TASK-1
a)
Application of pre-cast concrete in construction of building.

In the Construction Industry, there two types of concrete used as its required.

- In-situ concrete
- Pre-cast concrete

In-situ concrete

The concrete, where it cast in the site is called In-situ concrete.

Pre-cast concrete

The concrete units are made in the pre-cast yards. Here the only thing to do is to fix in the position, where it's to be placed. The pre-cast members are stronger, cheaper and more durable.
The pre-cast concrete used as,

- R.C.C. beams
- Lintels
- Doors
- Window shelves
- Piles
- Electrical poles

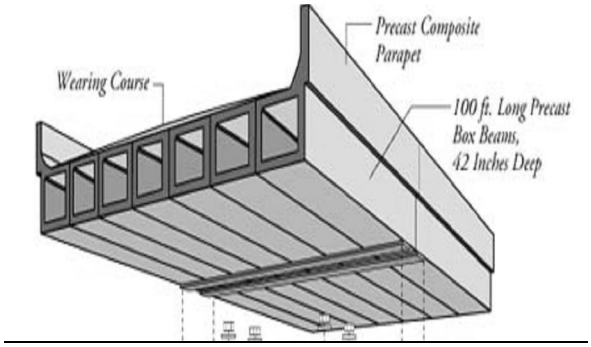


Fig : 01 PRECAST BEAM

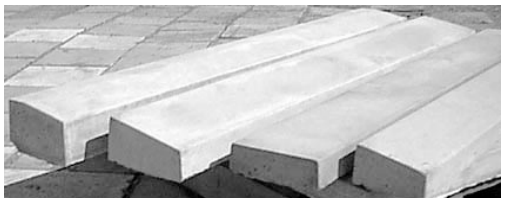


Fig : 02 PRECAST LINTEL

Pre cast

Pre cast concrete frames – these frames are suitable for single storey low rise application, the former usually in the form of portal frames which are normally studied separately. Pre cast concrete frames provide skeleton for the building and can be clad externally and finished internally all the traditional methods. The frames are usually produced as part of a manufacture's standard range of design and are there for seldom purpose made due mainly to the height cost of modules.

Fig: 3

Fig: 4

Fig: 5

Fig: 6

Fig: 7

Fig : 8

Fig : 9

Fig : 10

Fig : 11

Advantage of pre-cast

1. frames are proceed under factory controlled condition resulting in a uniform product of both quality and accuracy
2. repetitive casting lowers the coast of individual members
3. off side production release side space for other activities
4. frames can be assemble in cold weather and generally by semi-skilled labour

Disadvantages of pre-cast

1. although a wide choice of frame is available from various manufacture‘s these system lack the design flexibility of cast insitu purpose made frames.
2. Site planning can be limited by manufacturer’s delivery and unloading programmes and requirements.
3. Lifting plant of a type and size not normally required by traditional construction method may be needed.

b)
Method of construction of pre stressed beams.

Pre-stressed Concrete

Since concrete is weak in tension in normal reinforced concrete construction cracks develop in the tension zone at working loads and therefore all concrete in tension is ignored in design.

Pre-stressing involves inducing compressive stresses in the zone which will tend to become tensile under external loads. This compressive stress neutralizes the tensile stress so that no resultant tension exists, (or only very small values, within the tensile strength of the concrete). Cracking is therefore eliminated under working load and all of the concrete may be assumed effective in carrying load. Therefore lighter sections may be used to carry a given bending moment, and pre-stressed concrete may be used over much longer spans than reinforced concrete.

The pre-stressing force also reduces the magnitude of the principal tensile stress in the web so that thin-webbed I - sections may be used without the risk of diagonal tension failures and with further savings in self-weight. The pre-stressing force has to be produced by high tensile steel, and it is necessary to use high quality concrete to resist the higher compressive stresses that are developed.

There are two methods of pre-stressing concrete;

1. Pre-cast Pre-tensioned
2. Pre-cast Pre-tensioned

Both methods involve tensioning cables inside a concrete beam and then anchoring the stressed cables to the concrete.

Pre-tensioned Beams

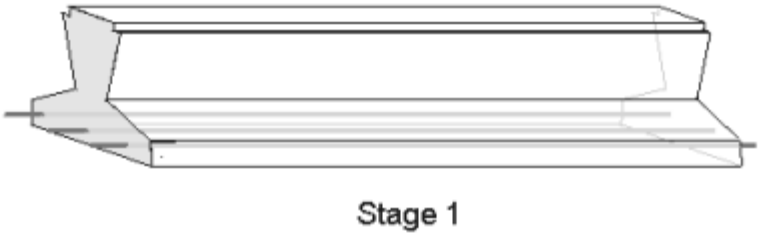


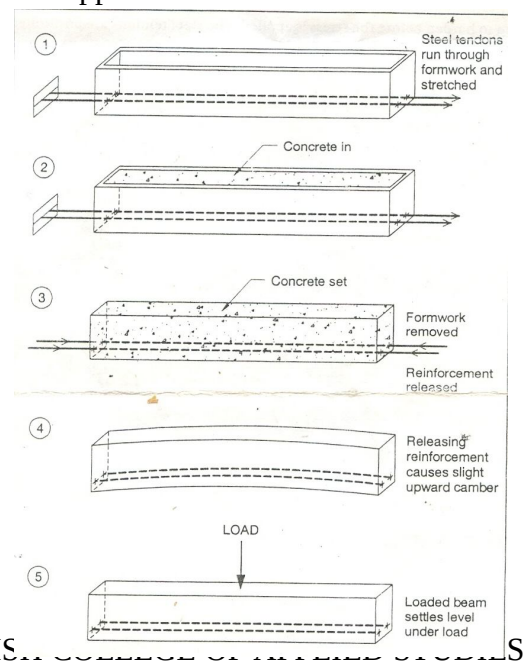
Fig : 12

1. Tendons and reinforcement are positioned in the beam mould.
2. Tendons are stressed to about 70% of their ultimate strength.
3. Concrete is cast into the beam mould and allowed to cure to the required initial strength.
4. When the concrete has cured the stressing force is released and the tendons anchor themselves in the concrete.

This type of tension suitable for small, medium size, members, and suitable for rectangular, circular members

Construction method –

- In the first stage the steel strands are placed in a casting bed, stress to the required level and anchored between two supports.
- The concrete is then cast around the strands and allowed to set during this curing stage, the strands bond to the surrounding concrete.
- When the concrete has developed sufficient compressive strength the strands are released from the supports.



