SNS COLLEGE OF TECHNOLOGY

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COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING

19CET3042-DESIGN OF STEEL STRUCTURES

III YEAR / VI SEMESTER

Unit 1 : INTRODUCTION & CONNECTIONS

What is steel structure?

Steel structure is a metal structure which is made of *structural steel** components connect with each other to carry loads and provide full rigidity. Because of the high strength grade of steel, this structure is reliable and requires less raw materials than other types of structure like concrete structure and timber structure.

ADVANTAGES OF STEEL STRUCTURES

1. Steel has a high strength and so steel components have smaller sections for the same strength compared to corresponding components of other material.The existing steel structures and structural component may be strengthened by connecting additional sections or plates.
2. Steel members are gas and watertight, because of high density of steel.
3. Steel structures can be fabricated at site easily.
4. Steel structures have great durability and serve for many years.
5. Steel members can be readily disassembled or replaced.
6. The existing steel structures and structural component may be strengthened by connecting additional sections or plates.

DISADVANTAGES OF STEEL STRUCTURES

1. Steel structures are liable to corrosion and need painting frequently.
2. Steel structures have a low fire resistance and are liable to lose their strength and get deformed at high temperature.

Where & when use steel structures?

- ☑ Long-span structures
- ☑ Multi-storey & high-rise buildings
- ☑ Buildings of heavy duty plants
- ☑ Tower & mast structures
- ☑ Portal frames
- ☑ Bridges
- ☑ Infrastructures
- ☑ Deployable structures
- ☑ Generalized structures: mechanical

2.2.4 *Properties*

The properties of structural steel for use in design, may be taken as given in **2.2.4.1** and **2.2.4.2**.

2.2.4.1 Physical properties of structural steel irrespective of its grade may be taken as:

a) Unit mass of steel, $\rho = 7\,850$ kg/m^3
b) Modulus of elasticity, $E = 2.0 \times 10^5$ N/mm^2 (MPa)
c) Poisson ratio, $\mu = 0.3$
d) Modulus of rigidity, $G = 0.769 \times 10^5$ N/mm^2 (MPa)
e) Co-efficient of thermal expansion $\alpha_t = 12 \times 10^{-6}$ /°C

2.2.4.2 *Mechanical properties of structural steel*

The principal mechanical properties of the structural steel important in design are the yield stress, f_y; the tensile or ultimate stress, f_u; the maximum percent elongation on a standard gauge length and notch toughness. Except for notch toughness, the other properties are determined by conducting tensile tests on samples cut from the plates, sections, etc, in accordance with IS 1608. Commonly used properties for the common steel products of different specifications are summarized in Table 1.

Rolled Structural Steel Sections

- The steel sections manufactured in rolling mills and used as structural members are known as rolled structural steel sections.
- The steel sections are named according to their cross sectional shapes. The shapes of sections selected depend on the types of members which are fabricated and to some extent on the process of erection.
- Many steel sections are readily available in the market and have frequent demand. Such steel sections are known as regular steel sections.
- Some steel sections are rarely used. Such sections are produced on special requisition and are known as special sections. 'ISI Handbook for Structural Engineers' gives nominal dimensions, weight and geometrical properties of various rolled structural steel sections.

What Is Structural Steel?

Structural Steel can be defined as a high-utility ferrous material in the form of elongated beams, piping, or channels. In general, they are made from a versatile type of carbon steel grade (rolled steel). The use of structural steel is found in all engineering aspects ranging from bridges to residential and commercial constructions, from parking garages to machine bases, and various chemical, petrochemical, steel, nuclear, food, pharmaceutical, and power plants. Even though the structural steel sections are produced from Steel, various different types of metals can be used to produce shapes similar to structural steel shapes. **ASTM A36** is one of the most popular structural steel materials

The Benefits of Structural Steel

Structural steel provides a multitude of advantages in engineering. Some of the important benefits of using structural steel are:

- Structural steel is cost-effective as compared to other available options. Overall costs including material, fabrication, and erection are considerably lower.
- Working with structural steel is quite easy and possible even in adverse weather conditions.
- Existing structural steel members can be easily recycled and reused.
- Easy fabrication.
- High strength and ductility, Good strength-to-weight ratio.
- High load-bearing capability.
- High reliability.
- Easy availability.

