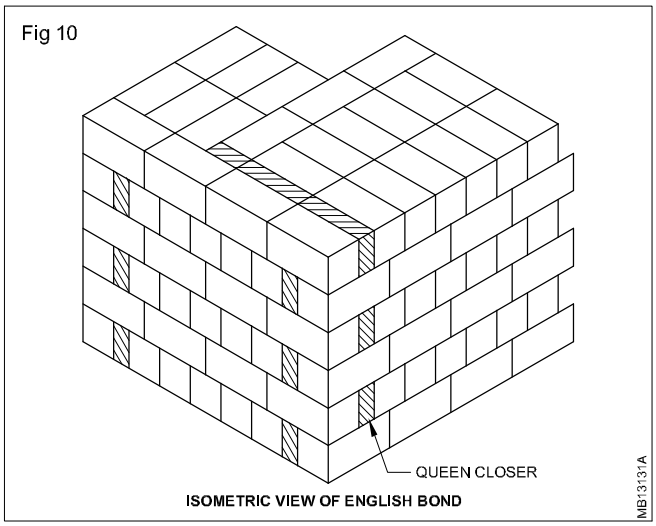


2 1/2 BRICK WALL IN ENGLISH BOND

MB131319

- In one course the quion is placed in one direction while in the other course it is place at right angles to its previous position in the previous course as shown in (Fig.10)

Fig 10



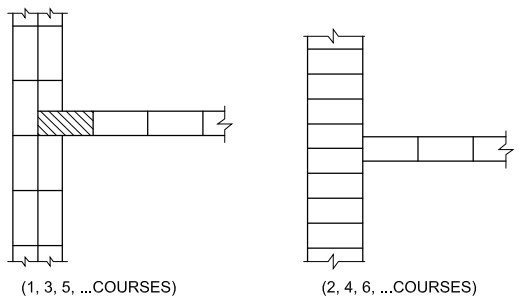
ISOMETRIC VIEW OF ENGLISH BOND

MB13131A

“T” Junction

- Here the two walls meet at right angle but not at the corner. (or) when a main wall meets a cross wall at ‘T’ Junction is formed. as shown in (Fig 11).

Fig 11

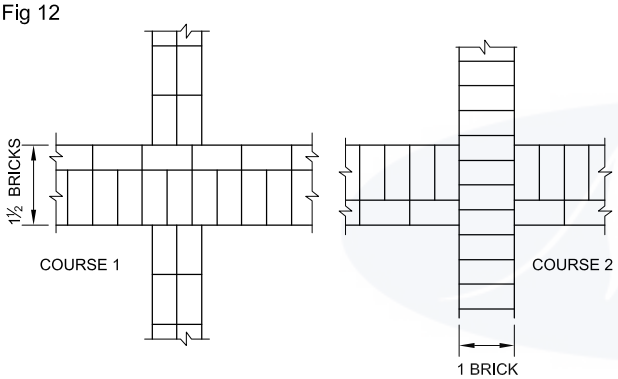


ONE AND ONE HALF BRICK T-JUNCTION (ENGLISH BOND)

Cross Junction

- When two walls meet at right angles and cross each other a cross junction is formed. In the cross junction queen closer is not used. as shown in (Fig 12).

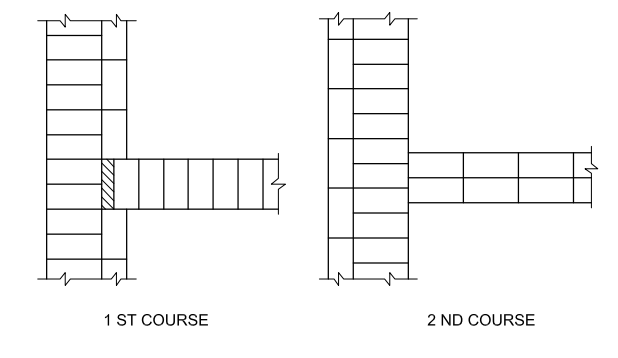
Fig 12



CROSS WALL IN ENGLISH BOND

- The following figures will illustrate the arrangement of brikcs in walls and columns in English Bond.
- 11/2 Brick mainwall and 1 Brick wall meet at right angle ‘T’ Junction as shown in (Fig 13)

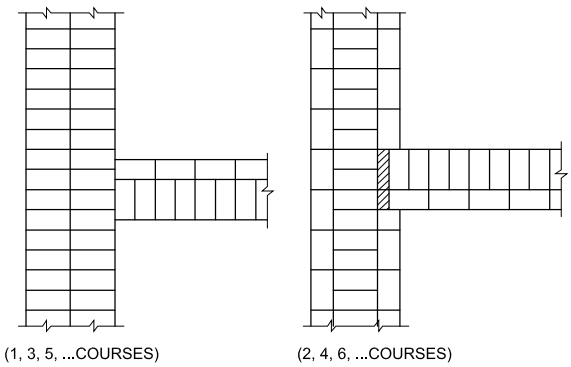
Fig 13



T- JUNCTION ENGLISH BOND

- 2 Brick main wall meet with 11/2 Brick wall at right angle each other and formed ‘T’ Junction as shown in (Fig 14)

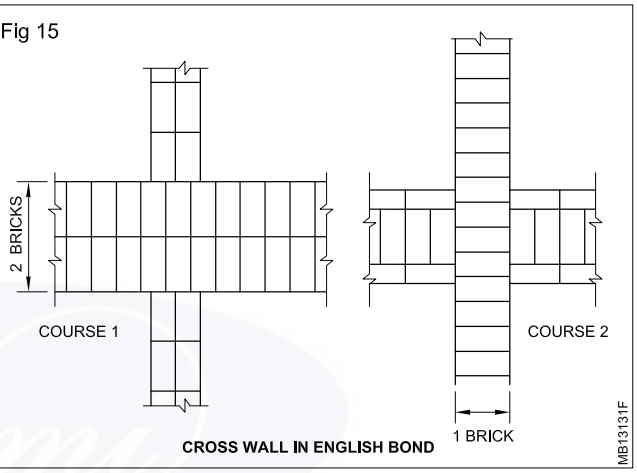
Fig 14



2 AND 1-1/2 BRICK T-JUNCTION ENGLISH BOND

- 2 Brick wall and 1 Brick wall
- ‘T’ Junction in English Bond as shown in (Fig 15)

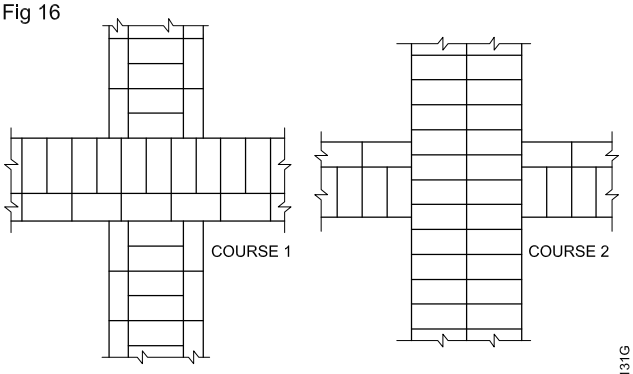
Fig 15



CROSS WALL IN ENGLISH BOND

- plans showing the bonding arrangementsof alternate courses of a 2 brick wall cross a 11/2 Brick wall in English bond a shown in (Fig 16)

Fig 16



CROSS-WALLS OF UNEVEN THICKNESS ENGLISH BOND

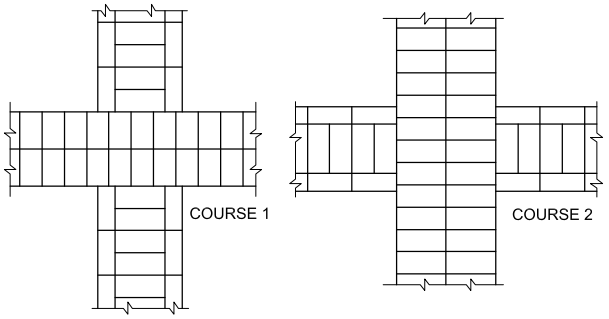
- Plans showing the bonding arrangements of alternate courses of a 2 Brick wall cross a 11/2 Brick wall in English bond as shown in (Fig 17)

Squint Junction

- When two walls meet each other at an angle other a right angle, the junction is known as squite junction.
- There are two types of squint junction

- Ocute squint junction
- Abtuse squint junction.

Fig 17

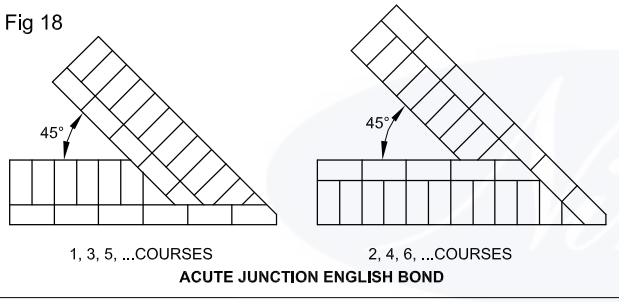


CROSS WALL IN ENGLISH BOND

Acute junction

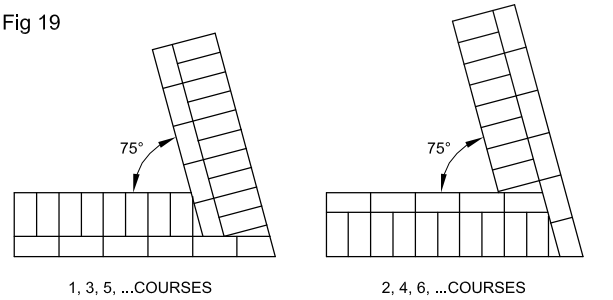
- AAcute junction are those where the walls meet each other at angle less than 90^0 as shown in (Fig 18 and 19)
- 11/2 Brick thick, Two walls meet each other at an angle less than 90^0 and Fig 18 and 19 shows two walls meet each other at 45^0 angle and 75^0 angle.

Fig 18



ACUTE JUNCTION ENGLISH BOND

Fig 19

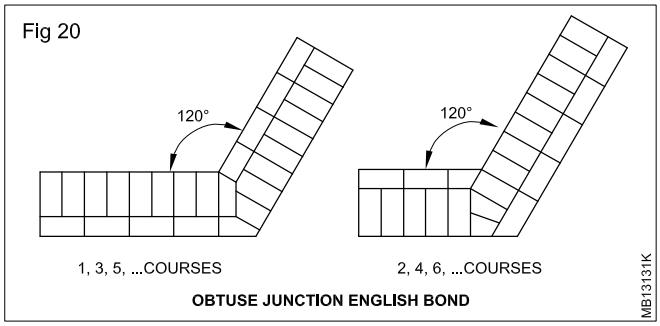


ACUTE JUNCTION ENGLISH BOND

Obtuse Junction

- Where as the obtuse junctions are those where the walls meet at an angle which is more than 90^0
- Two main wall 11/2 Brick thick meet each other at anangle 120^0 (Obtuse) as shown in (Fig 20).
- The principle of construction the same as for outer walls but the aim should be to obtain the maximum lap with the minimum of cutting If the walls are to be plastered necessary but the principle of correct bonding should be observed and contineous vertical joints should be avoided

Fig 20

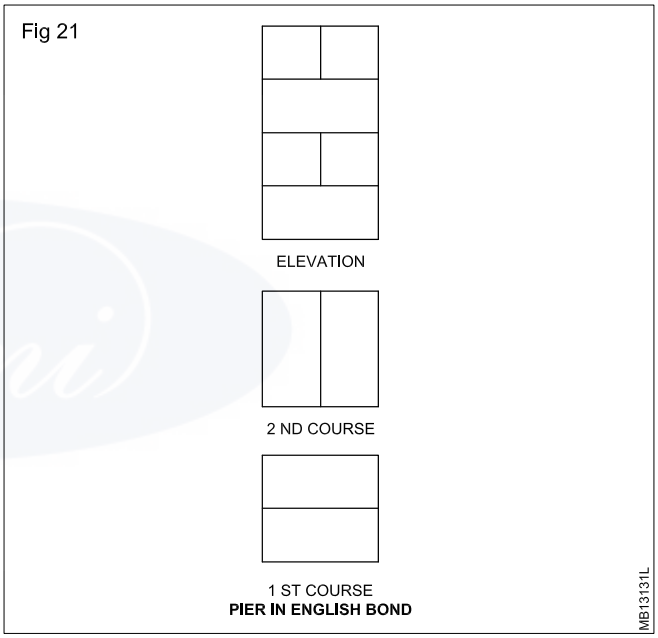


OBTUSE JUNCTION ENGLISH BOND

Columns

- When brick columns are to be constructed in the arrangement of bonds cannot be properly maintained For example ina 30 x 30 cm Column the arrangement can either be of an English bond pattern on one side and flemish bond pattern on both the sides.
- 23 x 23 cm thick square brick column 1st course and 2nd course with elevation showing the (Fig 21).