Post-tensioned Beams

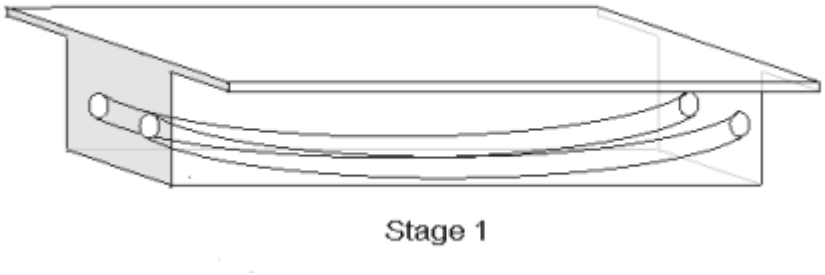


Fig : 14

1. Cable ducts and reinforcement are positioned in the beam mould. The ducts are usually raised towards the neutral axis at the ends to reduce the eccentricity of the stressing force.

2. Concrete is cast into the beam mould and allowed to cure to the required initial strength.

3. Tendons are threaded through the cable ducts and tensioned to about 70% of their ultimate strength.

4. Wedges are inserted into the end anchorages and the tensioning force on the tendons is released. Grout is then pumped into the ducts to protect the tendons.

This tension is more suitable for huge members. Here the tension forced is applied after the casting at the site.

Construction method- -

- The concrete is cast around a hollow duct.
- After concrete has to set a tension (*consisting of strands)* is pushed through the duct.
- Once concrete is reached to sufficient strength in compression, the tendons are jacked with hydraulic jacks at one end by a anchoring other end.

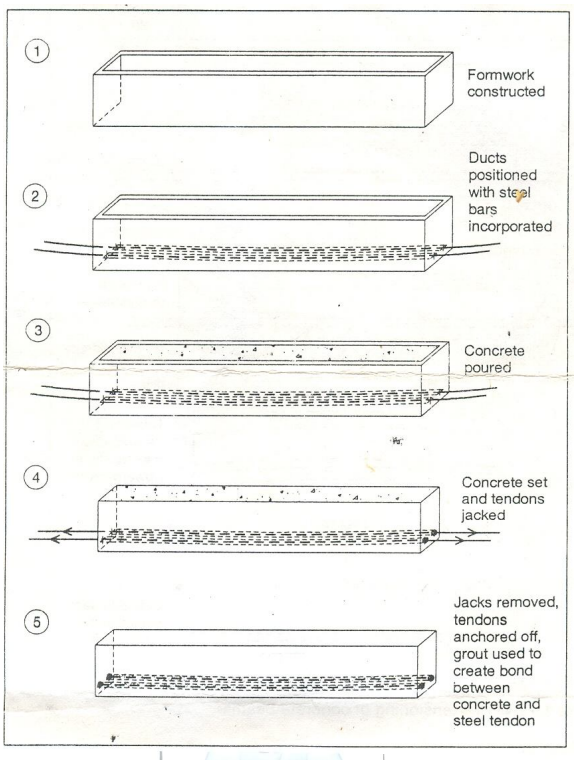


Fig : 15

Loss of Pre-stress

When the tensioning force is released and the tendons are anchored to the concrete a series of effects result in a loss of stress in the tendons. The effects are :

a. relaxation of the steel tendons
b. elastic deformation of the concrete
c. shrinkage and creep of the concrete
d. slip or movement of the tendons at the anchorages during anchoring

Total losses in pre-stress can amount to about 30% of the initial tensioning stress

c)
Application of steel frame work in buildings with justification of selection of steel frame work for the factory building.

Introduction

Steel is a material, which is presently highly demanded in the Construction Industry. Steel is used for various types of purposes; steel is generally used to,

- Foundations
- Columns
- Beams
- Roof

Types of Steels

- Mild steel
- Tor steel
- High carbon steel
- Stainless steel
- Electrical steel

Applications of steel

- Structural steel
  - Roof trusses
  - Space trusses (telecommunication towers, electricity supply towers)
  - Steel frames

