

01- March - 2024

GATE $\rightarrow$ 3-5 marks
ESE (Pre) $\rightarrow$ (20-24 M)
ESE (Mains) $\rightarrow$ [04 Marks]

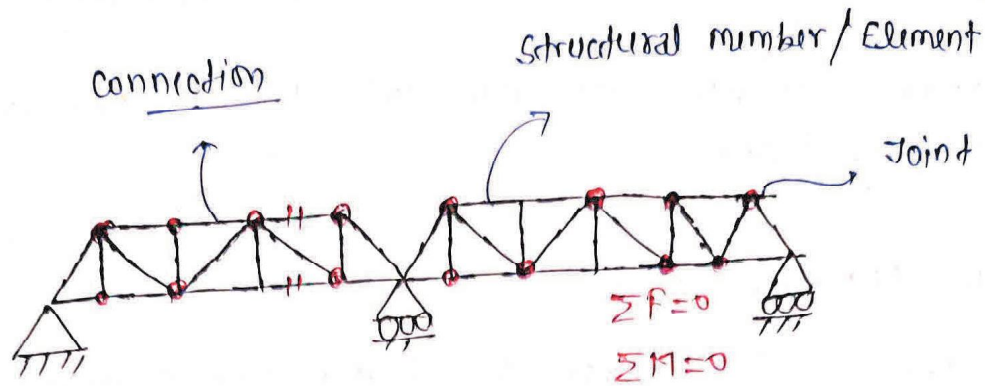
- * Theory
- * Code provision
- * concepts.

Book $\rightarrow$ S.K. Duggal

or
Made easy theory Book

DESIGN * OF * STEEL * STRUCTURES

INTRODUCTION



Truss Bridge

Ques - What is steel structure?

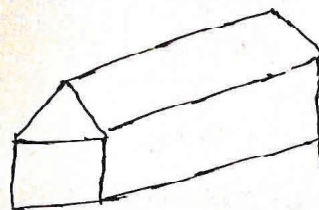
Ans → A steel structure can be defined as a combination of various structural members or elements which are interconnected with each other in an organized pattern, so that the entire framework can sustain the upcoming loading effects safely.

Examples of steel structure

① Railway Bridge :- It consists of a set of parallel chorded trusses which are connected with each other with the help of pin or hinge joints.

② Industrial Building :-

The Roofing system of an industrial building consists of Roof truss or Pitched truss, Purlins and Roof covering material (G.I sheet).



NOTE ① - Purlins are always placed at the joint location to avoid moment in the truss elements. Hence the truss elements are designed only for axial forces.

NOTE ② → Truss elements are also subjected to reversal of loading / stresses.

EX ③ → Framed Buildings :-

It consist of combination of Beams and columns which are mainly designed for moments and forces and thus the members are rigidly jointed.

NOTE ③ - In the design of steel structure Priority is given to connections over members bcz connection failure occurs abruptly whereas the member failure is ductile in nature.

In Truss → Axial tension or Axial compression asked only.

In Frame structure → Bending moment and Shear force asked only.

SYLLABUS

1. General Design Requirements

→ Structural steel and Design Philosophies

2. Design of Simple connections

- Riveted Joint
- Bearing-type Bolt
- Friction type Bolt

} Numerical

3. Design of Simple Welded Connections.

- Butt / Groove Weld
- Fillet Weld
- Plug & Slot Weld

→ Numerical

4. Design of Eccentric Connection.

- Seated connection
- Framed connection
- Type-1 Bracket connection
- Type-2 Bracket connection

} Numerical.

5. Design of Tension Member

- Net Sectional Area
- Yielding failure
- Rupture failure
- Block shear failure.

General Design Requirements

6.) Design of Compression Member

- Effective Length
- Slenderness Ratio
- Column Formula
- Built-up column

7.) Design of Flexural Members

- Laterally Supported Beams
- Laterally Unsupported Beams
- Bending Strength
- Shear Strength
- Web Buckling & Web Crimping
- Deflection.

8.) Design of Column Base Plate (ESE)

- Slab base
- Gussated Base
- Grillage Footing

9.) Design of Plate Girder (ESE)

- Web Plate
- Flange Plate
- Connection between Flange & Web
- Stiffeners
- Web splice
- Flange splice.

10) Design of Gravity Girder

- Maximum Wheel load calculation
- Deflection limits
- Impact loads.

11) Roof Truss (E.S.E)

- Economical spacing
- Loads on Roof truss
- Design of Purlin
- Bracing element.

12) Plastic Analysis (GATE)

- Assumptions
- Behavior of Beam in Flexure
- Plastic moment
- Plastic Hinge
- Plastic Hinge length
- Shape Factor
- Load Factor
- Theorems
- Methods to determine collapse load
- Collapse load for standard cases
- Analysis for Frames

Important Code & Handbook

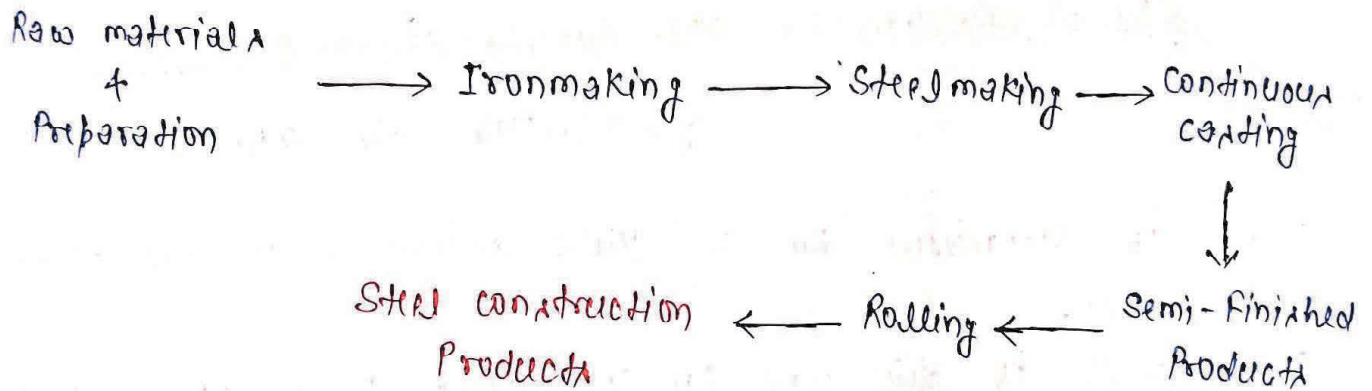
- ① IS 800:2007 → I.S. Code
- ② SP 16 → Steel Table
- ③ IS 1893 → Earthquake Design
- ④ IS 875 (Part I-V) → Design loads.

CHAPTER - 01 General Design Requirements

1.1 → Structural Steel :-

- A steel is an alloy of iron (appr. 98%) and carbon (0.1% to 1.1%).
- With the increase in carbon content the strength of the steel increases but its ductility reduces.
- The properties of steel can be enhanced by adding certain alloys such as chromium, Vanadium and Titanium. By adding such alloys the strength and the resistance towards the corrosion increases in steel.

Formation of Structural Steel.



- ⇒ Structural steel is a category of steel used for making construction material in a variety of shapes.
- Many structural steel shapes take the form of an elongated beam having a profile of specific cross-section.
- Structural steel are manufactured in steel plants either by hot working process or cold working process.
- In case of hot working process high temp is used to heat the steel. due to heating, the plastication of steel can be done without losing its ductility.