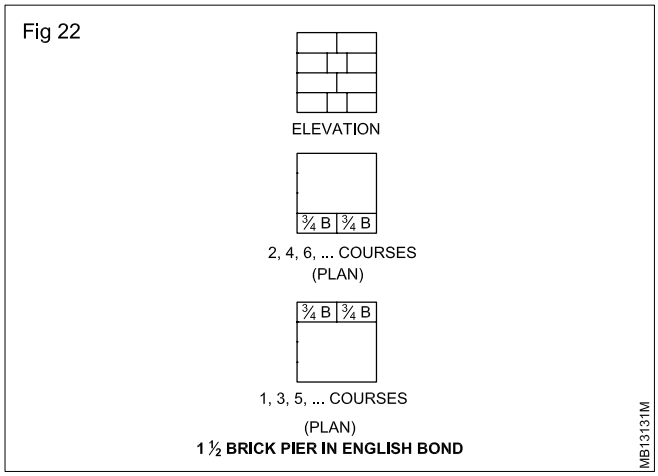
Fig 21



PIER IN ENGLISH BOND

- 11/2 Brick thick square Brick column showing the bonding arrangement of bricks showing the first course and 2nd course with Elevation as shown in (Fig 22)

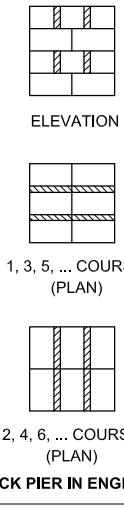
Fig 22



1 ½ BRICK PIER IN ENGLISH BOND

- 2 Brick x 2 Brick square brick column shows the arrangement of bond shown in the (Fig 23)

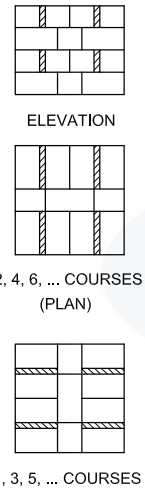
Fig 23



TWO BRICK PIER IN ENGLISH BOND

- 21/2 x 21/2 brick square column as shown in (Fig 24)

Fig 24

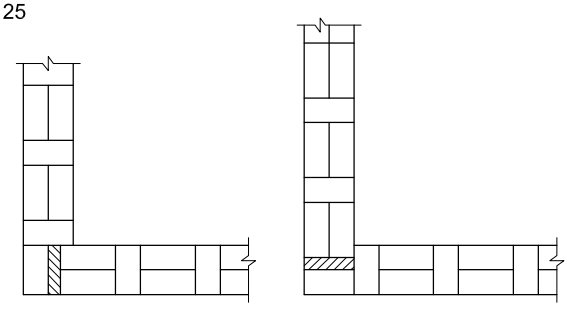


2 ½ BRICK PIER IN ENGLISH BOND

Flemish Bond

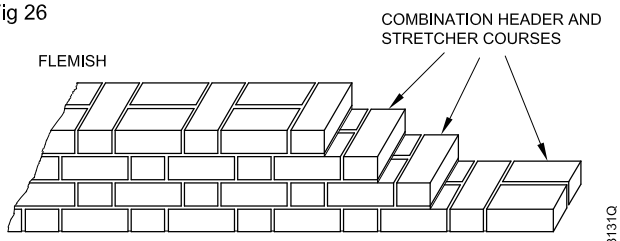
- In this arrangement of bonding each course headers an stretchers are alternately placed.(25 & 26)

Fig 25



PLAN
DOUBLE FLEMISH BOND CORNER WALL

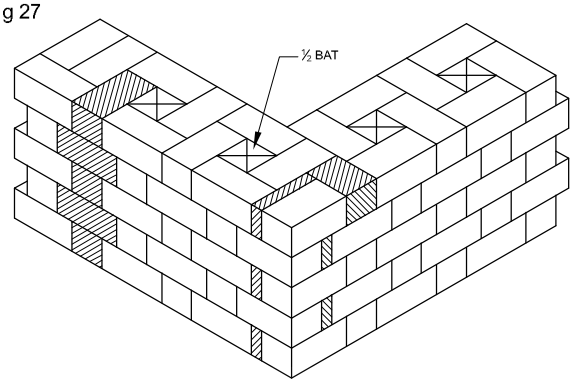
Fig 26



DOUBLE FLEMISH BOND

- Every header is centrally supported over at stretcher below it as shown in (Fig 27)

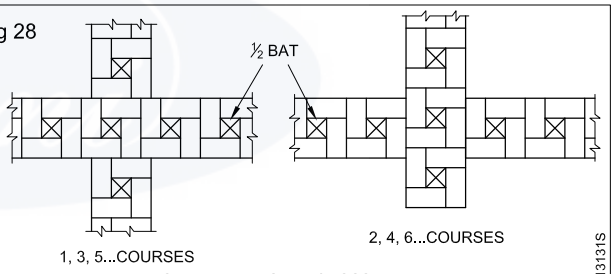
Fig 27



DOUBLE FLEMISH CORNER WALL

- Large number of half bats are used in Flemish bond (Fig.28)

Fig 28



DOUBLE FLEMISH IN CROSS WALL

- Short contineous vertical joints are formed which are unavoidable
- Skilled labour is required for the construction of this bond for having a neater face appearance

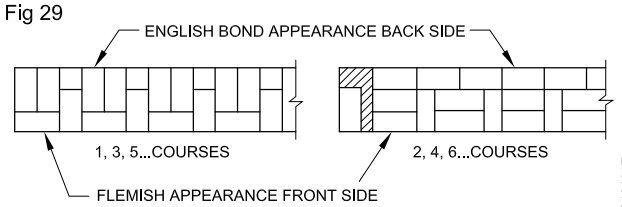
The flemish bond is divided into two groups

- **Single flemish bond**
- **Doubel flemish bond**

Single Flemish bond

- The single Flemish bond the face elevation is made in Flemish and back elevation in English bond.
- A single Flemish bond is the combination of an English bond and Flemish bond.
- The appearance of a flemish bond and strength of an english bond is combined together as shown in (Fig 29)

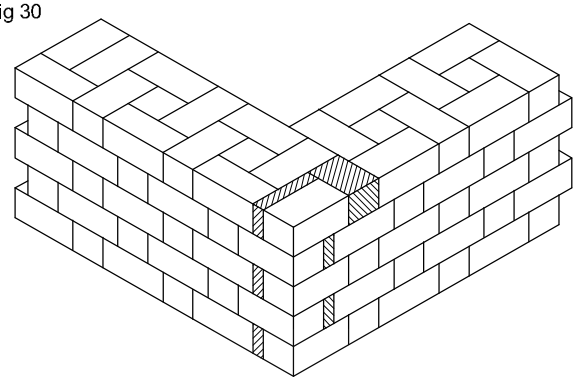
Fig 29



Double Flemish bond (Fig.30)

- In double Flemish headers and stretchers are alternately placed in each course in the front as well as on the back.

Fig 30

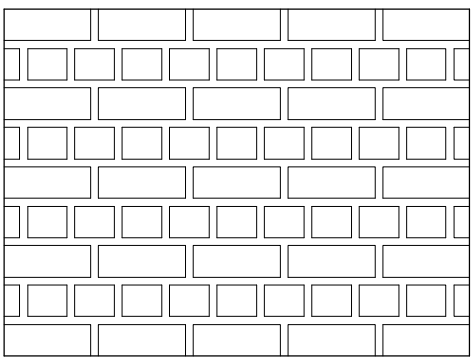


ISOMETRIC VIEW OF 1 ½ BRICK DOUBLE FLEMISH CORNOR WALL

Comparison of English bond and Flemish bond

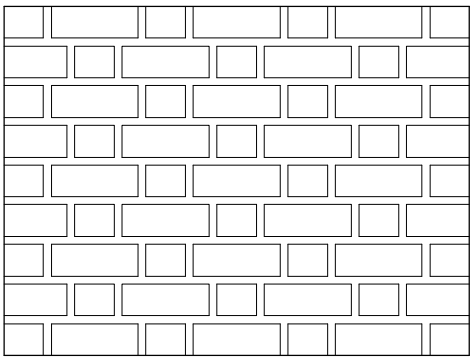
- The strength of an English bonded wall is more than that of a flemish bonded wall
- The Flemish bond has a better appearance than English bond
- Large number of brick bats are used in the flemish bond and hence the bond is economical
- When the thickness of the wall is 1 brick, a fairly uniform face appearance is obtained on both sides of the wall
- The construction cost of flemish bond wall is more as extra care is taken to see that the vertical joints of the alternate courses fall in one line.
- The following figures will illustrate the arrangement of double and single Flemish bond in walls (Fig.31 &32)

Fig 31



ELEVATION OF ENGLISH BOND

Fig 32

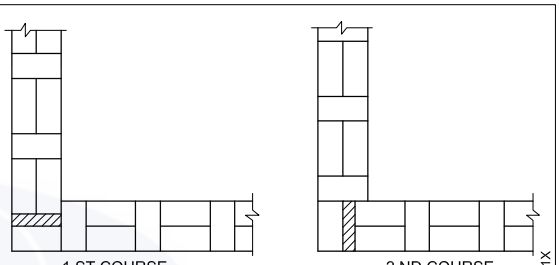


ELEVATION OF FLEMISH BOND

Corner wall

- One Brick wall showing the same elevation front and back of the wall is called double Flemish wall as shown in (Fig 33)

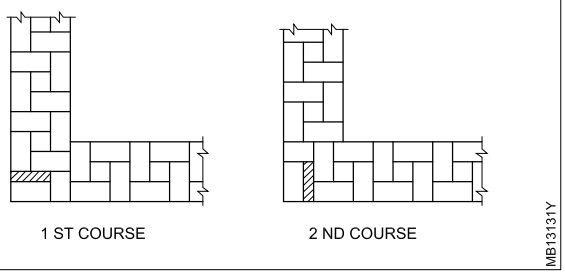
Fig 33



DOUBLE FLEMISH BOND IN CORNER WALL

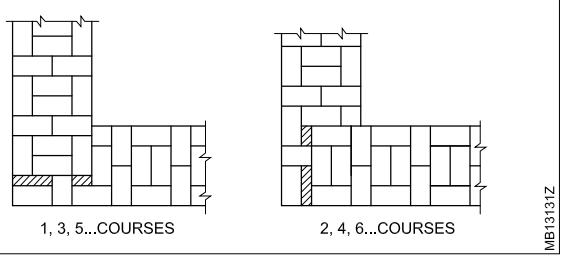
- 11/2 Brickwall corner in double Flemish bond as shown in (Fig 34)

Fig 34



- 2 Brick wall corner in double flemish bond as shown in (Fig 35)

Fig 35



“T” junction

- 11/2 Brick wall “T” - Junction in single flemish bond as shown in (Fig 36)
- 11/2 Brick wall “T” Junction in double Flemish bond as shown in (Fig 37)