TYPES OF ROLLED STRUCTURAL STEEL SECTIONS (STRUCTURAL STEEL SECTIONS)

The various types of rolled structural steel sections manufactured and used as structural members are as follows:

1. Rolled Steel I-sections (Beam sections).
2. Rolled Steel Channel Sections.
3. Rolled Steel Tee Sections.
4. Rolled Steel Angles Sections.
5. Rolled Steel Bars.
6. Rolled Steel Tubes.
7. Rolled Steel Flats.
8. Rolled Steel Sheets and Strips.
9. Rolled Steel Plates.

Properties of Structural Steel

The features of structural steel influence the design and construction of steel structures, and the value of different steel characteristics are highlighted below. The various tests that produce the importance of mechanical properties of structural Steel and the desired values of each parcel have been discussed in this article.

1. **Density**: The density of Structural Steel is 7750 to 8100 kg/m^3.
2. **Young's Modulus of Elasticity:** Typical values for structural steel range from 190-210 GPa
3. **Poisson's ratio**: For structural Steel, the acceptable value ranges from 0.27 to 0.3.
4. **Tensile strength:** Structural Steel has high tensile strength, so it is preferred over other construction materials.
5. **Yield strength:** The yield strength, also known as the yield point, is the stress at which an object permanently deforms. When stress is removed, it does not revert to its former shape. Carbon structural steel has a yield strength ranging from 187 to 758 MPa. The values of structural Steel constructed of alloys range from 366 to 1793 MPa.

6. **Shear strength:** The shear strength of steel structure is specified at the failure under shear stress, and it is about 0.57 times the yield stress of structural Steel.
7. **Hardness:** The resistance of an object to shape change when force is applied is referred to as hardness. There are three different types of hardness tests. Scratch, indentation, and rebound are all terms used to describe the process of scratching and indenting, and the hardness of structural Steel manufactured with alloys ranges from 149 to 627 kg. Carbon structural steels have a weight range of 86 to 388 kg.
8. **Melting point:** Because there are so many different types of structural Steel, there is no standard melting point.
9. **Specific heat:** The amount required to raise an object's temperature by a particular quantity is known as specific heat or heat capacity. A higher specific heat value indicates that the thing is more insulating. The units of measurement are Joules per Kilogram Kelvin. Specific heat for carbon structural steel ranges from 450 to 2081 J/kg-K, while for structural alloy steel, it ranges from 452 to 1499 J/kg-K

