DESIGN OF BEAMS
Beam classification

- **Main or Primary beams / girders**
- **Secondary beams/joists**

- **Girders**
- **Joist**
- **Lintels**
- **Purlins**
- **Rafter**
- **Spandrels**
- **Stringers**

- **Laterally Stable**
- **Laterally Unstable**

PERMISSIBLE STRESS DESIGN

Stresses in Structures at working loads are not allowed to exceed a certain proportion of the yield stress of the material.

- Stress levels are limited to elastic range
- Leads to highly conservative solutions.

LIMIT STATE DESIGN OF BEAMS

- In this method, the structure has to be designed to withstand safely all loads and deformations likely to occur on it throughout its life.
- 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.

Limit States

- Ultimate Limit States

  - (flexure, shear, bearing, compression, torsion, lateral-torsion)

- Serviceability Limit States

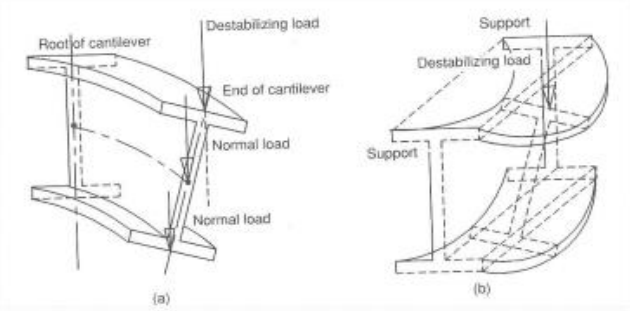
  -(deflection, vibration, fire, durability)

Types of Loads

- Dead loads
- Imposed loads (Live Load, Crane Load, Snow Load, Dust Load, Wave Load, Earth pressures)
- Wind Loads
- Earthquake Loads
- Erection Loads
- Accidental Loads (Blast, Impact of vehicles)
- Secondary Effects (temperature effects, differential settlements, eccentric connections, varied rigidity)

Stability of Beams

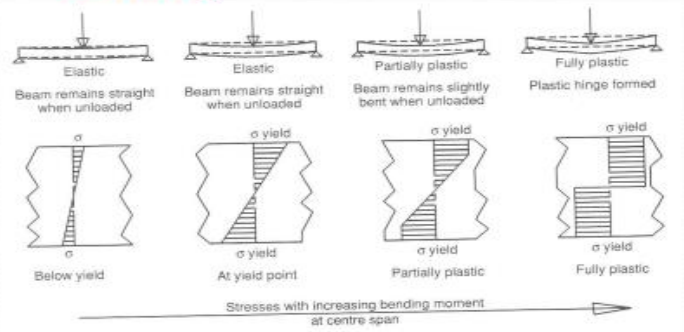
- Laterally Unrestrained Beams
- Laterally Restrained Beams



Lateral-torsional Buckling in Beams

Failure Modes in Beams

- Bending

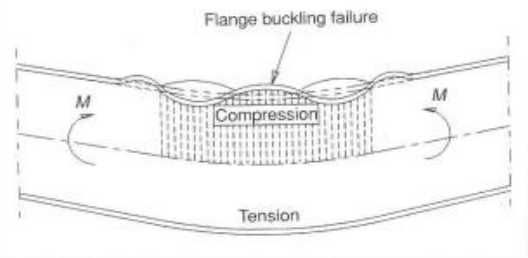


➢When all the beam cross-section has become plastic the beam fails by formation of a plastic hinge at the point of maximum imposed moment.

➢The bending moment cannot be increased and the beam collapses as though a hinge has been inserted into the beam.

Failure Modes in Beams...

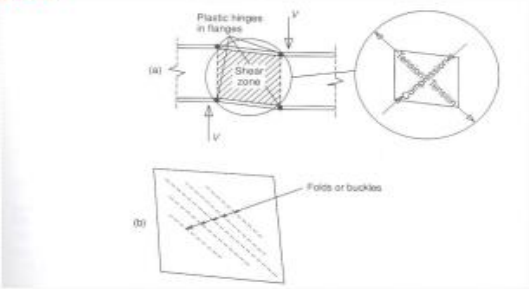
- Local buckling



Local Flange buckling failure

Failure Modes in Beams...