Fig 36

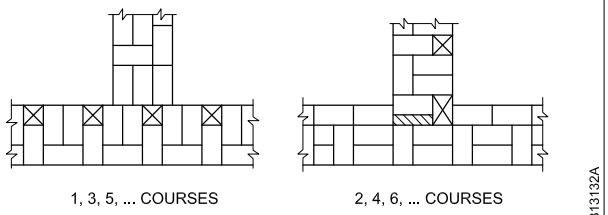
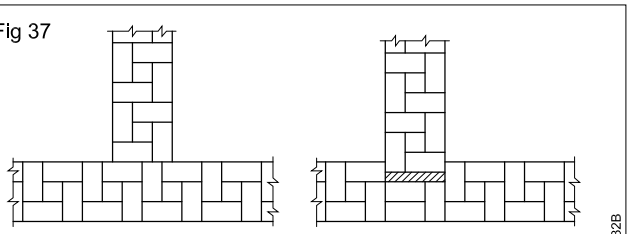
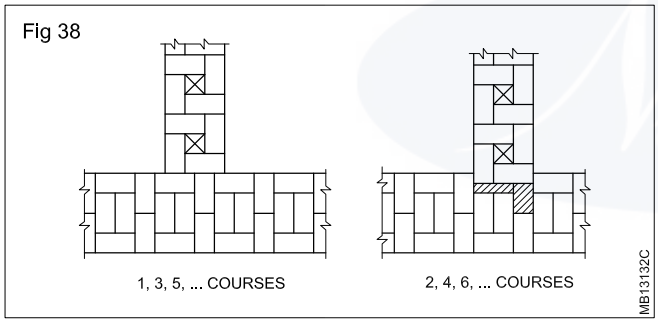


Fig 37



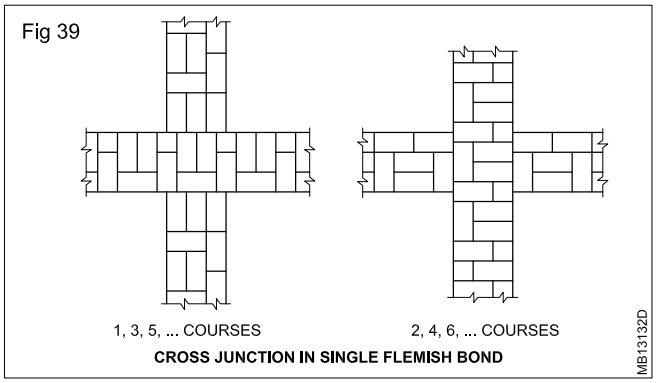
- 2 Brick main wall meet with 11/2 Brick cross wall at right angle ‘T’ junction in double Flemish bond as shown in (Fig 38)

Fig 38



- Cross Junction
- 11/2 Brick main wall and cross wall meet eachother as shown in (Fig 39) single Flemish bond.

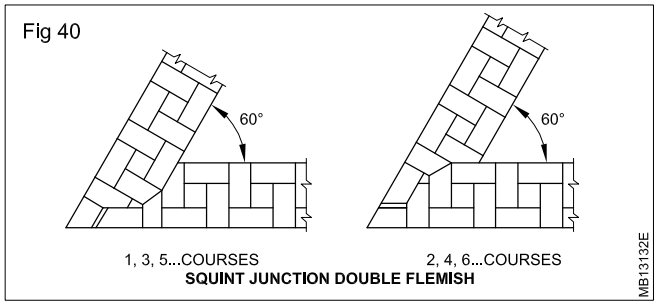
Fig 39



Squint Junction (Flemish)

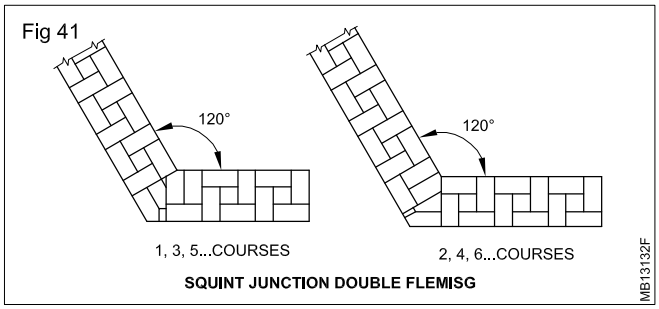
- The two main walls meet each other less than 90° is known as Acute angle as shown in (Fig 40)

Fig 40



- 11/2 Brick thick two main walls meet each other at angle more than 90º is known as Abtuse angle as shown in (Fig 41)

Fig 41



Garden wall bond

- This type of bond as the name suggests is used for the construction ofboundary walls, compound walls, garden walls etc
- This bond is only suitable for walls having a thickness of one brick
- The main characteristics of the bond is that it is possible to build uniform faces without much expense or labour, but is not so strong as the English bond
- Garden wall bond is of two types
- English garden wall bond
- Flemish garden wall Bond

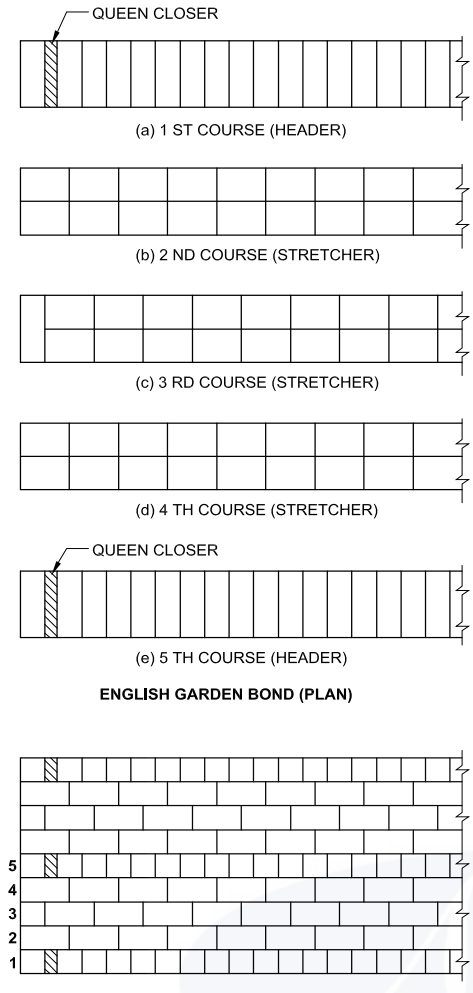
English garden wall bond

- This pattern of bond consistst of three or five courses of stretchers followed by a course of header
- The remaining construction is the same as that of the ordinary English bond as shown in (Fig 42).
- In English garden wall bond onecourse heades and three courses stretchers are placed as shown in Fig 42

Flemish Garden wall bond

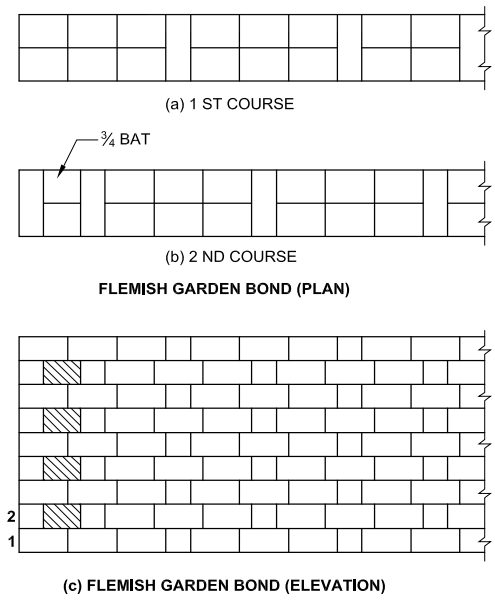
- In this type of bond after every three to five stretchers, one header is introduced in every course.
- Each alternate course willcontain a three quarter brick placed next to the quion.
- The header is placed centrally over the stretcher in the proceding course. The remaining construction is the same for an ordinary Flemish Bond.

Fig 42



- In Flemish garden wall bond three stretchers and following one header is placed in Every course as shown in (Fig 43)

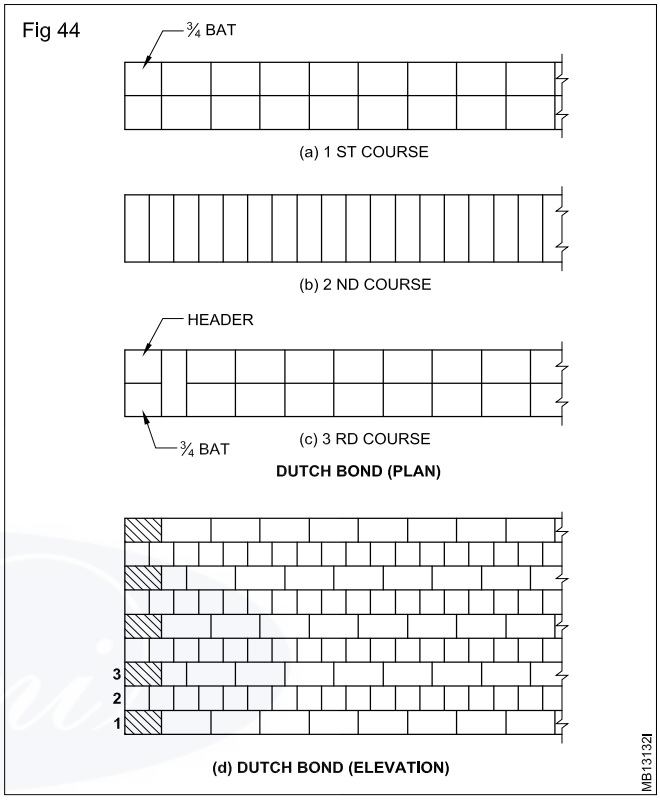
Fig 43



Dutch Bond

- This is a amodification over the English Bond and is very similar to it.
- It also consists of alternate courses of headers and stretchers
- Each stretchers course starts with a three quarter brick
- Every alternate course a header is placed next to the three quarter brick as shown in Fig 44.
- In Dutch bond 3/4 bat is used in Stretcher course
- No Queen closer isused as shown in (Fig 44)

Fig 44



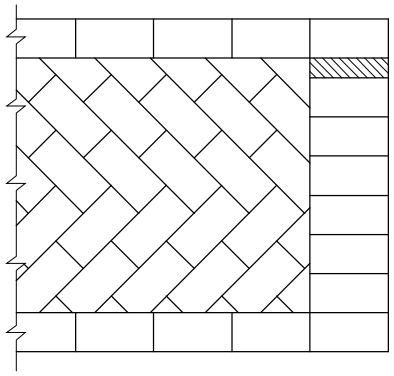
Raking bond

- This is one of the oldest types of bond
- In walls having a thickness of more than one and a half brick
- Stretchers or headers are used on the face and back of the wall in alternate courses.
- The interior part of the wall is filled with headers only, in the diagonal direction.
- This type of bond inwhich the bricks are used diagonally is known as Raking bond.
- Raking bond is of two types
- Herring bone bond
- Diagonal bond

Herring bone bond

- This type of bond is best suited for walls which are atleast four brick thick wall

Fig 45



HERRING BONE BOND

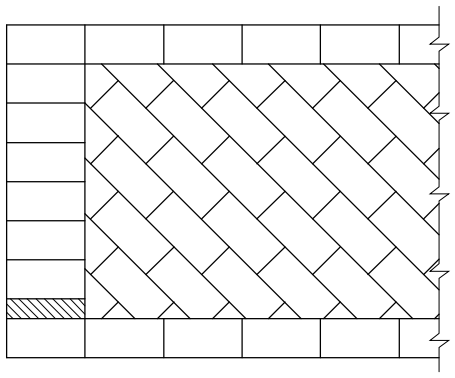
MB13132J

- In this type of bond the bricks are laid at angle of 45^0 from the centre line of the wall. as shown in (Fig 45)
- The face and back of the wall will consists of alternate headers and stretchers as in the English Bond.
- The interior will consists of herring -bone bond

Diagonal bond

- Thist ype of bond is suitable for walls having a thickness of two to four bricks.
- The bond is introduced after four to five courses of regular straight bond (English bond or Flemish bond)
- For the construction of this bond, the face bricks are laid. Then bricks are diagonally as shown in (Fig 46).