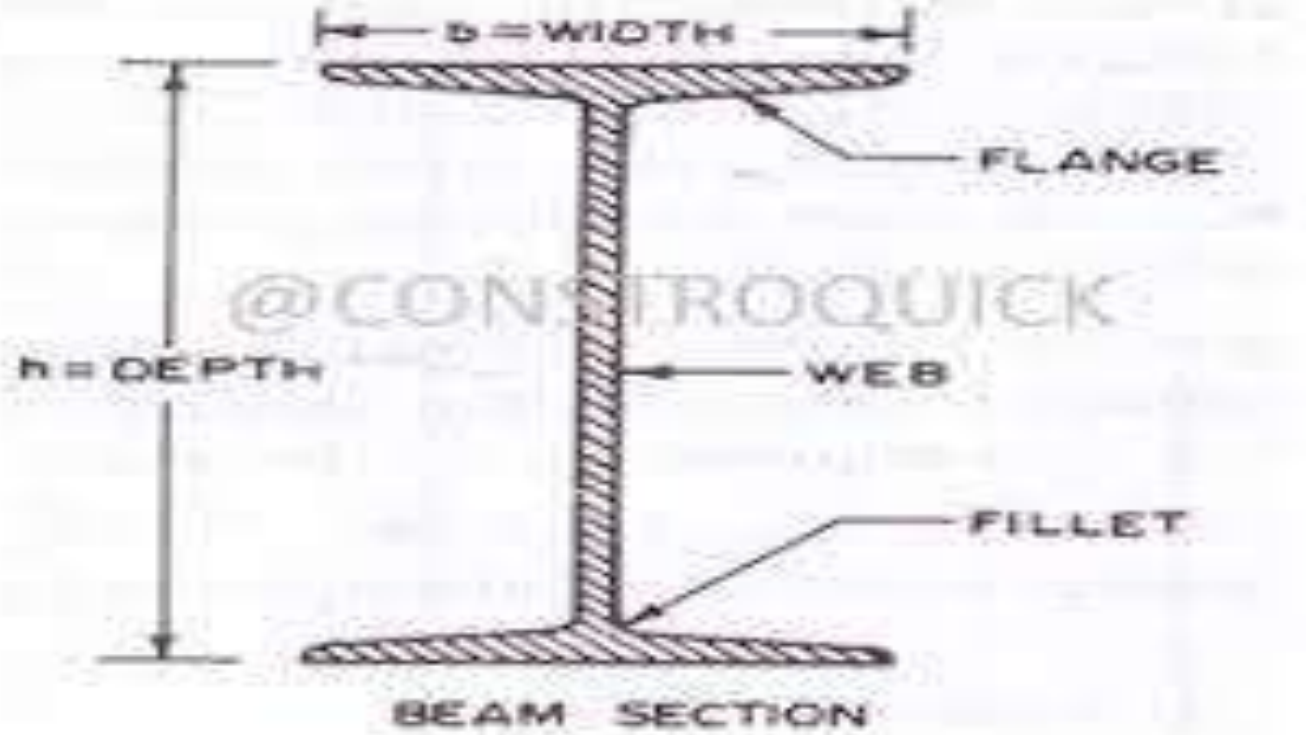
1. Rolled I – Sections (Beam sections)

I sections which are also called as steel beams or rolled steel joist are extensively used as beams, lintels, columns etc. It consists two flanges and a web connected as shown in figure.

The rolled steel beams are classified into following four series as per BIS : (IS : 808-1989)

1. Indian Standard Joist/junior Beams - ISJB
2. Indian Standard Light Beams - ISLB
3. Indian Standard Medium Weight Beams - ISMB
4. Indian Standard Wide Flange Beams - ISWB
5. The rolled steel columns/heavy weight beams are classified into the following two series as per BIS (IS : 808-1989)