- Decorate material
- Form work for concrete
- Steel nails, bolts

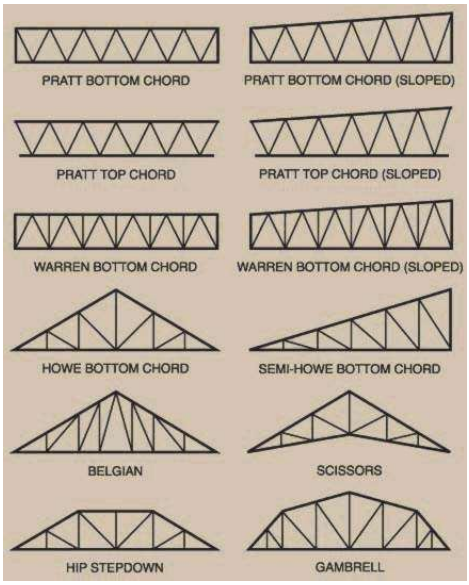


Fig : 16 TYPES OF ROOF

Fig : 17 TELECOMMUNICATION TOWER

Fig : 18 A STEEL STRUCTURE

Types of frame

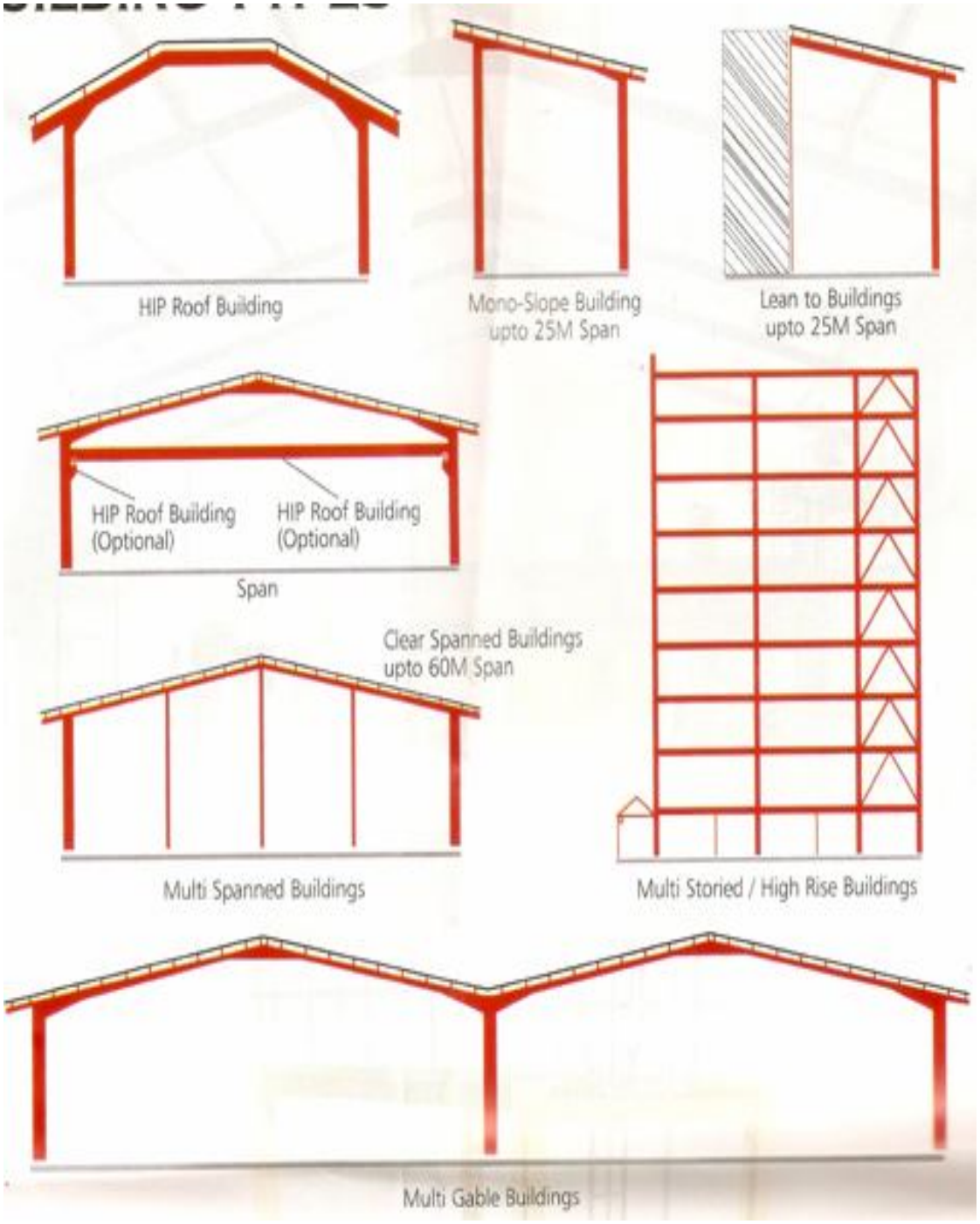


Fig : 19

Portal frames

A portal frame is distinguished by the rigid connection of the rafters to the posts of the frame so that the moments are distributed through the rafter and posts. In designing portal frames plastic theory will be applied. in general, short span portal frames are fabricated off site as one frame and medium frames can be fabricated in two halves for easy transporting and handling. These are assembled at site with bolted connection using high strength friction bolts.

The single storey clear span building is in constant demand for warehouse, factories and many other purposes. The clear internal appearance makes it much more appealing than a trussed roof building and it also requires less maintenance.

d)
The standard steel section that you propose for each elements of factory building with proper sketches.

Structural steel

- Since the 20th century structural steel is using as a material for the construction frame work. Steel has good tensile stress but it has poor compressive stress. For the structural steel frame construction work

Round Bars

- Round bars are circular in cross section with diameter varying from 5cm to 3cm which are used in construction sites of RCC floors, lintels, grill work, etc.

Square Bars

- Square bars have the length of side varying from 5cm to 30cm are used in construction of steel grill work for windows.

Steel Plates

- Plates are wider sections of the flat bars with thickness varying from 5mm to 50mm. they are mostly used for three fold purposes
  1. To connect steel beams.
  2. To serve as tensional members of steel roof.
  3. To from built up section.

The common industrial names of the different plates are:

• Ship Plates

• Boiler Plates

• Mild Steel Plates

• Checkered Plates, etc

Advantages of Structural Steel

- Steel allows for reduced frame construction time and the ability to construct in all seasons
- Steel makes large spans and bay sizes possible, providing more flexibility for owners
- Steel is easier to modify and reinforce if architectural changes are made to a facility over its life
- Steel is lightweight and can reduce foundation costs
- Steel is durable, long-lasting and recyclable

Different shapes of steel sections

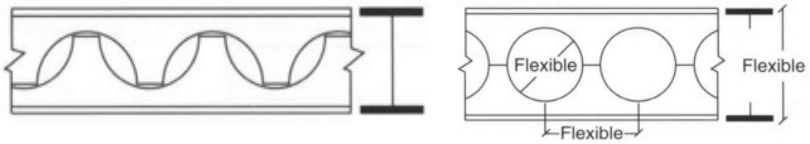
The cross sectional view of steel is called as steel section. The different kinds of sections are

- T section
- I section
- Z section
- Channel
- H section & etc

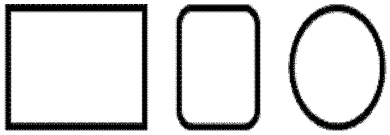
Each section has its particular use in steel structure. The various sections are fabricated form while hot steel by passing it through rolling mills or other machines.

I & H – sections

Castellated beams



Hollow steel sections



Others: channels, L angles,

T-sections

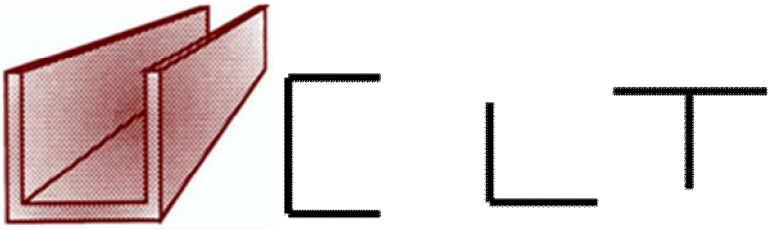


Fig : 20

Types of structural steel frames

According to the structural designs there are several types of structural frames are using for the construction works. These standard structural frames are designed by the British Construction Steel work Association and the Steel Construction Institute.