Fig 46



DIAGONAL BOND

MB13132K

Building Materials Cement

Objectives: At the end of this lesson you shall be able to
- **describe the ingredients of cement**
- **describe the manufacturing of cement**
- **describe types of cement and uses of cement.**

Fore word

- Cement is one of the most important building material
- The cement is artifically manufactured
- It is obtained by burning at a very high temperature a mixture of calcarious and ag materials. This product is called clinker.
- A small quantity of gypsum is added to the clinker and it is then grinding into very fine powder is known as the cement
- The common variety of artifical cement is called Normal setting cement or ordinary cement.

Composition of Ordinary cement

The ordinary cement contains mainly two ingredients

- Calcarious
- Argillaceous

In calcarious materials the calcium corbonate predominates

In argillaceous materials the clay predominates

- Lime - 62 to 67%
- Silica - 17 to 25%
- Alumina - 3 to 8%
- Calcium sulphate - 3 to 4%
- Iron oxide - 3 to 4 %
- Magnesia - 0.1 to 3%
- Sulphur - 1 to 3%
- Alkalies - 0.2 to 1%

Lime

- This is the important for manufacture of cement. The proportion of this lime should be carefully maintained.

Caution

- If it is excess makes cement unsound.
- If it is less the strength of the cement is decreased
- This is also another important ingredient of cement.

Silica

- Silica gives strength to the cement

Caution

If silica in excess quantity the strength of cement increases and setting time is prolonged.

Alumina

- Alumina imparts quick setting property

Calcium sulphate

- Calcium sulphate is in the form of gypsum and it work is to increase the initial setting of time of cement

Iron oxide

- This ingredient gives colour, hardness and strength to the cement

Magnesia

- Magnesia if present in small amount, imparts hardness and colour to the cement.

Caution

- A high content of magnesia makes the cement unsound.

Sulphur

- A small amount of sulphur is useful in making sound cement

Caution

- If it is in excess it causes cement to become unsound

Alkalies

- The most of the alkalies present in raw materials are carried away by the flue gases during heating.

Caution

- If the alkalies are excess in cement they causes efflorescence etc.

Manufacture of ordinary cement

The following operations are involved in the manufacture of ordinary port land cement

- Mixing of raw materials
- Burnings
- Grinding

Mixing of raw materials

- The raw materials such as lime stone or chalk and shale or clay may be mixed in dry condition or in wet condition
- The process is according know as the dry process or the wet process of mixing

Dry process

- In this process the raw materials are first reduced in size of about 25mm crushers
- A dry air is then passed over these dried materials
- These dried materials are then pulverised into fine powder in ball mill and in tube mill
- All these process are done separately for each raw material and they are stored in hoppers.
- Then these raw materials are then mixed in correct proportions.
- These mix is fed into rotary kiln and the temperature increased to 850^0C as hot gas at temperature of 1000^0C is blown against the falling gradient
- This finely ground in to powder and in storage by dry process.

Wet Process

- In this process the calcarious materials such as lime stone are crushed and stored in silos or storage Tanks
- The argillaceous materials such as clay is throughly mixed with water in a container known as the wash mill This washed clay is stored in basins
- The crushed lime stone from storage tank and the wet clay from basins are allowed to fall in a channel in correct proportions.
- This channel leads to grinding mill for well mixing and this is called as slurry
- The slurry is fed into upper end of kiln.
- Burning is carried out in a rotary kiln.
- The portion of the kiln near its upper end is called dry zone.
- In this zone the water of slurry is evaporated
- The rise in temperature the carbon di oxide from slurry is evaporated
- The small lumps known as the nodules are formed at this stage
- After the rising temperature is about 1500ºC the nodules burnt in burning zone and converted into small pieces which are known as clinkers.

Grinding

- The clinkers taken from rotary kiln are finely ground in ball mill and tube mill
- During grinding a small quantity of gypsum is added about 3 to 4%
- gypsum controls the initial setting of cement
- If gypsum is not added the cement would set as soon as water is added.
- Then the fine powder of cement is storage in silos.

Caution

Storage of cement

The cement should be stored carefully otherwise it may absorb moisture from the atmosphere and may become

useless for the structural work and the other construction works.

Types of cement

The following are the various types of cement other than portland cement

- Coloured cement
- Expanding cement
- High alumina cement
- Low heat cement
- Quick setting cement
- Rapid Hardening cement
- White cement
- Sulphate resisting cement

Uses of cement

- The cement is commonly used in the construction of various works.
- Cement mortar is used for masonry work, pointing, plaster work etc.
- Cement concrete is used laying floors, slab for roof, casting of lintels and beams, stair case, pillar works etc.
- Cement mostly used for construction of heavy structures such as dams, bridges, culverts , reserviors, tunnels
- Manufacture of precast pipes, fencing posts
- Construction of wells, water tanks, septic tank , man hole inspection chamber, jointing of cement pipes.

Building materials LIME

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

- **describe the types of lime and the uses**
- **describe the method of mixing lime mortar**
- **describe good quality of of lime.**

- Lime has been used as a building material

Types of Lime

Based on chemical composition there are three main types of lime

- High calcium lime
- Magnesian lime
- Hydraulic lime

High calcium lime

- Pure lime stones with little impurities yields high calcium limes which are most commonly drawn at fat lime. such lime can be readly slaked
- Mortars prepared from these possess excellent working qualitites but they take a very long time to develop adequate strength.

Magnesia lime

- Lime stones which possess a high proportion of magenesium oxide give magnesium limes.
- They are generally produced from dolomitic lime stones
- Magnesium lime slakes with difficulty and there fore, the slaking magenesian lime needs more attention.
- The properties of magnesian lime properly slaked resemble those of high calcium lime.

Hydraulic lime

- Somelime stones contains clay more or less uniformly distributed
- Lime obtained from such lime stones are self hardening. ie they have hydraulic property and are, therefore called hydraulic lime
- Hydraulic lime may described as either eminently hydraulic or semi hydraulic lime depending on their hydraulic properties, mortar made from hydraulic lime develop early strength.

Classification

- The Indian standard Institution (ISI 712 - 1956) has classified lime as follows:
- **Class - A :** - Eminently hydraulic lime which are used for structural purposes.
- **Class - B :-** Semi - hydraulic limes which are used for masonry works.
- **Class - C:-** Fat lime used mostly for finishing coat in plastering, white washing and with suitable admixture such as surki or any other puzzolanic material.
- It has been specified that class B lime shall be supplied as hydrated lime only.
- Class A and C shall be supplied both as quick lime and hydrated lime

Choice of aggregates and proportioning

- From consideration of strength as well as economy lime is mixed with certain aggregates such as sand, surki, cinder etc for use in mortar.
- Normally the proportions of lime and aggregates employed are 1 of lime and to 2 - 3 of aggregate.

Sand

- A sharp sand is necessary for mixing with lime if strength is required A poor sand can be used for secondary non load bearing work.

Pozzolana

- To obtain increased strength from lime mortars it is necessary to employ some pozzolanic materials such as surki, cinder etc. for mixing with lime.

Preparation of mortars and plaster

- A mortar and a plaster mix are one and the same. For final coat of plaster certain precautions must be taken.
- The sand must be all finer that 64mesh to an inch (IS 25) surki finer than 144 mesh to an inch (IS 10)
- Strength and quality of the mortar or plaster depend inter alia, on the method adopted for mixing .
- There are essentially two method of mixing lime mortars
- Manual mixing on a platform
- Grinding in a mortar mill run either by animal or mechanical power.

Manual mixing

- For manual mixing of mortar, measured quantity of slacked lime in the powdered form (putty) and fine aggregates are placed on a water tight masonry platform.
- The ingredients are first mixed by turning over two or three times with a spade. water is added and mixing is further continued till a mortar of uniform consistency is obtained.

Mortar mill mixing

- The bullock - drawn mortar mill is popularly turned the lime chakki or ghanni.
- In this mill slaked lime which is generally in the form putty and aggregate are added in the requisite proportions along with water and grinding is done till a mortar of uniform consistency is obtained.
- Grinding is done generally for 80 to 180 revolutions of the stone roller depending upon the nature of lime.

Good qualities of Lime

The lime posses the following unique properties which results in better quality construction.

- Better Workability and plasticity.
- Early stiffening
- Low shrinking on drying which makes for durability.
- Good strength
- Resistance to moisture
- Freedom from major cracking
- Excellent adherence to masonry units.
- Adjustments to stresses in the masonry in course of time due to slow setting.
- Improvement in strength contineously with time.

Recommended specifications

- It has been found that mixtures such as 1 cement, 1 lime, 6 sand or (1:1:6)
- 1 cement, 2 lime, 9 sand are satisfactory for general purpose mortars

Half brick wall One brick wall	11 cm 23 cm one part cement One part lime six parts sand	1:1:6
Cavity wall External wall plaster Internal plaster on all walls	 1:1:6 1:2 1:1:1	

Lintels

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

- **state the types of Lintels**
- **describe wooden lintel and stone lintel**
- **describe brick lindel and steel lintel**
- **describe R.C.C lintel.**

Lintels are small beams provided over the small openings of doors, windows, cupboards, verandah etc.

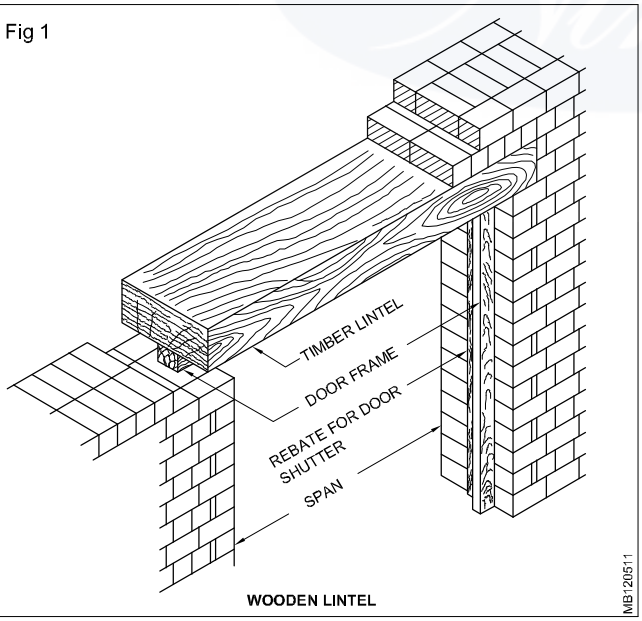
The ends of the lintels are built in the masonry and they transfer the load coming over them on the wall on which they rest.