1. Indian Standard Column Sections ISSC
2. Indian Standard Heavy Weight Beams ISHB


b = WIDTH
FLANGE
h = DEPTH
WEB
FILLET
BEAM SECTION

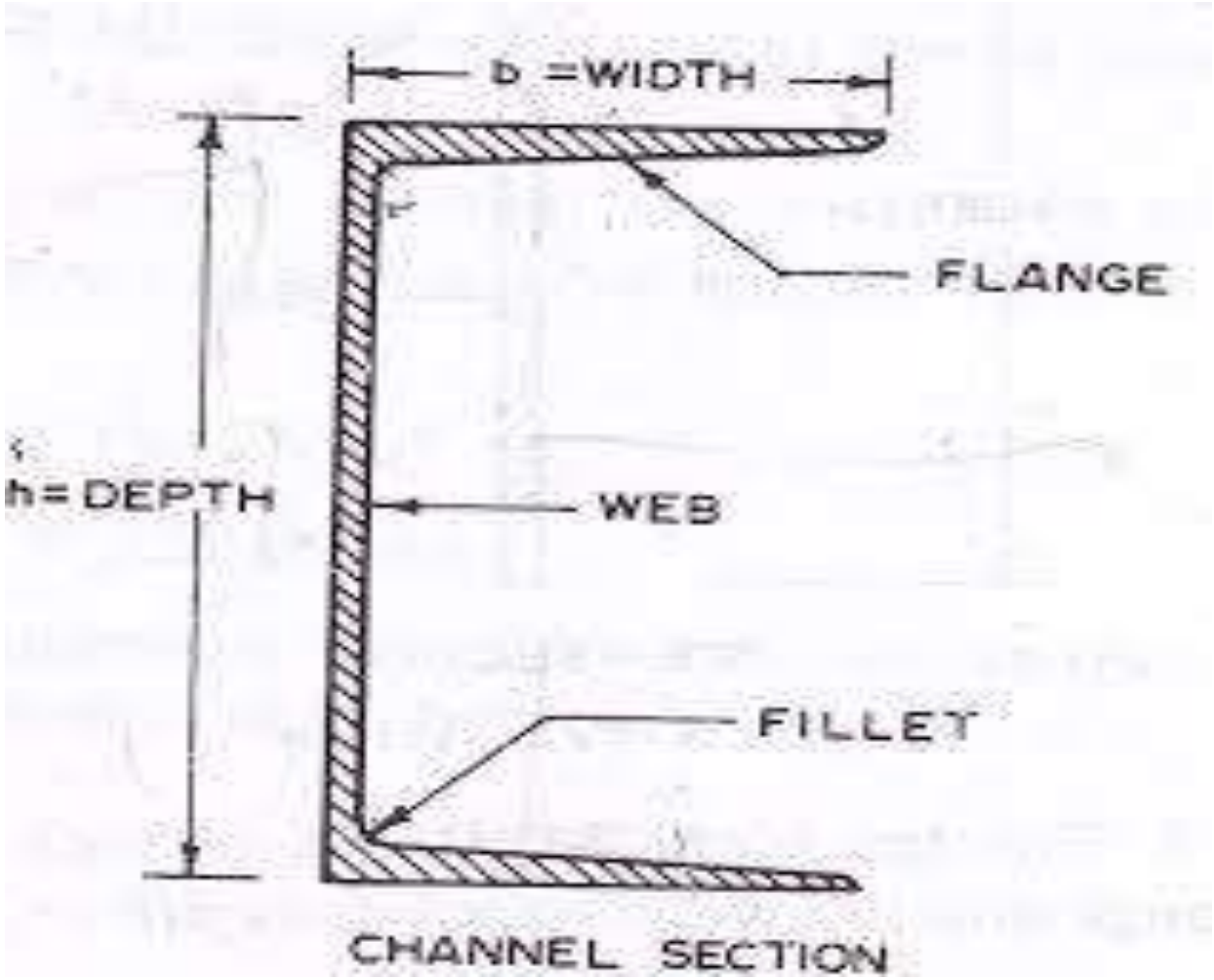
2. Rolled Steel Channel Sections

The channel section or C- section consists two equal flanges connected to web at both ends. Channel sections are extensively used in steel framed structures.

The rolled steel Channel sections are classified into four categories as per ISI, namely,

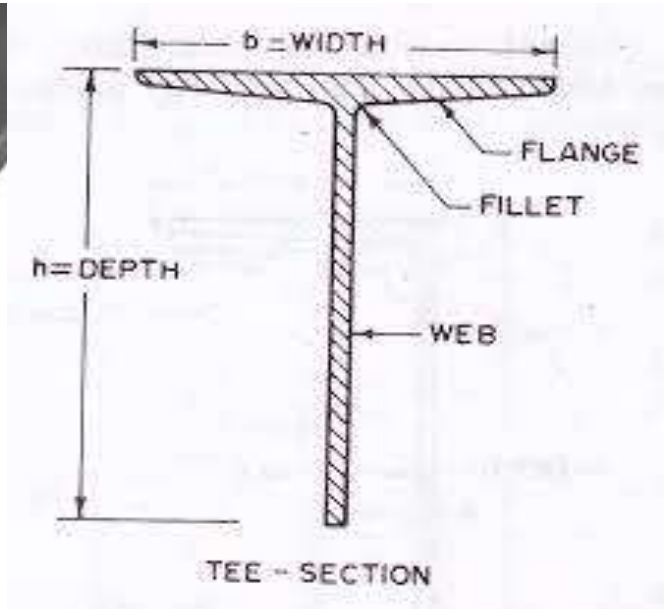
1. Indian Standard Joist/Junior Channels - ISJC
2. Indian Standard Light Channels - ISLC
3. Indian Standard Medium Weight Channels - ISMC
4. Indian Standard Medium Weight Parallel Flange Channels - ISMCP

2. Rolled Steel Channel Sections



3. Rolled Steel Tee Sections

T section consists of flange and web arranged in “T” shape. They are used in steel roof trusses to form built up sections. Two angle sections can also be joined to get T section.