Alternative steel material

1. Universal beams
2. Universal columns
3. Joists
4. Channels
5. Angles
6. 'T' bars

Universal beams

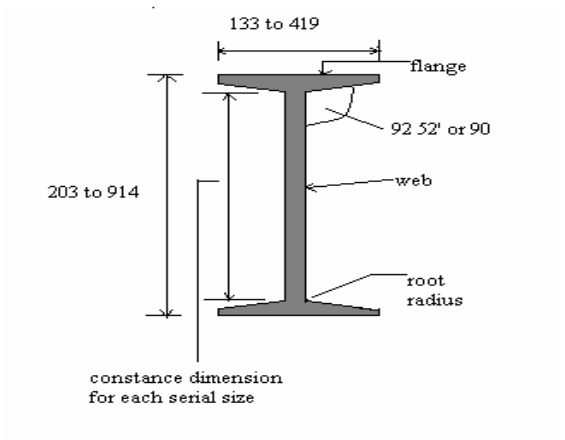


Fig : 21Universal beam

Universal columns

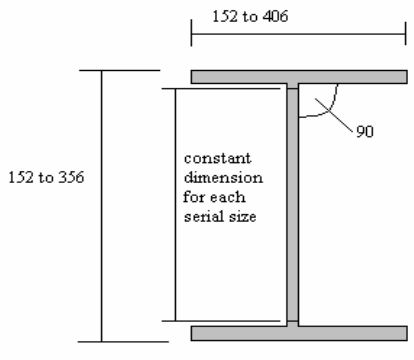


Fig : 22Universal column

These members are rolled with parallel flanges and are designed in the same manner as universal beams. It is possible to design a column section to act as a beam and conversely a beam section to act as a column.

Joists

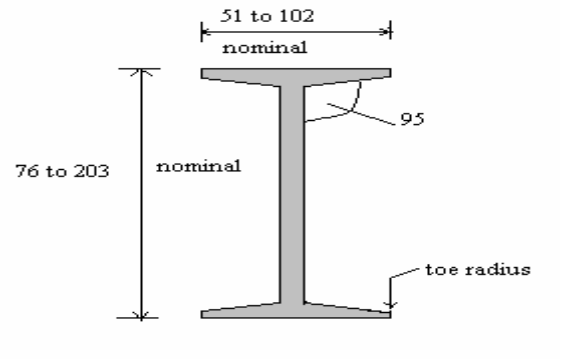


Fig : 23 Joist

These are a range of small size beams which have tapered flanges and are used for lintels and small frames around openings. In the case of joists the serial size is the overall nominal dimension.

Channels

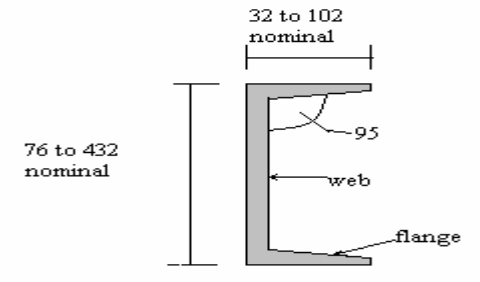


Fig : 24 Channel

These are rolled with tapered flanges and designated by their nominal overall dimension × mass / meter run and can be used for trimming and bracing members or as a substitute for joists sections.

Angles

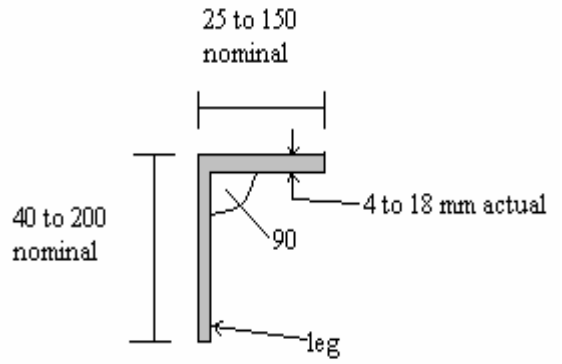


Fig : 25 Angle

These are light framing and bracing sections with parallel flanges. The flange or leg length can be equal or unequal and the sections are designated by the nominal overall leg lengths × nominal thickness of the flange.

‘T’ bars

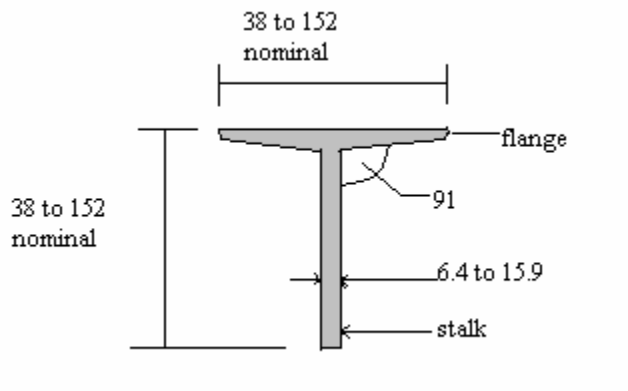


Fig : 26 ‘T’ bar

These are same purpose as angles and are available as rolled sections with a short or long stalk or alternatively, they can be cut from a standard universal beam or column section. Design is given by the nominal overall breadth and depth × mass per meter run.