Lintels are made of different materials

- Wooden Lintel
- Stone Lintel
- Brick Lintel
- Reinforced brick, Lintel.
- Steel Lintel
- Reinforced concrete Lintel

Wooden Lintel (Fig 1)

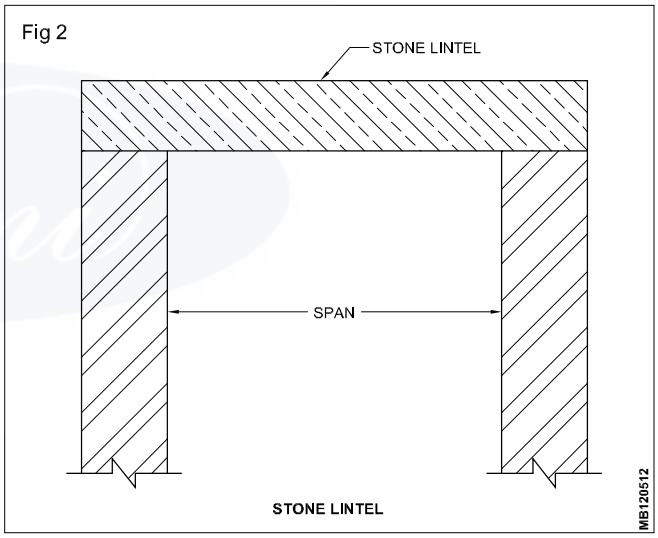
Fig 1



- These Lintels consists of wooden beams placed over the opening.
- The two ends of the Lintels are embedded in the masonry.
- Coal tar should invariably be painted over the ends and top to be embeded.
- This will prevent the material from dry rots.
- The thickness of the wooden Lintels generally varies from 15cm to 20cm.
- Wooden Lintels are normally provided with relieving arches.
- Timber to be used for the purpose should be properly seasoned and of a good quality.
- Wooden Lintels should be properly preserved against white ants.

Stone Lintel (Fig 2)

Fig 2

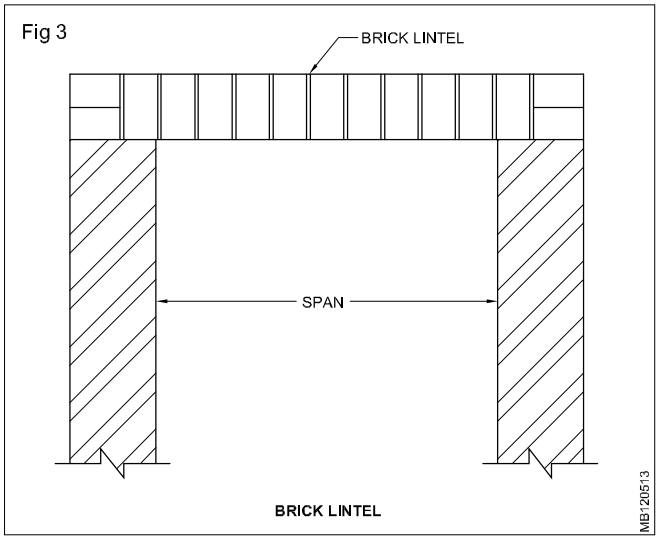


- Stone slabs were used as Lintels in olden days, in those places were good quality of stones are easily and cheaply available.
- Stone Lintels may be used as a single piece or more than one piece.
- Stone Lintels having less tensile resistance stone lintel cannot be used for larger spans.
- Stone Lintels are very heavy and it is difficult to obtain the required size of the stone, as shown in thefigure 2
- They are costly, particularly for those places, where good quality of stones are not easily available.

Brick Lintel: (Fig 3)

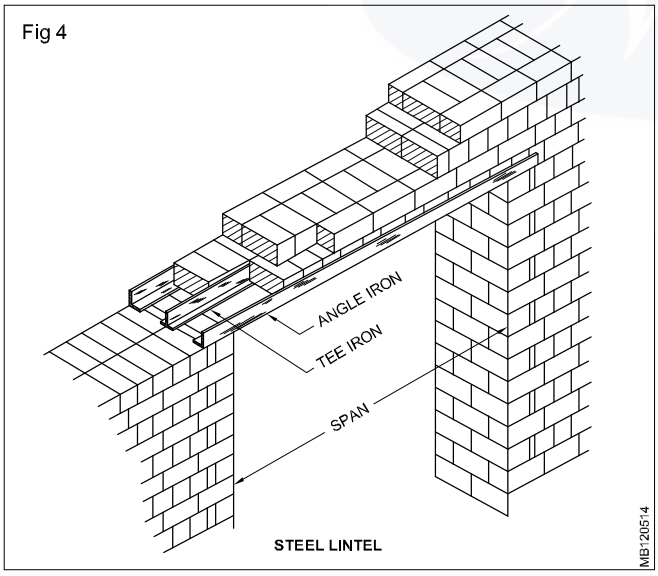
- These are Lintels, which consists of bricks placed end to end.

- Brick Lintels are nothing but brick flat arches which have been already explained brick Lintel in weak and suitable for small spans upto 1m. (Fig 3)



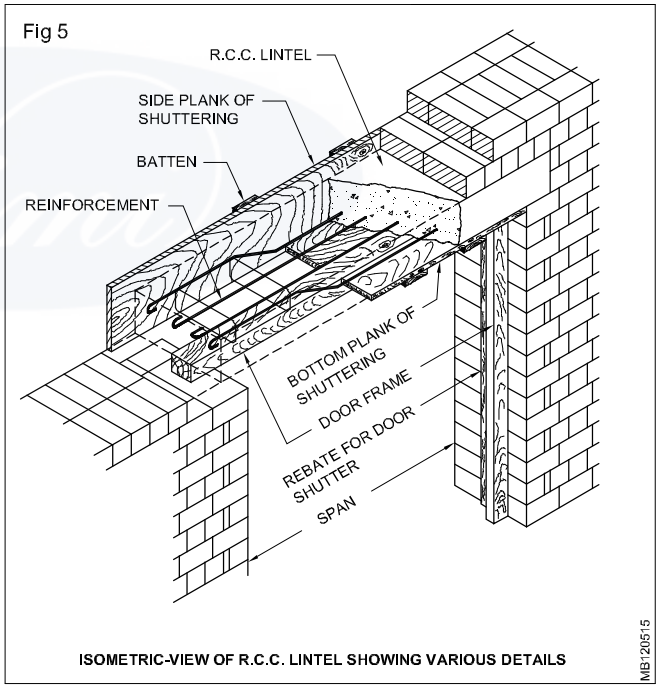
Steel Lintel: (Fig 4)

- These Lintels consists of steel section, such as 'I' - section, 'T' - sections or channel section embeded in brick work or cement concrete.
- I - sections embeded in cement concrete can be used for very large spans and are called Bressumers.
- The function of embedding steel sections in brick or concrete is to protect the steel from corrosion etc.



Reinforced cement concrete (R.C.C) Lintels:

- R.C.C Lintels consists of steel reinforcement embedded in cement concrete
- Cement concrete is a material which is very strong in compression but comparatively very weak in tension.
- To overcome this weakness, steel reinforcement is provided to take up in tensile stresses.
- R.C.C Lintels are stronger and more durable.
- These are fine proof and economical These can be used for very large opening.
- R.C.C Lintels are usually constructed with 1:2:4 cement concrete Reinforced with steel bars.
- For smaller spans precast R.C.C Lintels can also be used.
- The precast Lintels are manufactured and cured in factories or sites before they are used.
- The precast Lintels are economical in construction as then no form work is required and the same mould can be used again and again.



Requirement of good concrete

Objectives: At the end of this lesson you shall be able to
- **state the requirements of good concrete**
- **state cement concrete test**
- **state fine and aggregate**
- **state water cement ratio.**

Cement concrete is a material obtained by cementing together hard in organic materials, such as sand, gravel, crushed stones, slages etc. Known as aggregate with portland cement and water in suitable proportions to form a workable mixture.

This workable mixture can be casted or moulded into any desired shape. Few hours after mixing, this mixture starts becoming solid and becomes solid due to chemical reaction occured in the presence of water.

The concrete having cement aggregate and water for its manuscript is known as “plain cement concrete and it is simply called as P.C.C

It has very Light compressive strength.

But it is very poor in and practically can not be used for taking any tensile forces in the structure.

Uses of P.C.C

- P.C.C is used for construction of roads, sewer, pad stones, bed block massive gravity dams, heavy foundation floor of buildings etc

Requirements of good concrete

Strength : Plain cement concrete should have sufficient strength to with stand without any damage all the external loads coming over it with the required factor of safety.

Durability
Plain cement concrete should be durable and should not be affected by the atmospheric efforts such as temperature, light, wind, rain etc.

Workability
- It should be easily workable and it should be possible to mould or cast into required shapes and size.

Cement
- Portland cement is normally used for all types of cement concrete works.

Tests of cement
Before using the cement concrete its samples must be tested to ascertain that it full fils the minimum requirements of becoming cement or not. Because if the cement is poor quality the whole structure may fail or collapse.

Compressive test
This is also done by testing cement sand cubes of 1:3 mortar by weight. This test is done by compression testing machine.

Generally the following tests are done

Test for setting time

- The main object of this to differentiate between the normal cement and quick setting cement
- It also tells the determination of cement due to long storage.

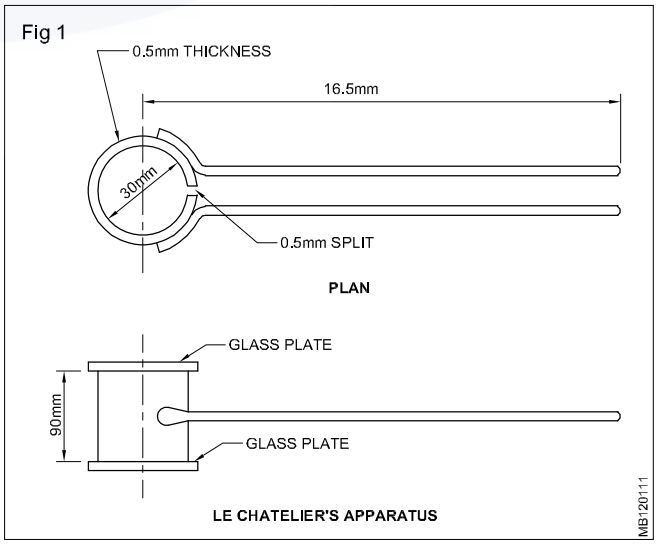
Test for consistency

For determining the quantity of water required to mix in this cement for getting normal consistency this test is performed.

Test for soundness

- This test is done to determine the presence of free lime in the cement
- If cement contains free lime it will slowly slake and expand, causing cracks, blistering in cement concrete as shown in the (Fig 1).

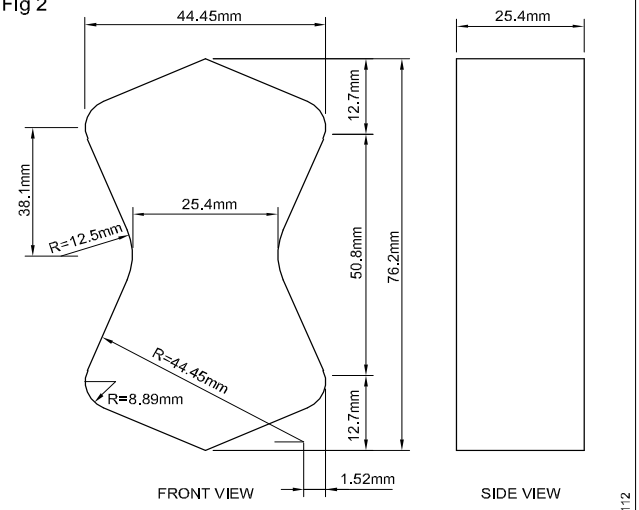
Fig 1



Tensile strength

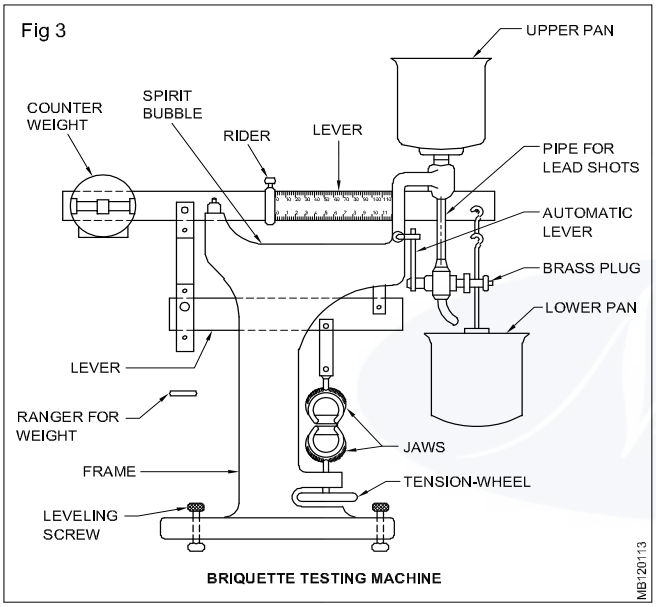
- It is done by testing the tensile strength of cement sand mortar 1:3
- Briquetle of size as shown in (Fig 2)
- Twelve briquettes are casted at one time.
- These briquettes are kept curing tanks after 24 hrs. Six briquettes are tested in briquette testing machine as shown in (Fig 3).

