UNIT – IV

BEAMS

Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Web splices – Design of beam columns

PART - A

TWO MARK QUESTIONS AND ANSWERS

1. What is meant by limit state design

Designs should ensure that the structure does not become unfit for the use for which it is required. The state at which the unfitness occurs is called a limit state.

2.What are special features of limit state design method

• It is possible to take into account a number of limit states depending upon the Particular instance

• This method is more general in comparison to the working stress method. In This method, different safety factors can be applied to different limit states, which is more rational than applying one common factor (load factor) as in the plastic design method.

• This concept of design is appropriate for the design of structures since any new knowledge of the structural behavior, loading and materials can be readily incorporated.

3.Explain the behavior of steel beams?

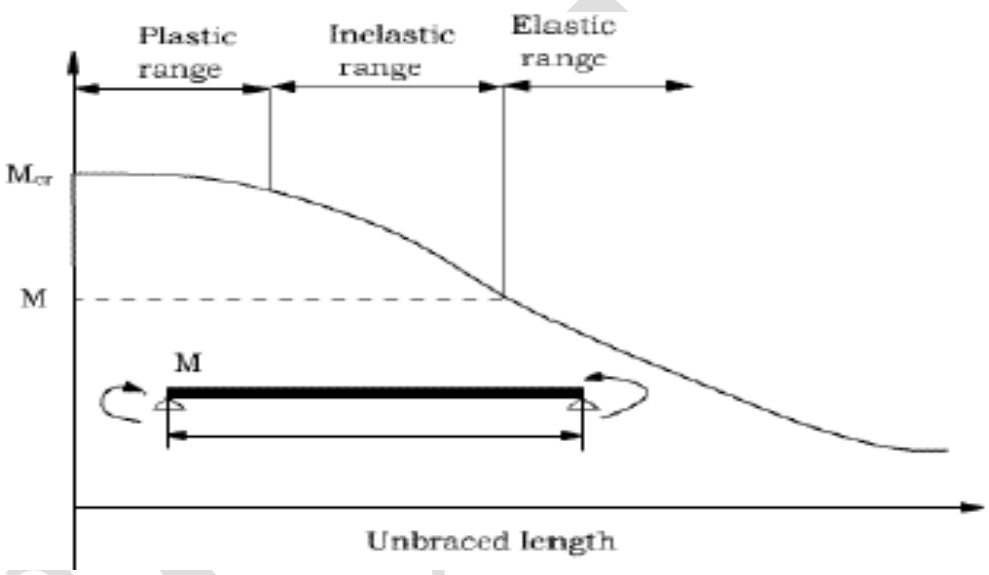
Laterally stable steel beams can fail only by (a) Flexure (b) Shear or (c) Bearing, Assuming the local buckling of slender components does not occur. These three conditions are the criteria for limit state design of steel beams.

Steel beams would also become unserviceable due to excessive deflection and this is classified as a limit state of serviceability.

The factored design moment, M at any section, in a beam due to external actions Shall satisfy

$$M < M_d$$

Where $M_{d=}$ design bending strength



4. Write Short notes on compact sections

When the lateral support to the compression flange is adequate, the lateral buckling of the beam is prevented and the section flexural strength of the beam can be developed. The strength of I-sections depends upon the width to thickness ratio of the compression flange. When the width to thickness ratio is sufficiently small, the beam can be fully plastified and reach the plastic moment, such section are classified as compact sections.

5.what is meant by slenderness sections?

When the width to thickness ratio of the compression flange is sufficiently large, local buckling of compression flange may occur even before extreme fibre yields. Such sections are referred to as slender sections.

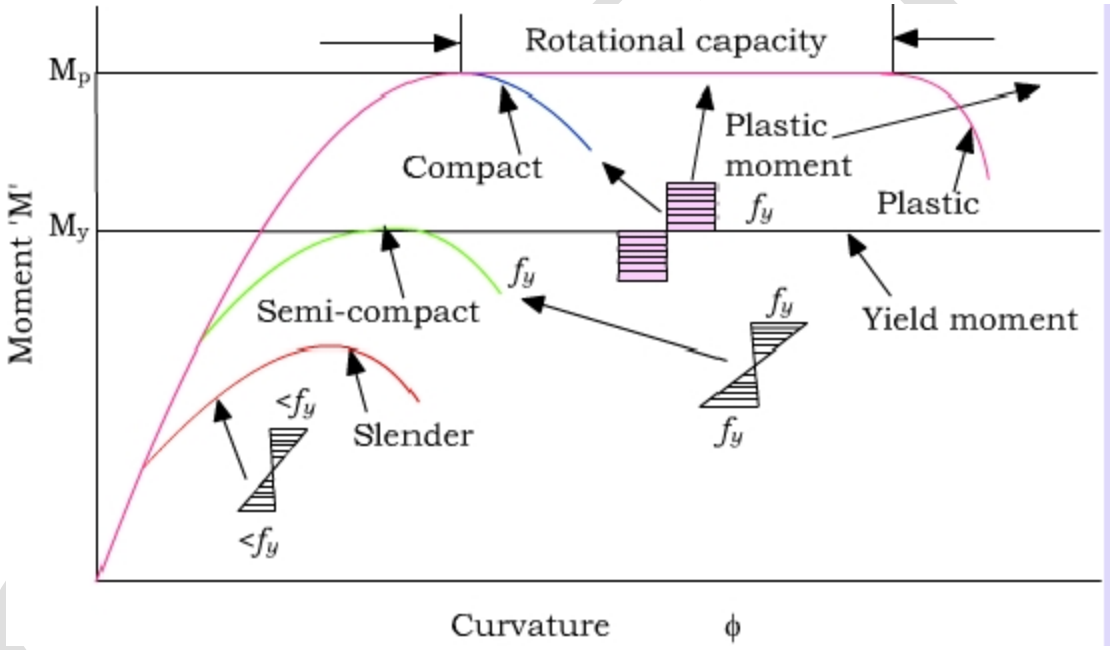
6. Write short notes on shear lag effects?