TYPE OF STEEL

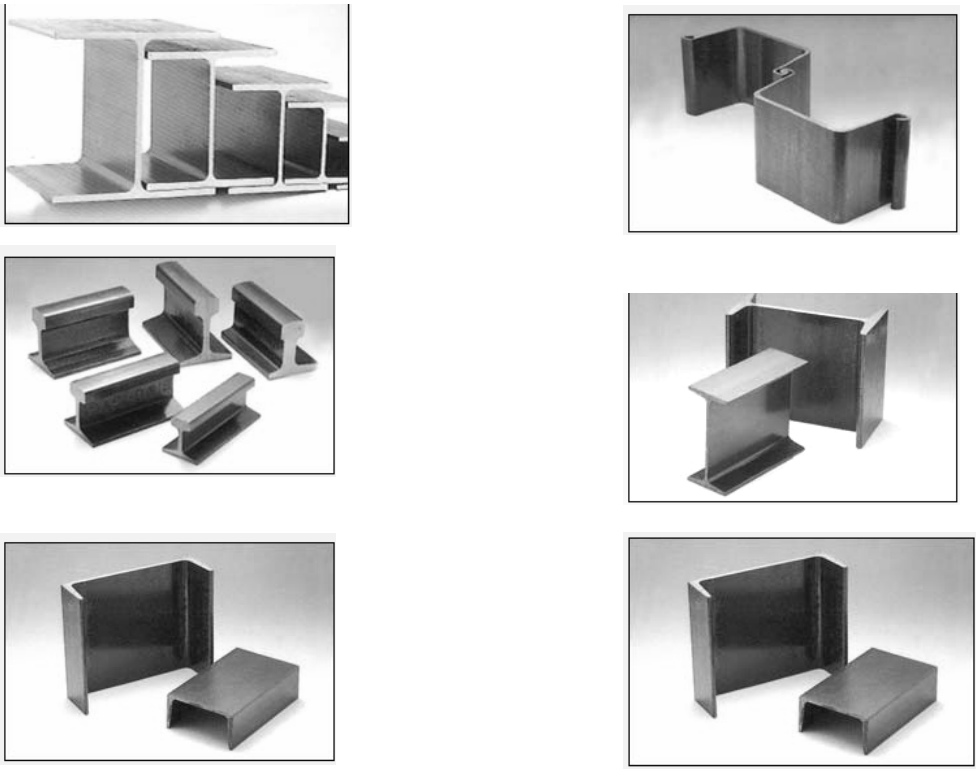


Fig : 27 Type of steel

e)
The method of connection of the members providing suitable sketches for the connection of each member.

standard sections of steel connections

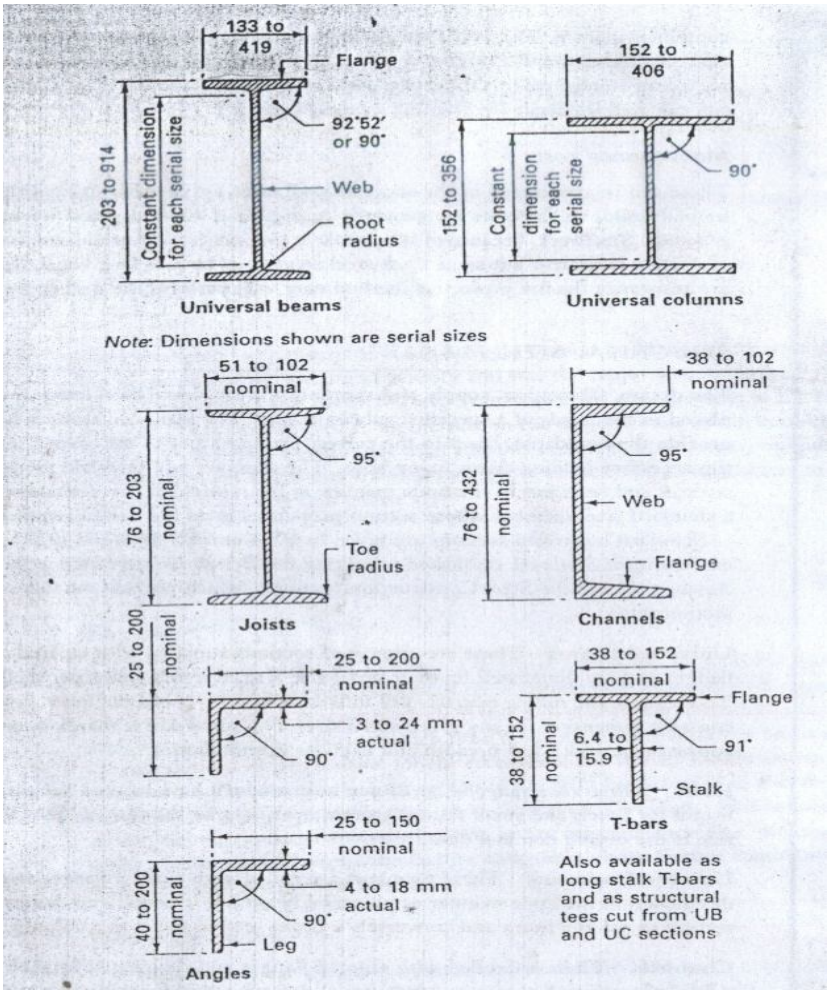


Fig : 28

Combined sections of steel connections

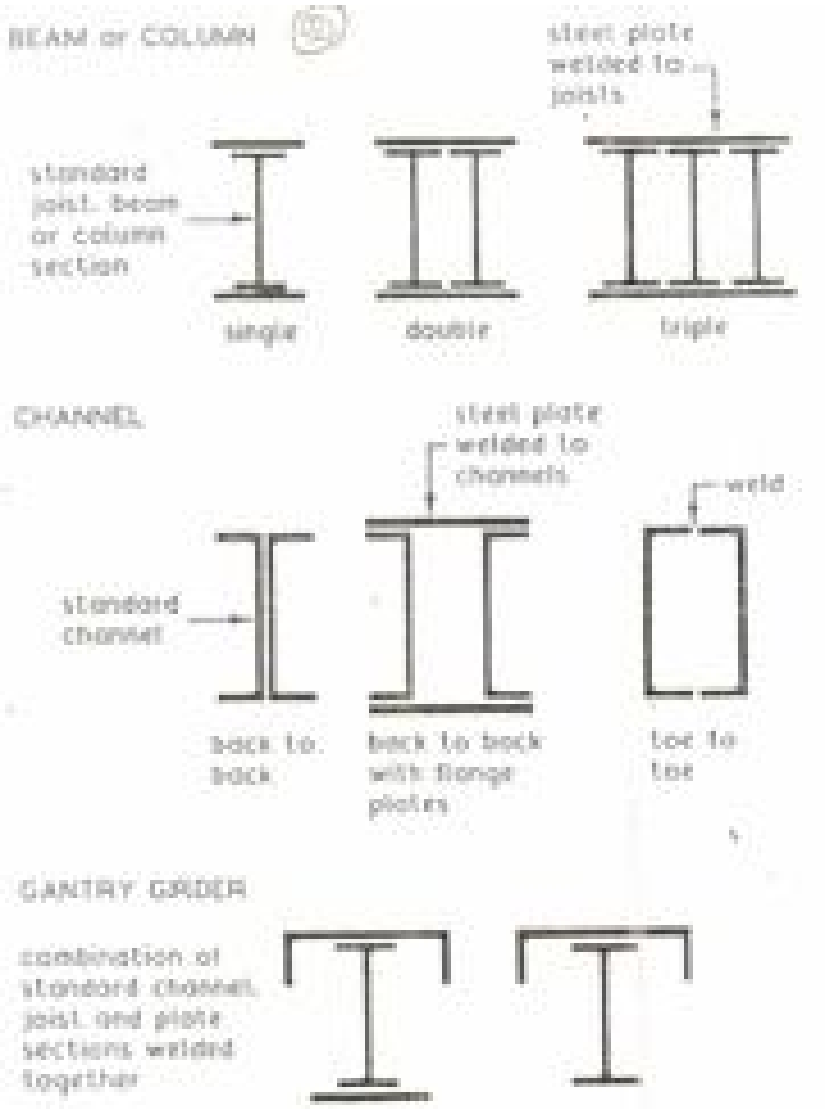


Fig : 29

There are four basic connectors used in making structural steel connections.