Fig 2



STANDARD SIZE OF BRIQUETTE

Fig 3



BRIQUETTE TESTING MACHINE

The minimum compressive strength of cement sand cubes 1:3 should be as follows.

After 3 days - 115Kg/cum

After 7 days - 175kg/cum

Aggregate

- It is desired from sedimentation Igneous and metamorphic rocks.
- It may also be manufactured from bricks, slags etc. Depending on the size of the aggregate it is classified fine or coarse aggregate.

Fine aggregate

- Aggregate which can pass through I.S sieve no 480 is known as fine aggregate.
- The maximum size of its particles is 4.75mm
- This aggregate should not contain more than 8% fine particles in it which may pass through 1.S sieve no 15
- Natural coarse sand obtained from river-beds, Pits, lake-beds which is free from clay, silt, salts and other organic matters is mostly used in cement concrete.

Coarse Aggregate

- Aggregate which cannot pass through IS sieve no. 480 has been classified as coarse aggregate.
- The maximum size of coarse aggregate mainly depends on the type of structure and nature of work.
- For all types of building works 20 to 25mm maximum size is used.
- For mass concrete works such as dam even 200mm size aggregate may be used.

Bulking of sand

If dry is brought in contact with moisture or water, thin film of water is formed around the sand particles and increases the volume of sand. This is called bulking of sand.

Water

- Clear sparkling water fit for drinking is also fit for concrete works.
- Water should have the following qualities.
- It should be free from ashes, soil and dissolve iron.
- It should be free from fats and oils.
- IT should be free from acids or alkalies or organic and inorganic impurities.
- Water is very important ingredient of cement concrete
- It acts as lubricant for the fine aggregate and coarse aggregate.
- It acts chemically with the cement to convert into hard stone material.

Water cement Ratio

Mathematically water cement ratio of particular concrete is

$$\text{water cement Ratio} = \frac{\text{Weight of mixing water}}{\text{Weight of cement used.}}$$

The increase in water cement ratio the strength of concrete reduces. Therefore as far as possible it should be kept as low as possible.

Proportions of mixing P.C.C

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

- **state method of mixing cement**
- **state placing compaction and curing of concrete**
- **state joint in crecrete.**

Mixing

All concrete should be mixed throughly until it is uniform in appearance and all ingredients are uniformly distributed.

- Mixing will be done either
- Hand mixing
- Machine mixing.

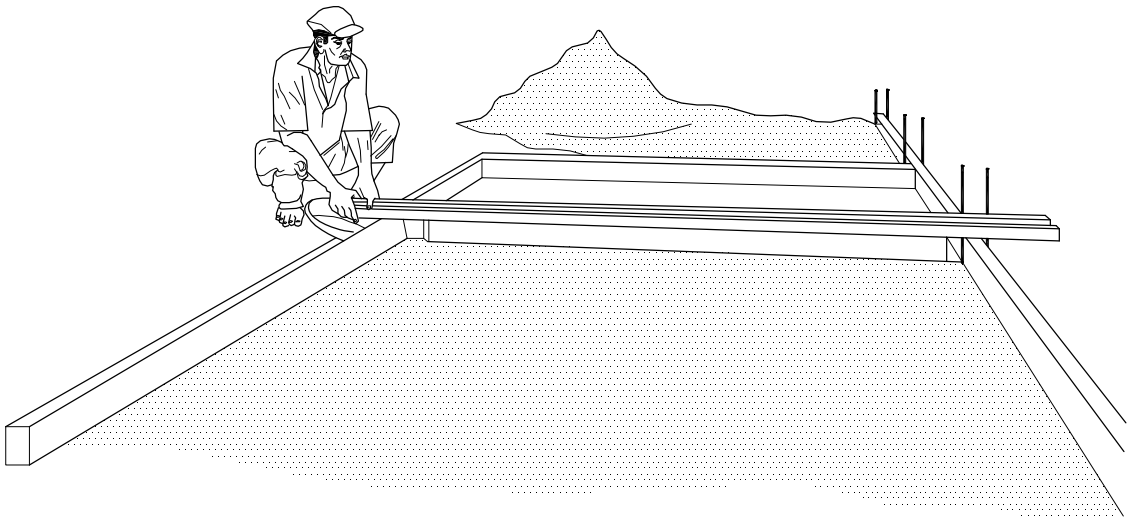
Hand mixing

- Hand mixing of concrete is done on hard platform.
- This method is mainly employed at such places where the quantities of concrete to be mixed in small.
- Cement and sand are first mixed together in dry condition.
- The coarse aggregate is spread on the platform in uniform thickness varying from 20 to 30cm
- The mixed cement and sand are spreaded in a uniform thick layer over the stack of coarse aggregate.
- These are mixed together first in dry state.
- Then measured quantity of water is sprinkled over it and the mass is continously mixed till uniform workable concrete is obtained.

Machine mixing

- Machine employed for mixing concrete are known as “Concrete mixers”
- These mixers may be of continous mixing type or batch mixing type. For big projects where large quantity of concrete is required continuous mixing type mixers are used.
- The ingredients of concrete may be fed in the mixture by means of continous moving conveyor belts or by other suitable methods.
- For small works of building mostly tilting drum type mixtures are used.
- While mixing concrete with mixtures first the coarse aggregates are fed in the mixture, then sand and then cement.
- After dry mixing the measured quantity of water is poured in the mixture and the concrete is mixed for 2 to 3 minutes to obtain the desired workable concrete
- Before placing concrete in position care should be taken that proper mould is prepared alaround where the concrete is to be laid. as shown in the (Fig. 1)
- All the faces of moulds coming in contact with concrete properly coat with crude oil. So that it may not absorb water from concrete and it is difficulty while removing batterns.

Fig 1



CEMENT CONCRETE IS USING A TEMPLATE TO CHECK THE SUBGRADE FOR SMOOTHNESS AND PROPER HEIGHT

MB120211

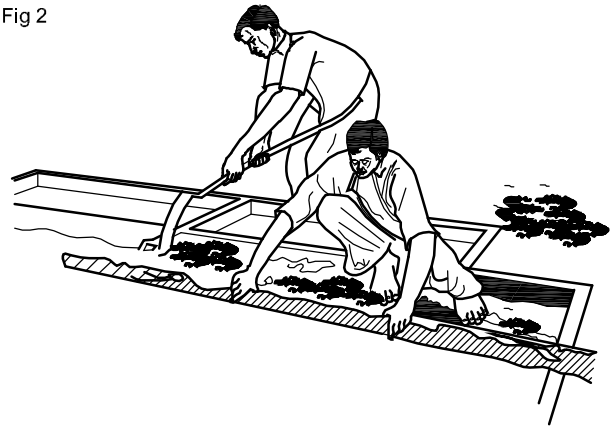
Placing of concrete

- Placing of concrete is most important, as the concrete must be placed in position, properly compacted within 30 minutes after adding water in as after this time the initial setting of cement will start
- While mixing concrete it is most important that only the required quantity of concrete which can be used within 30 minutes, after adding water in it should be used.

Compaction of concrete

- Immediately after placing concrete in position, it should be properly compacted to obtain uniform compact concrete.
- The main object of compaction is to remove all the air pockets and porousness of the concrete
- The concrete will gain only strength if its is compact
- Compaction of concrete may be done by “hand or machine”
- While doing compaction by hand concrete, ironbars, hammers or rammers, tampers are employed.
- Rodding is done in compacting concrete of beams, Lintels or thin structures.
- Tamping is done by bricks wooden tampers in compacting the floor slab concretes.
- For compacting heavy mass of plain concrete hammers are used.
- Machines are employed for compacting concrete are known as vibrators.
- Needle vibrators
- Surface vibrators
- Shutter vibrators.
- Screeding of concrete will takes place after compaction is completed either hand or machine compaction as shown in (Fig 2).

Fig 2

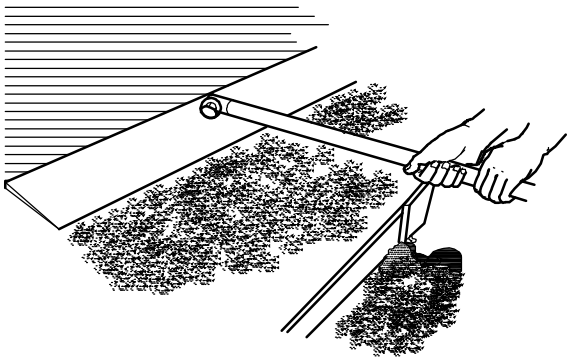


THIS CONCRETE IS BEING SCREEDED TO STRIKE OFF THE EXCESS

MB120212

- Bull float is used to eliminate high and low spots and to embed large aggregate in the concrete as shown in (Fig 3).

Fig 3



MB120213

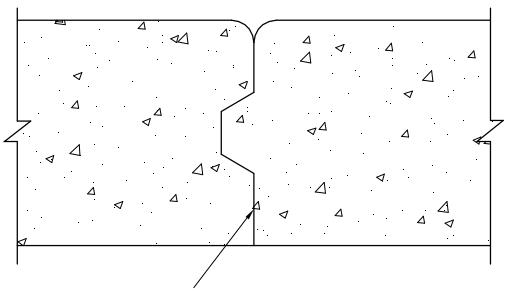
Curing of concrete

- The strength of the concrete depends on the chemical actions in the presence of water
- For gaining ultimate strength of concrete it is most essential that concrete should be kept damp or wet for at least 7 to 28 days.
- This process of keeping the concrete damp or wet is known as “Curing”

Joints in Concrete:

- During the construction of R.C.C or P.C.C structures it is impossible to do concreting work continously.
- When concrete work is stopped at one time and continue after same time concrete joint occur.
- For making the concrete at such joints strong enough certain care is taken while concreting at these joints are classifieds as

Fig 4



BREAK BOND WITH OIL,
PAINT OR CURING COMPOUND

MB120214

Expansion and contraction joints

construction joints

- A construction joint the wood key may be made from beveled 2 to 5cm strip and is used for slab 10 to 15cm thick. as shown in the (Fig 5).

- The expansion joints material may be flush in areas where no safety hazard from tripping exists as shown in 4 to 8 Figures.