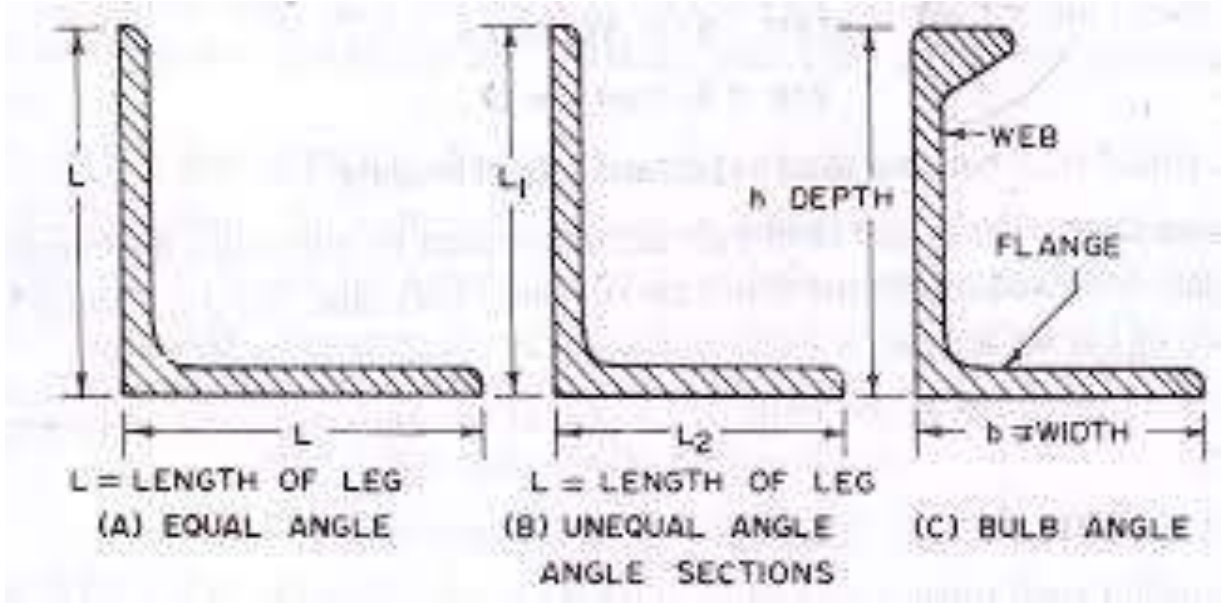
The rolled steel tee sections are classified into the following five series as per ISI:

1. Indian Standard Normal Tee Bars ISNT
2. Indian Standard Wide flange Tee Bars ISHT
3. Indian Standard Long Legged Tee Bars ISST
4. Indian Standard Light Tee Bars ISLT
5. 5.Indian Standard Junior Tee Bars ISJT

4. Rolled Steel Angles Sections.

Angle sections are manufactured in “L” shape. It contains two legs. Some angle sections contains legs with similar dimensions are called as equal angle sections and some contains different legs are called as unequal angle sections.

4. Rolled Steel Angles Sections.



The rolled steel angle sections are classified in to the following three series.