- bolts
- welds
- pins
- rivets

Bolts

Bolts are used more than any other type of connectors. They are easy to use and, in contrast to all other types of connectors, require little special equipment. The development of higher strength steels and improved manufacturing processes have resulted in the production of bolts that will produce strong structural steel connections. Specifications for most bolted structural joints call for the use of high-strength steel bolts tightened to a high tension. The bolts are used in holes slightly larger than the nominal bolt size.

Base connection

There are one or two forms, the slab or bloom base and the gusset base. In both methods a steel base plate is requires to spread the load of the column onto the foundation. The end of the column and the upper surface of the base plate should be machined to give a good interface contract when using a bloom base. The base plate and column cab be connected together by using cleats or by fillet welding.

Steel column base connection

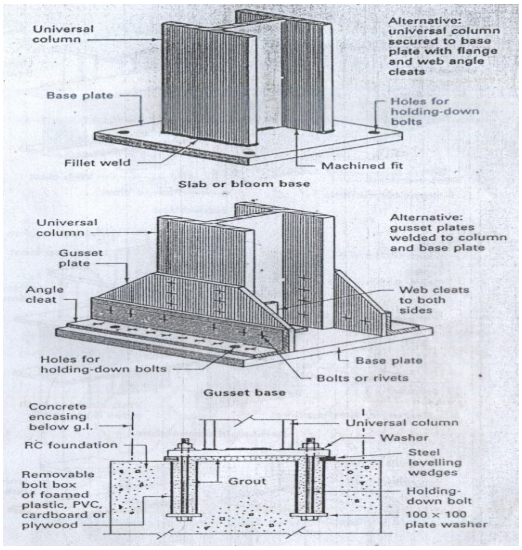


Fig : 30

Beam to column connections

These can be designed as simple connections where the whole of the load is transmitted to the column through a seating cleat. This is an expensive method requiring heavy sections to overcome deflection problems. The usual method employed is the semi-rigid connection where the load is transmitted from the beam to the column by means of top cleats or web cleats; for ease of assembly an erection cleat on the underside is also included in the connection detail.

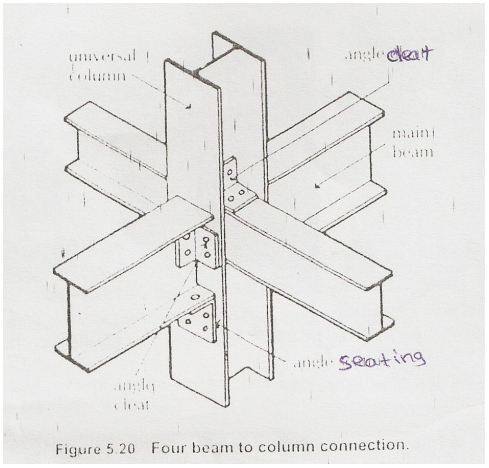
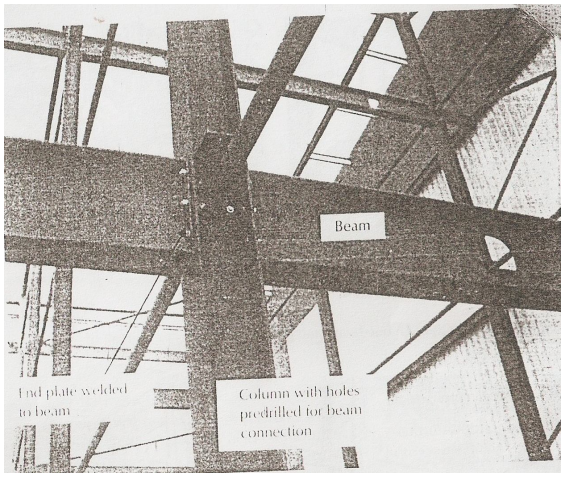


Figure 5.20 Four beam to column connection.



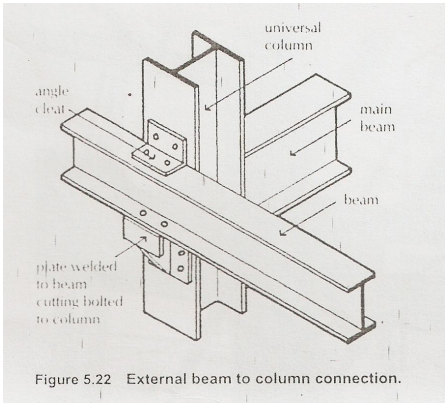
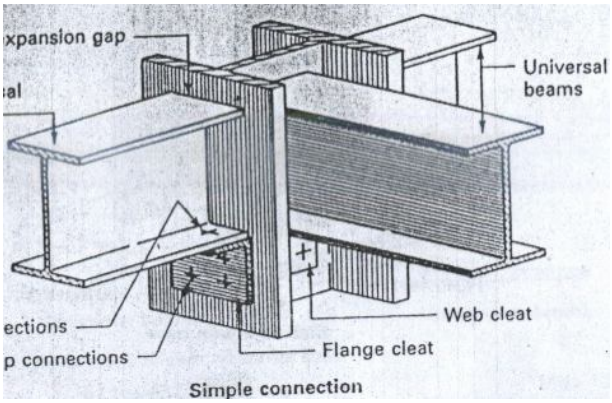
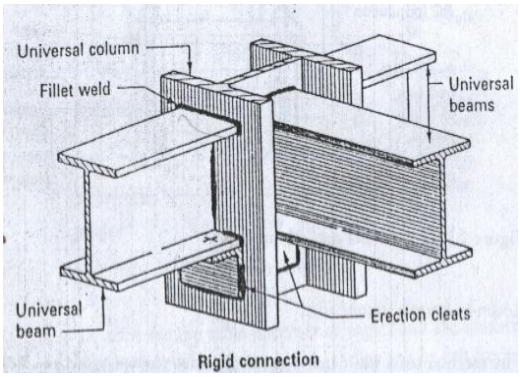


Figure 5.22 External beam to column connection.