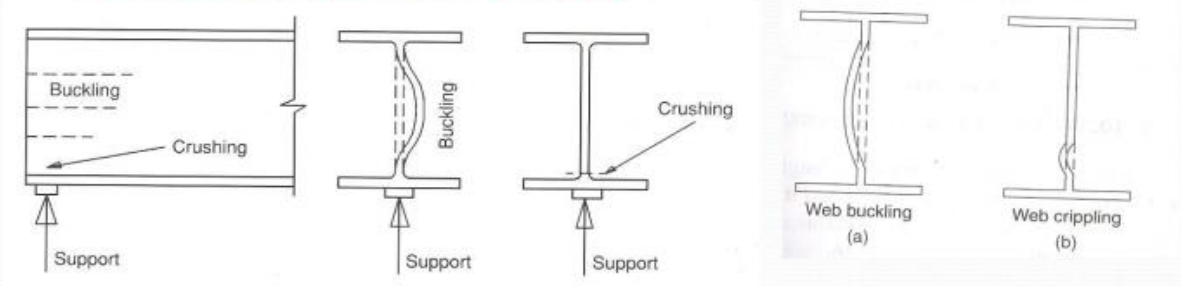
- **Shear**



During the shearing process, if the web is too thin it will fail by buckling or rippling in the shear zone as shown in fig.

Failure Modes in Beams...

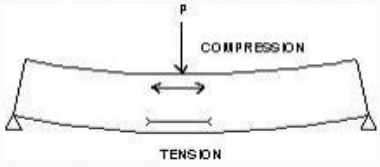
- **Web bearing and buckling**

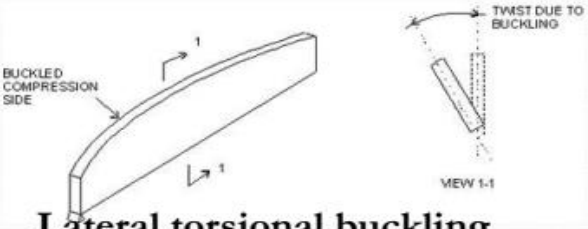


Due to high vertical stresses directly over a support or under a concentrated load, the beam web may actually crush or buckle as a result of these stresses.

Failure Modes in Beams...

- **Lateral-torsional buckling**

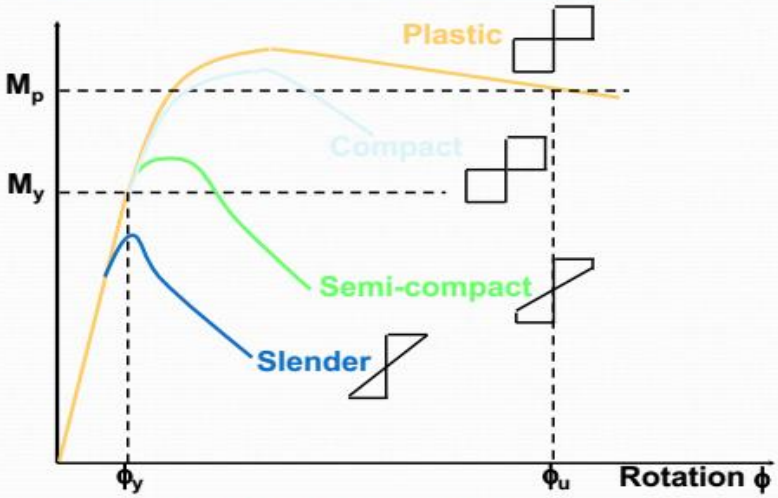




Lateral torsional buckling of a simply supported beam

Behaviour of beam with restraints

SECTION CLASSIFICATION



Section Classification based on Moment-Rotation Characteristics