1. Indian Standard Equal Angles ISA
2. Indian Standard Unequal Angles ISA
3. Indian Standard Bulb Angles ISBA

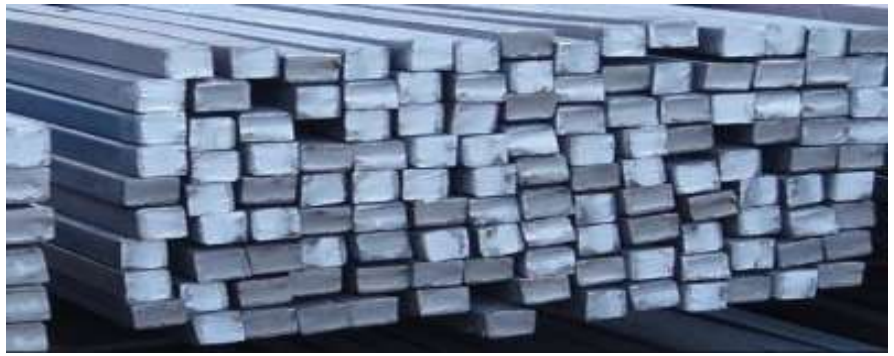
5. Rolled Steel Bars.

The rolled steel bars are classified in to the following two series:

1. Indian Standard Round Bars ISRO
2. Indian Standard Square Bars ISSQ

Round bars contain circular cross sections and these are used as reinforcement in concrete and steel grill work etc. Round bars are available in various diameters varies from 5 mm to 250 mm.

Square bars contain square cross sections and these are widely used for gates, windows, grill works etc. the sides of square cross section ranges from 5 mm to 250 mm.



6. Rolled Steel Tubes.

The rolled steel tubes are used as columns and compression members and tension members in tubular trusses. The rolled steel tubes are efficient structural sections to be used as compression members. The steel tube sections have equal radius of gyration in all directions.

7. Rolled Steel Flats.

Flat bars are also used for gates, windows, grill works etc. Flat bars are designated with width of the bar which varies from 10 mm to 400 mm. thickness of flat bars will be from 3 mm to 40 mm.

8. Rolled Steel Sheets and Strips.

The rolled steel sheet is designated by abbreviated reference symbol SH followed by length in mm x width in mm x thickness in mm of the sheet. The rolled steel strip is designated as ISST followed by width in mm x thickness in mm, e.g., SH 2000 x 600 x 8 and ISST 250 x 2.

9. Rolled Steel Plates

- The rolled steel plates are designated by abbreviated reference symbol PL followed be length in mm x width in mm x thickness in mm of the plates, e.g., PL 2000 x 1000 x 6.
- The rolled steel sheets and plates are widely used in construction. Any sections of the required dimensions, thickness and configuration may be produced by riveting or welding the separate plates.
- The rolled plates are used in the web and flanges of plate girders, plated beams and chord members and web members of the truss bridge girders. The rolled steel plates are used in special plate structures, e.g., shells, rectangular and circular steel tanks and steel chimneys.

What is cold-formed steel?

Cold-formed steel (CFS) members are made from structural quality sheet steel that are formed into C-sections and other shapes by roll forming the steel through a series of dies.

No heat is required to form the shapes (unlike hot-rolled steel), hence the name cold-formed steel.

A variety of steel thicknesses are available to meet a wide range of structural and non-structural applications.

Advantages	Disadvantages
The construction process is speedy because of using prefabricated element in the structure. It also reduces the waste of material in times of construction and also improves the quality of the work as site work is reduced.	Price is one of the greatest concerns in case of cold formed steel structure. Cold rolled steel costs twice as much as hot rolled steel.
High strength-to-weight ratio is one of the most advantageous properties of steel. The light weight of steel makes the foundation simple and also makes handling of element easier.	Buckling is one of the main problems in the cold formed steel element. Local buckling, global buckling, distortional buckling and shear local buckling are commonly seen in cold-formed sections.
Good quality of works and maintenance can be achieved. Cold formed steel structures also provide easy modification as non load carrying components. Termite-proof ness and rot-proof ness make cold formed steel section durable. Long-term corrosion resistance can be achieved by galvanizing cold-formed steel products.	Web Crippling is a great problem for cold formed steel sections. Web crippling can happen where concentrated load exists in support. Sometimes stiffener cannot be provided in cold formed sections and this problem becomes prominent.
Cold formed steel can be used in providing long span for its high strength to	Cold formed steel section has some limitation regarding ductility and plastic design. Sectional buckling and the effect of

THANK YOU