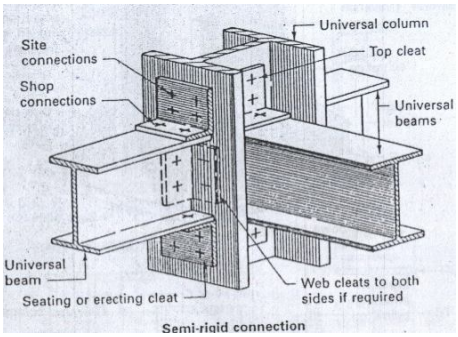


Fig : 31

Column to column connection

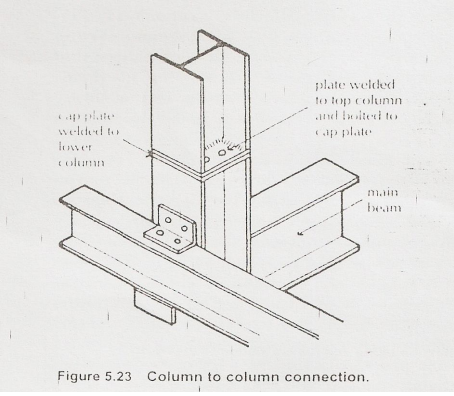
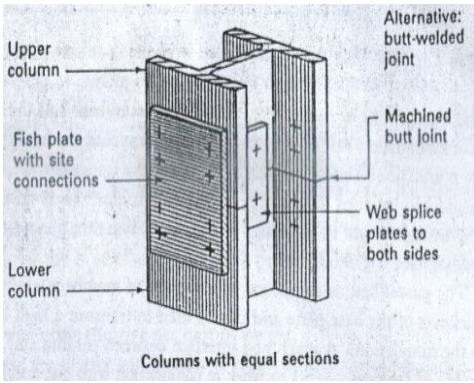


Figure 5.23 Column to column connection.



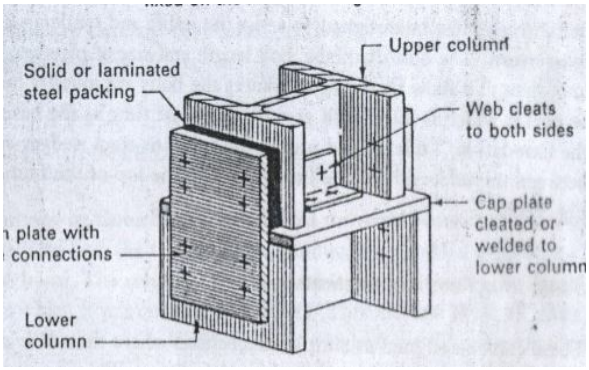
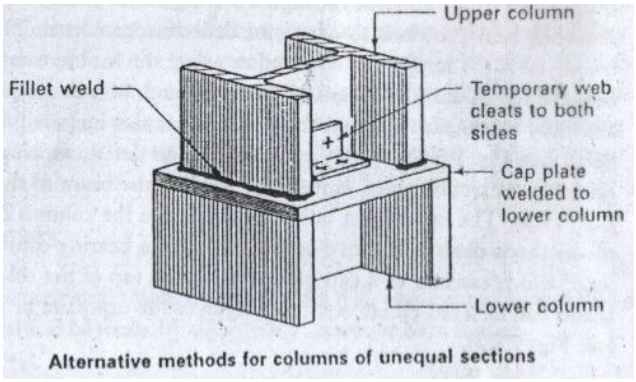


Fig : 32

Beam to beam connections

The method used will depend upon the relative depths of the beams concerned. Deep beams receiving small secondary beams can have a shelf angle connection whereas other depths will need to be connected by web cleats.



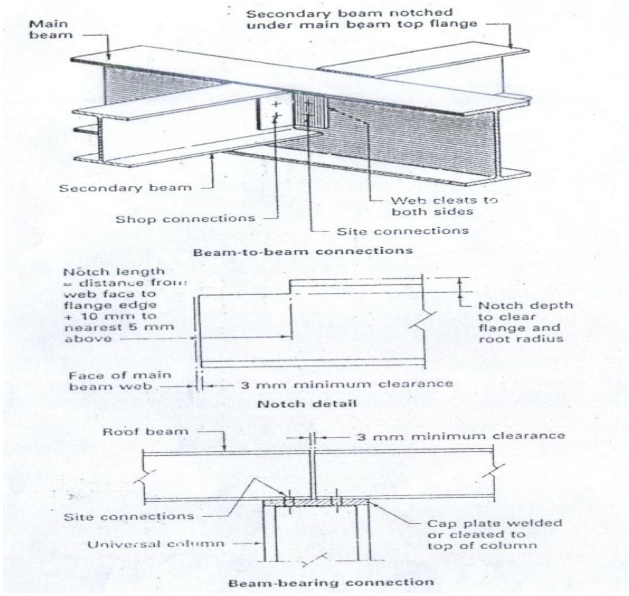


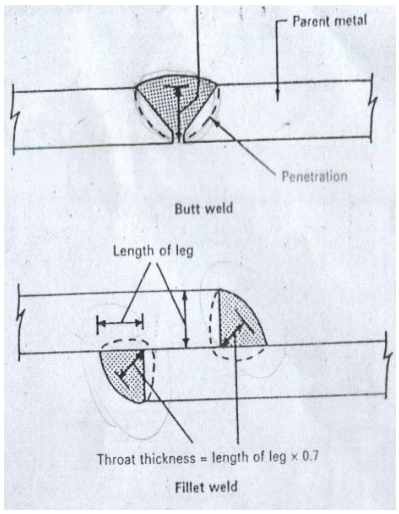
Fig : 33

Welds

Welding is primarily considered as a shop connection since the cost together with the need for inspection, which can be difficult on site, generally makes this method uneconomic for site connections. The basic methods of welding are oxy – acetylene and electric are. A blowpipe is used for oxy- acetylene which allows the heat from the burning gas mixture to raise the temperature of the surface together. For most structural steel applications, the oxy- acetylene method is limited to cutting. In the alternative method an electric arc is struck between a metal rod connected to a suitable low- voltage electrical supply and the surface to be jointed, which must be earthed or resting on an earthed surface. The heat of the arc causes the electrode or metal rod to melt and the molten metal can be deposited in layers to fuse the pieces to be jointed together. With electric arc welding the temperature rise is confined to the local area being welded, whereas the oxy – acetylene method causes a rise in metal temperature over a general area. Welds are classified as either fillet or butt welds. Fillet welds are used on the edges and ends of members and from a triangular fillet of welding material. But welds are used on chamfered end to end connections.