Fig 5

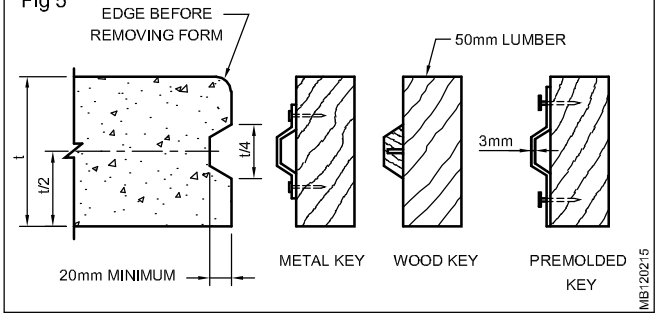


Fig 6

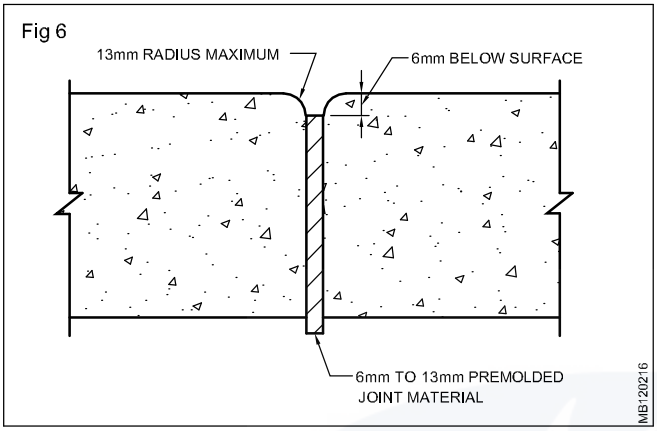


Fig 7

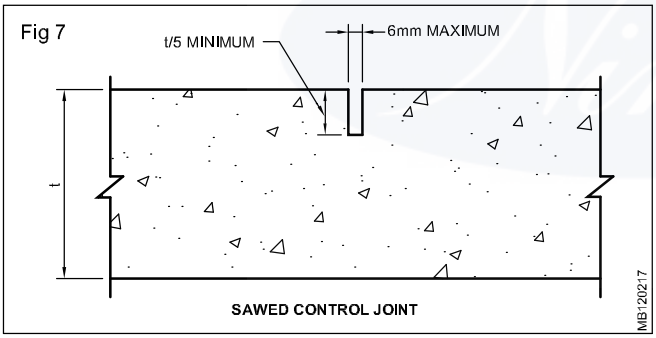


Fig 8

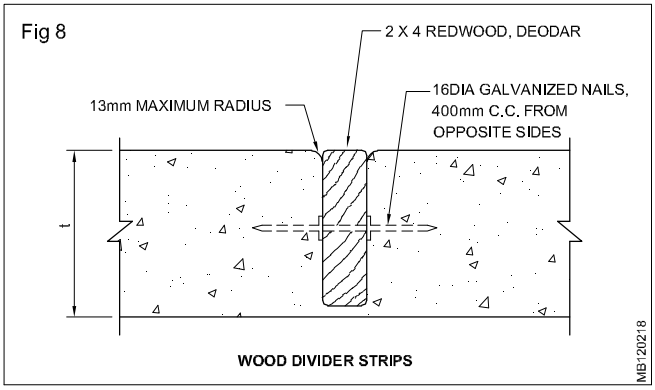
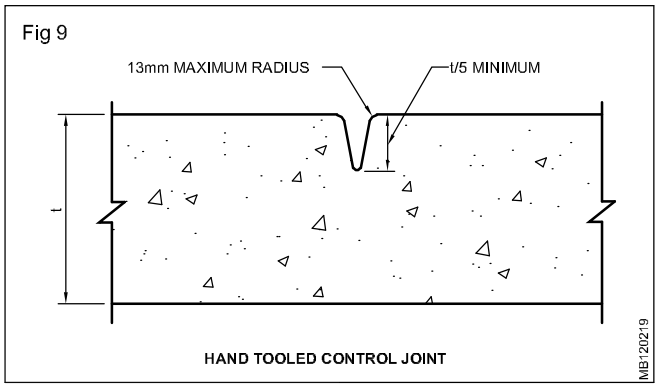


Fig 9



Piers

- piers or pillars adopted either to support loads transmitted to them by beams
- The pillars may be square, rectangular, circular or polygonal in plan.
- The pillars may be detached or attached to the wall.
- The maximum height of detached or isolated pillars should not exceed eighteen times of its least dimensions.
- Pillars are constructed in english bond as well as flemish bond.

Types of walls

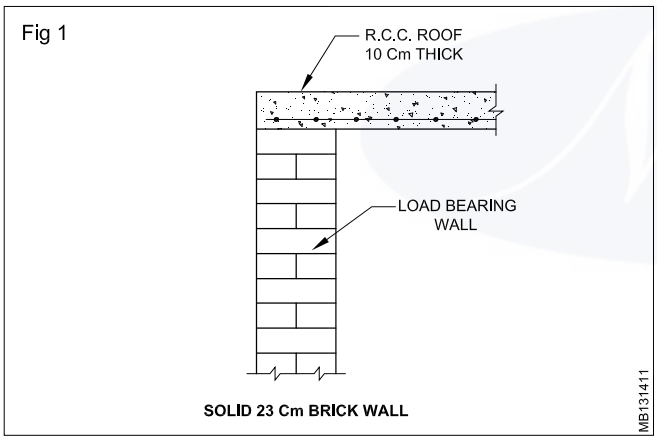
Objectives: At the end of this lesson you shall be able to
- **describe load bearing and non-load bearing wall**
- **describe cavity wall.**

In brick masonry walls are mainly divided into two types

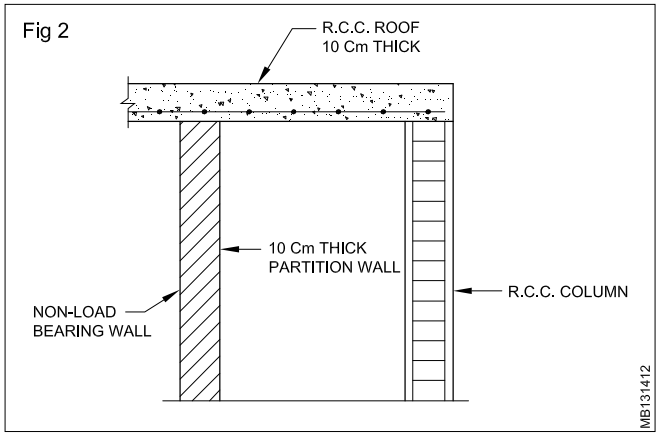
- Load bearing walls
- Non load bearing walls

Load bearing walls (Fig.1)

- Load bearing walls are those walls which are directly subjected to the action of load of the structure.
- The beams, trusses, or any other heavy fittings are always made to rest on these load bearing walls.
- A contineous foundation is provided for all load bearing walls.
- These walls support the load of the entire structure including thier own load.

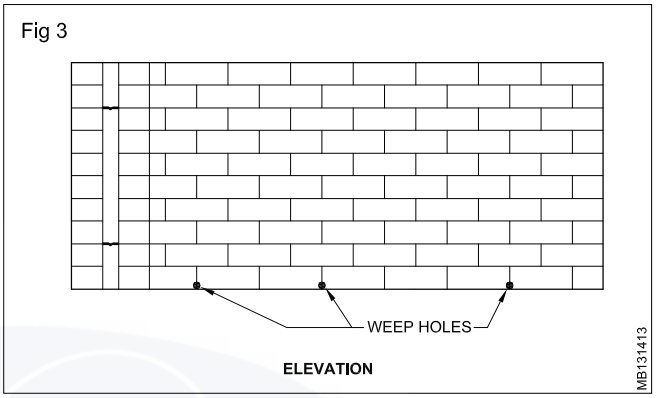


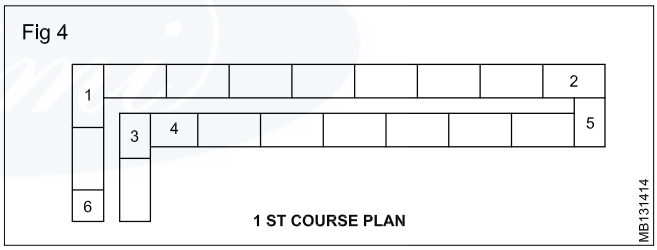
Non load bearing walls (Fig.2)

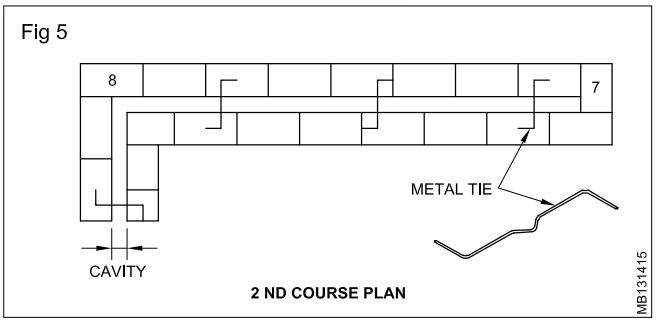


- The Non-load bearing walls are those which are not subjected to the action of load of the structure directly
- The non load bearing walls are called partition walls, curtain walls, screen, dwarf or filler walls.
- The walls are primilarly intended for screening and partitioning with a view to enclosing a space for privacy
- To carry no super imposed load and are only strong enough to support thier own load or weight.

Cavity walls (Fig.3,4,5)



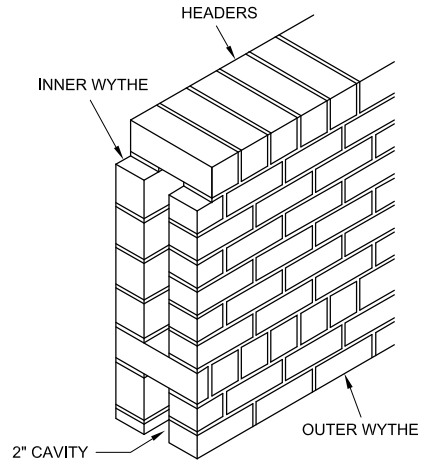




- Cavity walls or hollow walls, as they are sometimes called, are a modern method of construction.
- Cavity walls consists of two leaves outer leaf, and inner leaf
- Cavity wall seperated by a through cavity or hollow in between two leaves are constructed together by metal ties or tie bricks.
- The outer leaf of cavity wall is generally 10cm. thick.
- The inner leaf is sufficiently thick and strong to carry supper imposed loads and safely

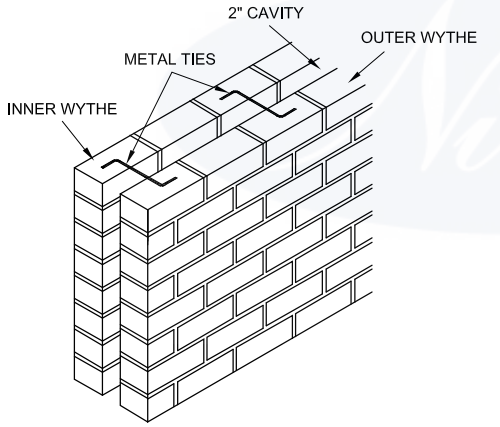
- The width of cavity varies from 5cm to 8cm
- The cavity should be uniform and contineous
- The outer and inner leaf should be properly connected by metal ties at regular intervals as shown in Figure
- The outer leaf (wythe) and inner leaf (wythe) of cavity wall bonded with brick headers as shown in (Fig 6).

