

# Beam Failures

## Structural Guide

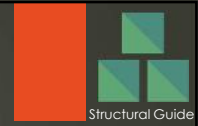


## Types of Beam Failures

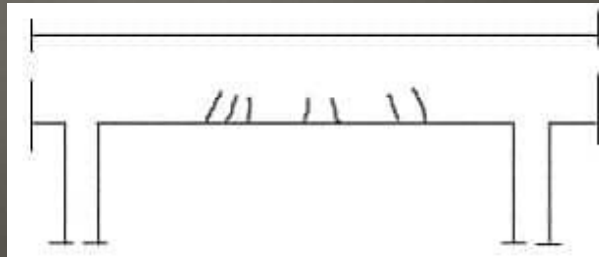
- ▶ Bending failure
- ▶ Shear Failure
- ▶ Torsional Failure
- ▶ Corrosion of reinforcements
- ▶ Overloading
- ▶ Over reinforcement
- ▶ Under reinforcement



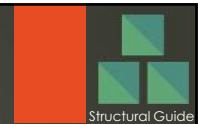
## Bending Failure



- ▶ This is a flexure failure of the beam
- ▶ When the bending stress exceeds the design capacity, the beam will fail
- ▶ There will be warnings such as cracking of the concrete, excessive deflections, etc if the design is done correctly.
- ▶ If the section is not over-reinforced, the crack will form before the failure.
- ▶ Excessive loads and construction issues could lead to these types of failures.
- ▶ Strengthening method shall be used to avoid the failure



## Shear Failure

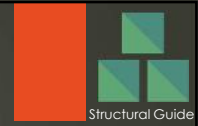
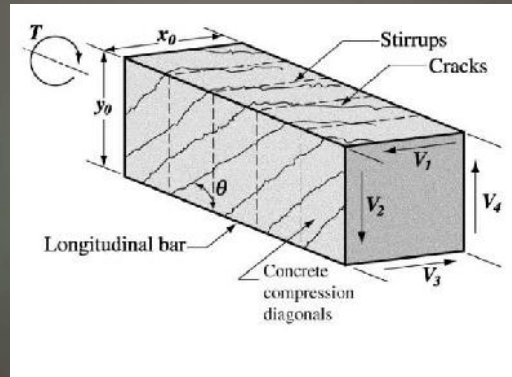


- ▶ When design shear stress exceeds the shear capacity
- ▶ Shear cracks appear before the failure
- ▶ Cracks will form near the support
- ▶ Should be careful with torsional cracks
- ▶ Increase in the loads, construction errors, design errors, etc. could be the reasons.



## Torsional Failure

- ▶ Torsional crack will appear on the concrete surface near the support.
- ▶ Difference between the shear cracks and torsional cracks should be known
- ▶ Cracks will appear due to a lack of torsional links or inadequate torsional links
- ▶ Necessary actions shall be taken after identifying the cracks

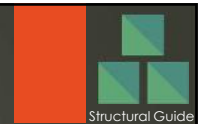


## Corrosion of Reinforcement

- ▶ Corrosion is due to the durability issues such as
  - ▶ Carbonation
  - ▶ Chloride attacks
  - ▶ Sulfate attack
  - ▶ Deterioration of concrete in the cover zone due to other issues
- ▶ Inadequate cover to the reinforcement
- ▶ Concrete grade
- ▶ Not consider the exposure conditions

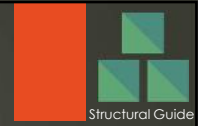


Corrosion of Reinforcement



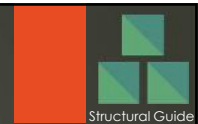
## Overloading

- ▶ Design could be done for a certain load
- ▶ There are load factors in the design
- ▶ When load exceed the design, there could be failures
- ▶ These may be accidental cases



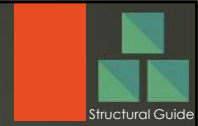
## Over-Reinforcement

- ▶ Sudden failure of the section without warning
- ▶ If under reinforced, there will be warnings before the failure
- ▶ Over reinforced section will not fail always. It fails suddenly only when the moment capacity is reached.
- ▶ We have to calculate the moment capacity manually and the general equation will not be applicable.



## Under- Reinforced

- ▶ Providing inadequate reinforcement for the section
- ▶ This could be due to the design or detailing the error
- ▶ Reinforcement will be yield
- ▶ Reinforcement stress/strain shall be calculated manually when moment capacity is calculated
- ▶ When loads are applied, the section may fail due to inadequate structural capacity.



Thank you



**Structural Guide**

Civil & Structural Engineering Knowledge Base