Types of weld

Fillet weld



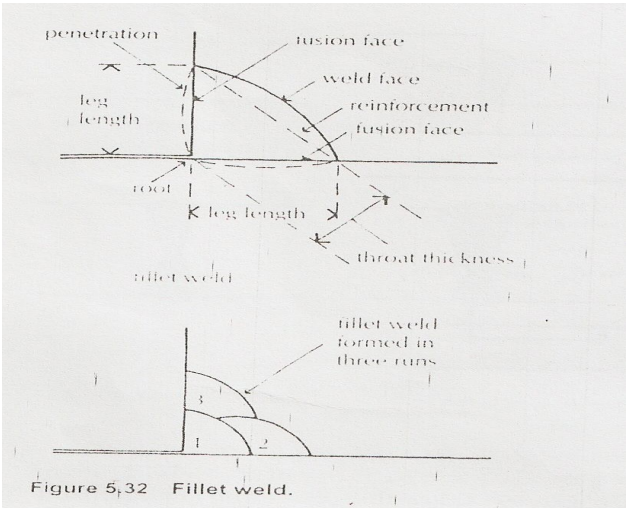


Fig : 34

Butt welds

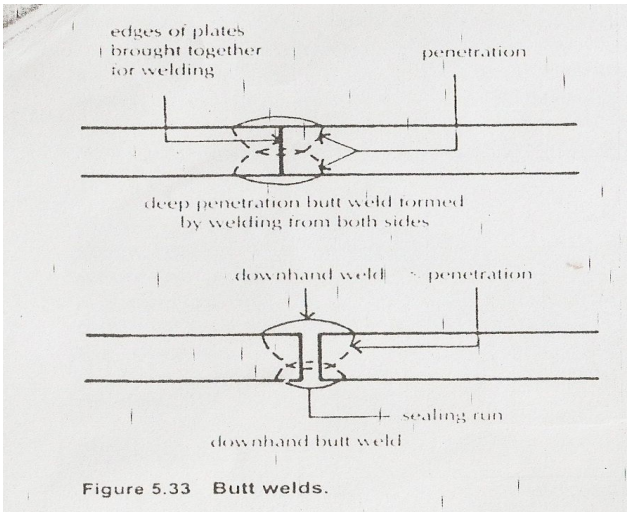


Figure 5.33 Butt welds.

Single V butt weld

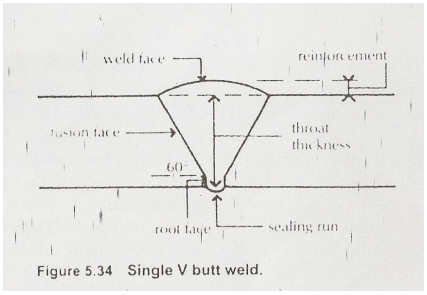


Figure 5.34 Single V butt weld.

Fig : 35

Pins

Pins for very large structures are manufactured especially for the type of job and may have diameters of 24 inches or more and be several feet in length. For most types of jobs, however, pins are between 1 1/4 inches and 10 inches in diameter. The two types of pins commonly used are threaded-bridge pins and cotter pins. Threaded pins are held in place after insertion by threaded recessed nuts on both ends of the pin. Cotter pins are held in place by small cotters that pass through holes drilled in the pins. Washers and separators, made from lengths of steel pipe, are used to space members longitudinally on pins. Holes for small pins are drilled; larger pinholes are bored.

Rivets

Made from mild steel to the recommendations of BS 4620, rivets have been generally superseded by bolted and welded connections for structural steel frames. Rivets are available as either cold or hot forged with a variety of head shapes ranging from an almost semi circular or snap head to a countersunk head for use when the projection of a snap, universal or flat head would create an obstruction. Small diameter rivets can be cold driven but the usual practice is to drive rivets while they are hot. Rivets, like bolts, should be positioned on the back mark of the section; typical spacing are 5/2 diameters centre to centre and 7/4 diameters from the end or edge to the centre line of the first rivet.

f)
Fire protection method available and fire protection method that you recommend for the frame work with proper justification of selected method.

Fire protection of the steel

1. Spray coating:

- There are two types of spray coating;
  - Mineral fiber spray coating
  - Vermiculite/gypsum/cement spray coating

- These materials are sprayed onto the steel surface.

  Advantage: This method is one of the cheapest methods and provides protection up to 4 hours.

  Disadvantage: The coating is easily damaged by knocks and abrasions.

2. Board casing:

- Made of various performed boards, are cut to the sizes, and fixed around steel sections as a hollow insulating fire protection material. The joints must cover, lapped or filled.
- Materials used for the boards are mineral fiber boards, vermiculite/gypsum and plaster board.

  Advantage: can withstand abrasion.

  Disadvantage: it id easily damaged by moderate knocks.

3. Performed casing

- Casing made of vermiculite and gypsum or with a steel finish on a fire resisting lining.
- Formed into L or U shale ready for fixing

4. in tumescent casing

- Include mastics and paints which swell when heated to form an insulating protective coat to act as a heat shield.
- These are applied onto steel sections to form a thin coating which can provide up to 2 hours of fire protection

5. Plaster and Lath

- Stretched metal lath is used to cover the steel section.
- The lath is then covered with vermiculite gypsum plaster

6. Concrete, Brick or block casings

- This is the traditional method of protecting the steel.

Advantage: the solid concrete casing are highly resistant to damage by knocks.

Disadvantage:

1. it adds to the total weight of the building
2. slows down the speed of erection
3. Brick and block laying is an expensive and labour intensive process.

❖ **Advantage**

a. High corrosion resistance
b. Fire and heat resistance
c. Easy cleaning
d. Good appearance
e. Used with a reduced material thickness
f. Resistance to extreme temperature variations
g. Durable

Fire load on steel structures

Examples of fire load in various structures

Type of steel structure	Kg wood / m2
School	15
Hospital	20
Hotel	25
Office	35
Departmental store	35