Fig 6



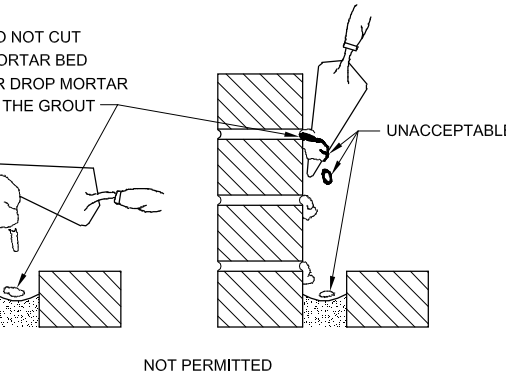
- The two leaves of cavity wall outer leaf and inner leaf bonded with metalz ties as shown in (Fig 7)

Fig 7



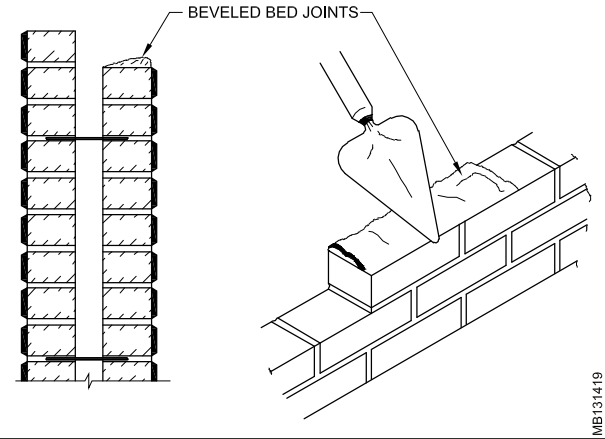
- Donot lay or cut mortar so it falls inside the cavity wall as shown in (Fig 8)

Fig 8



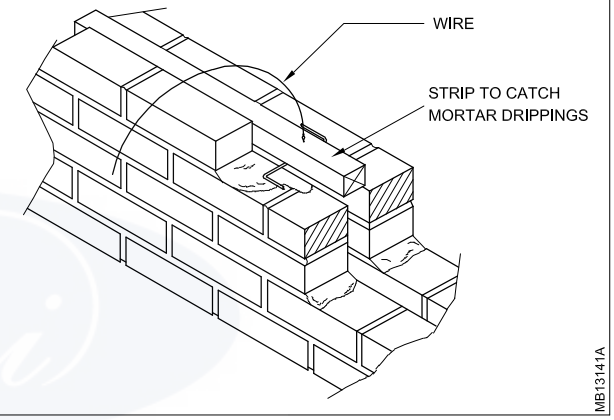
- It is good practice to lay mortar so it is beveled and does not fall inside the wall cavity as shown in (Fig 9)

Fig 9



- use wood strip to catch mortar dropping while constructing the cavity wall as shown in (Fig 10)

Fig 10



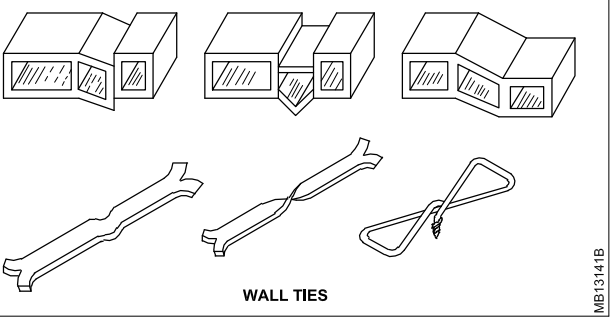
Metal ties (or) wall ties

Metal ties or wall ties are used to bond the two leaves together

Spacing of 50cm to 75cm center horizontally and 30cm to 40cm on center vertically is commonly used.

The various types of wall ties are shown in (Fig 11)

Fig 11



Weep Holes

- Weep holes are required at the base of the cavity wall just above the flashing.
- This allows any moisture that penetrates or condenses in the wall to flow outside.

- Weep holes are commonly located every 50cm to 75cm on center in the course immediately above the flashing. as shown in (Fig 12 and 13)

Fig 12

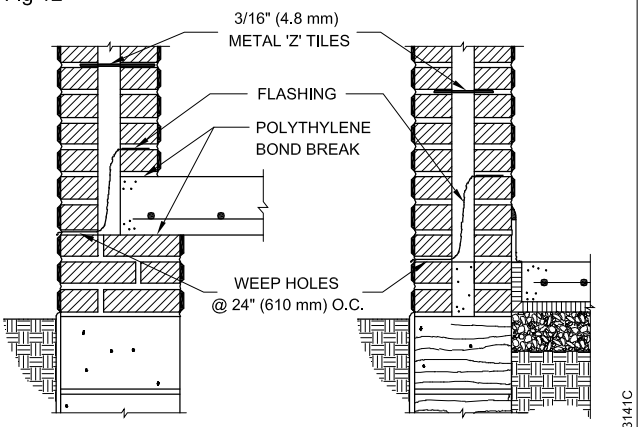
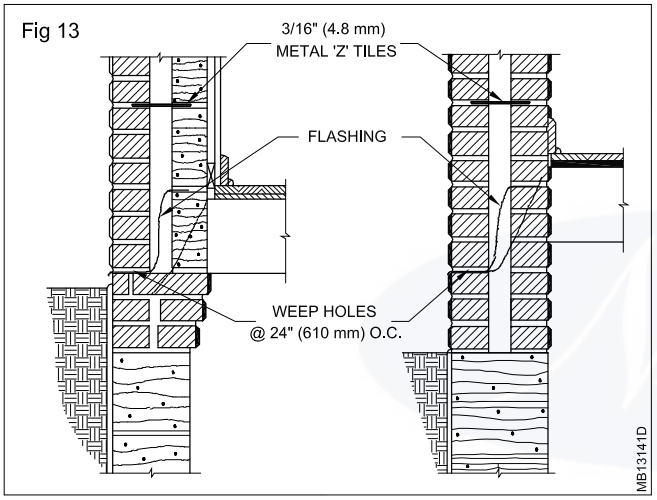


Fig 13



Cavity wall insulation

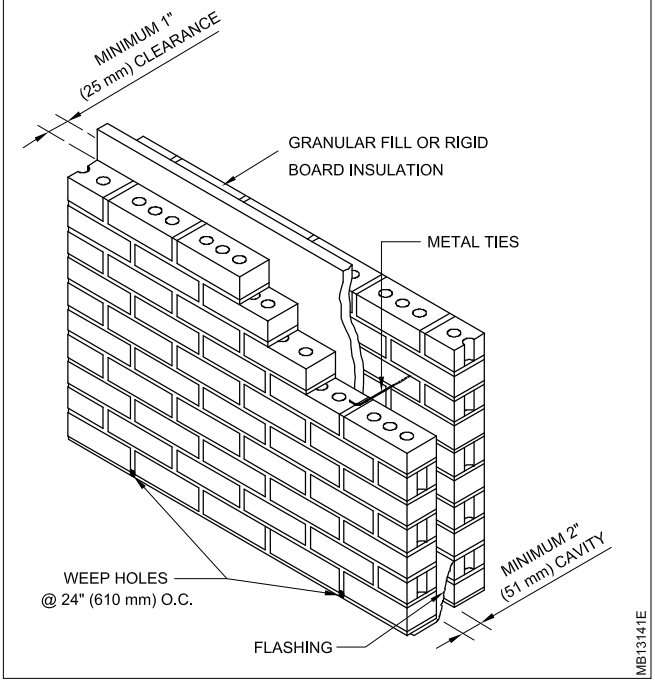
When insulation used in the cavity wall standard flashing and weep holes placement is still required Insulation can be divided into two ways.

- Loose insulation
- Rigid insulation
- Loose insulation is poured into the cavity Rigid insulation is attached to the back of the cavity on the backing leaf.
- There should be a 25mm air space between the rigid insulation and the back of the facing leaf.
- The flashing at the base should run behind the rigid insulation and into a bed course of the backing leaf. as shown in (Fig 14)

Grouting

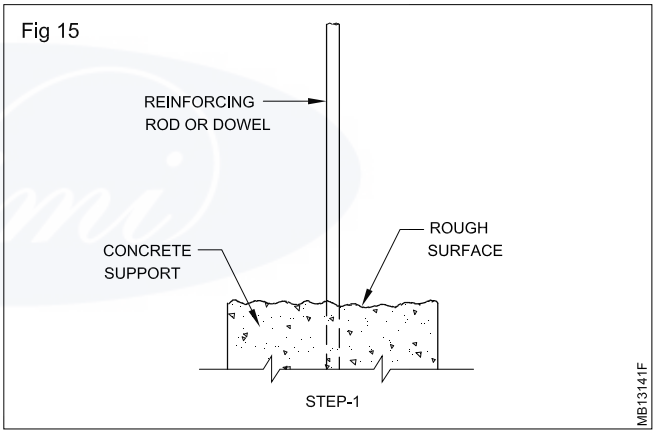
- Only few cm of grout are poured at any one time
- Steel reinforcement rod or dowels are already set in the concrete support base as shown in (Fig 14)

Fig 14



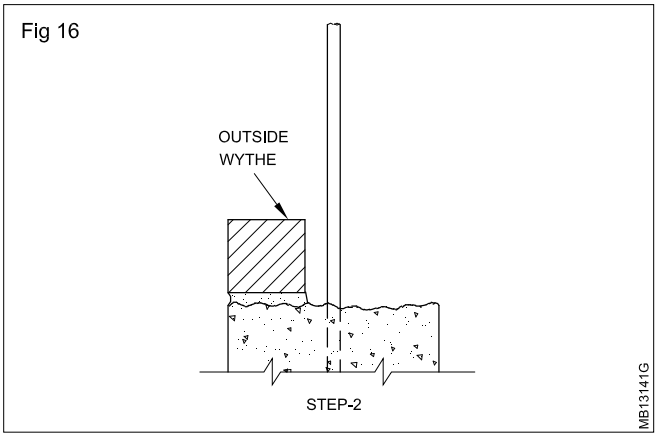
- A brick wall is laid one side of outer wall as shown in (Fig 15)

Fig 15



- The two leaves of cavity wall is laid as shown in (Fig 16)

Fig 16



- First cement grout pour in cavity as shown in (Fig 17)
- Outer leaf may laid about 40cm height than inside leaf as shown in (Fig 18)

Fig 17

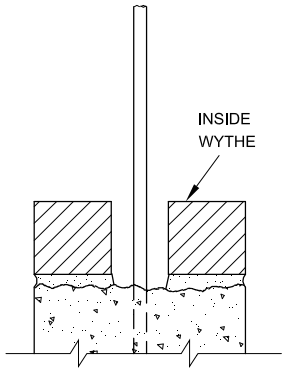
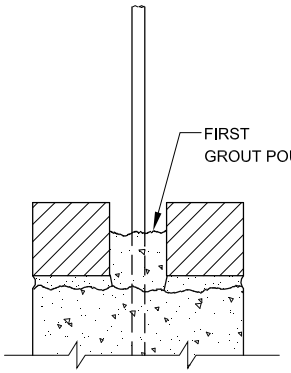
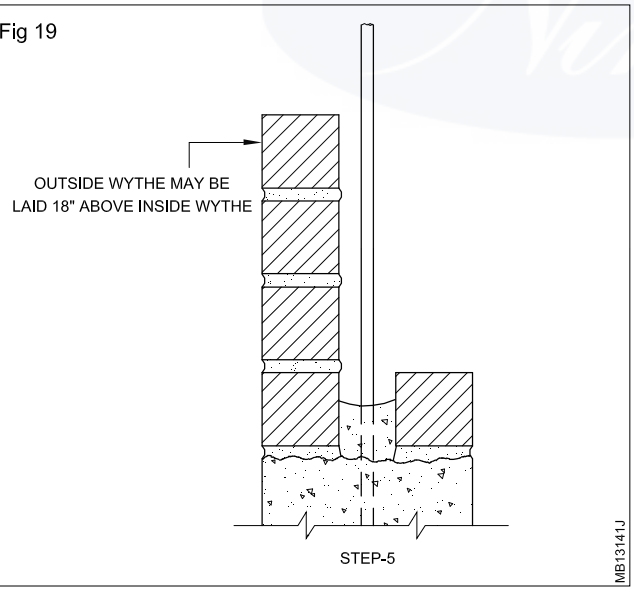


Fig 18



- Second grout is poured after raising sufficient height of cavity wall as shown in (Fig 19).

Fig 19



Construction of cavity walls (Fig.20)

- The two leaves of a cavity wall are constructed seperately
- Cavity walls connected together by metal ties or wall ties at a horizontal distance of 1m and vertical distance of 0.5m leaving clear cavity between them
- Outer cavity wall leaf is normally 10cm thick, and the inner leaf is 10cm to 23cm thick.
- As for as possible there should be no intimate contact between the two leaves of the cavity except with ties.
- The damp proof course should be laid seperately for the two leaves
- The cavity should be properly ventilated and drained by providing weep holes at bottom
- metal ties should be rust proof and preferably should be galvanished
- The cavity should start from the bottom just below the ground level and should extend up to the parapet

Fig 20