The simple theory of bending is based on the assumption that plane sections remain plane after bending. But, the presence of shear strains causes the section to warp. Its

effect in the flanges is to modify the bending stresses obtained by the simple theory, producing higher stresses near the junction of a web and lower stresses at points away from it .This effect is called 'shear lag'.

This effect is minimal in rolled sections, which have narrow and thick flanges and more pronounced in plate girders or box sections having wide thin flanges when they are subjected to high shear forces, especially in the vicinity of concentrated loads

7.**Draw the curvature for flexural member performance.**



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8. List the various factors affecting the lateral-torsional buckling strength .

• Distance between lateral supports to the compression flange.

• Restraints at the ends and at intermediate support locations (boundary conditions).

• Type and position of the loads.

• Moment gradient along the length.

• Type of cross-section.

9. How do you improve the shear resistance in plate girder?

i. Increasing in buckling resistance due to reduced *c/d* ratio;

ii. The web develops tension field action and this resists considerably larger

Stress than the elastic critical strength of web in shear

10. What are the classifications in Stiffeners?

a) Intermediate transverse web stiffeners

b) Load carrying stiffeners

c) Bearing stiffeners

d) Torsion stiffeners

e) Diagonal stiffeners and

f) Tension stiffeners

11. Write about the Box girders.

The design and detailing of box girders shall be such as to give full advantage of its higher load carrying capacity. Diaphragm shall be used where external vertical as well as transverse forces are to be transmitted from one member to another. The diaphragms and their fastenings shall be proportioned to distribute other force applied to them and in addition, to resist the design transverse force and the resulting shear forces. The design transverse force shall be taken as shared equally between the diaphragms.

12. Write Short notes on Purlin and sheeting rails

Purlins attached to the compression flange of a main member would normally be acceptable as providing full torsional restraint; where purlins are attached to tension flange, they should be capable of providing positional restraint to that flange but are unlikely (due to the rather light purlin/rafter connections normally employed) to be capable of preventing twist and bending moment based on the lateral instability of the compression flange.

13. Write the Special features of limit state design method?

• Serviceability and the ultimate limit state design of steel structural systems and their components.

• Due importance has been provided to all probable and possible design conditions that could cause failure or make the structure unfit for its intended

• The basis for design is entirely dependent on actual behaviour of materials in structures and the performance of real structures, established by tests and long-term observations

• The main intention is to adopt probability theory and related statistical methods in the design.

• It is possible to take into account a number of limit states depending upon the particular instance

PART - B

16 MARK QUESTIONS

1**.** Design a simply supported beam to carry uniformly distributed load of 44 kn/m.the effective Span of beam is 8 m. The effective length of compression flange of the beam is also 8 m. The ends of beam are not to free to rotate at the bearings.

2.The effective length of compression flange of simply supported beam MB 500 @ 0.869 kn/m. Determine the safe uniformly distributed load per metre length which can be placed over the beam having an effective span of 8 m. The ends of beam are restrained against rotation at the bearings.

3. ISMB 550 @1.037 kn/ m has been used as simply supported over a span of 4 m .the ends of beam are restrained against torsion but not against lateral bending. Determine the safe UDL per metre, which the beam can carry.

4.Design rolled steel I- sections for a simply supported beam with a clear span of 6m .it carries a UDL of 50 KN per metre exclusive of self-weight of the girder .the beam is laterally unsupported.

5. Check the beam section WB 500 @1.45 kn/m against web crippling and web buckling if reaction at the end of beam is 179.6 KN, The length of bearing plate at the support is 120 mm. Design bearing plate. The bearing plate is set in masonry.

PART - C

ASSIGNMENT QUESTIONS

1. A beam simply supported over an effective span of 7m, carries an uniformly distributed load of 50kN/m inclusive of its own weight. The depth of the beam is restricted to 450mm. design the beam, assuming that the compression flange of the beam is laterally supported by a floor construction. Take f_y = 250N/mm^2 and E = 2X10^{5}N/mm^2. Assuming width of the support is 230mm. (May/June 2007).

2. Design a bearing stiffener for a welded plate girder with the following specifications.
Web = 1000mm X6mm thick.
Flanges = 2 Nos. of 350X20mm plate on each side.
Support reaction = 350kN.
Width of the support = 300mm.. (May/June 2007).

3. A simply supported steel joist with a 4.0m effective span carries a udl of 40kN/m over its span inclusive of self weight. The beam is laterally unsupported. Design a suitable section. Take f_y = 250N/mm^2. (Nov/Dec 2007)

4. Design the step by step procedure for design of vertical and horizontal stiffeners in a plate girder. (Nov/Dec 2007)