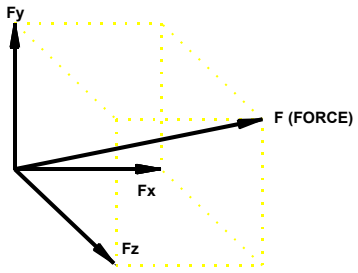
Structural Considerations for Bridges

Introduction

- Bridge members must be able to carry loads applied to them.
- Forces resisted by bridge members:
  - Axial forces
  - Bending forces
  - Shear forces
  - Torsional forces
- This presentation considers:
  - How bridge members are stressed by loads
  - How bridge materials resist stress
  - How bridges accommodate thermal movements

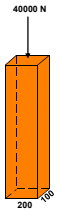
Force



Stress

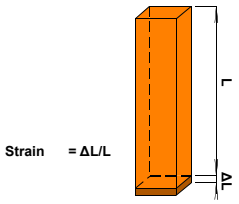
- What is a stress?
  - Loads cause stresses
  - Stresses are the internal forces
- How to calculate stress?

Stress = Force/Area
= 40000/200x100
= 2MPa



Strain

- It is described as the amount of deformation.
- It denotes the ratio of material's deformed dimension to its original dimension.



Deformation & Modules of Elasticity

- Elastic Deformation - It is reversible distortion of a material.
- Plastic Deformation – It is the irreversible distortion of a material.
- Modulus of Elasticity (E) = Stress/Strain

Response to Loading

- Forces resisted by bridge members:
  - Axial forces
  - Bending forces
  - Shear forces
  - Torsional forces

Response to Loading

Rigid Body

- **A rigid body does not deform under load.**

Equilibrium

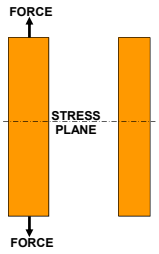
- **When a particle is at rest or moves with constant velocity.**

$\sum V = 0$

$\sum H = 0$

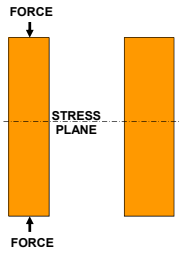
$\sum M = 0$

Types of Applied Stresses



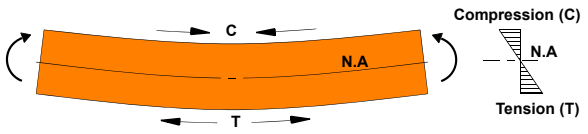
Tensile Stress

Types of Applied Stresses



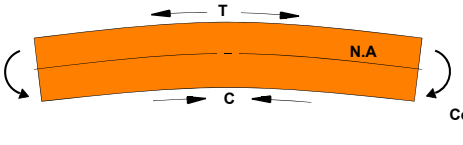
Compressive Stress

Types of Applied Stresses



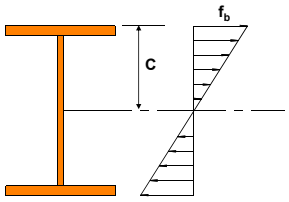
Positive Moment

Types of Applied Stresses



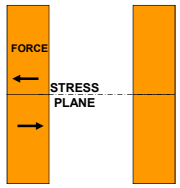
Negative Moment

Bending Stress



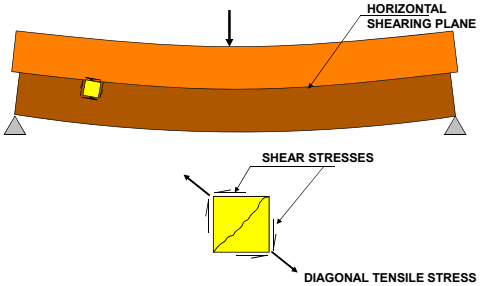
Bending Stress
$f_b = Mc/I$

Types of Applied Stresses

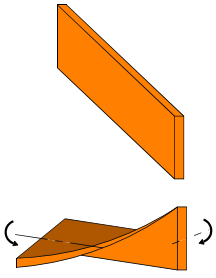


Shear Stress

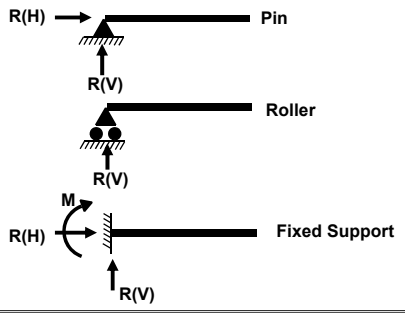
Beams – Horizontal Shear Stress



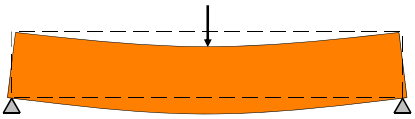
Torsional Forces



Types of Supports

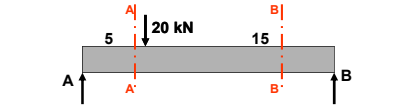


Span Classification



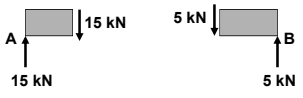
Simple Span

Shear



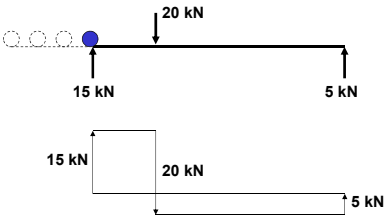
$R_A = 20x15/20 = 15$ kN

$R_B = 20x5/20 = 5$ kN

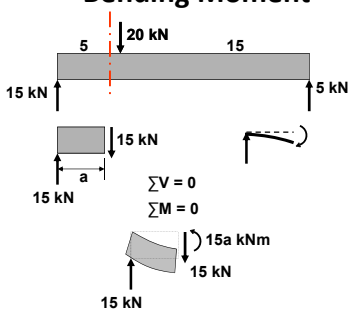


$\sum V = 0$

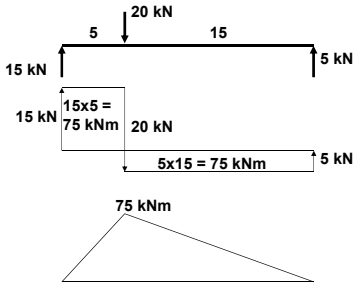
Shear Diagram



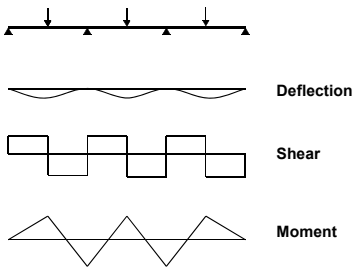
Bending Moment



Bending Moment Design

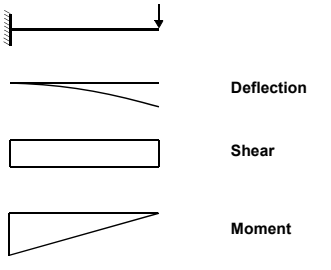


Span Classification



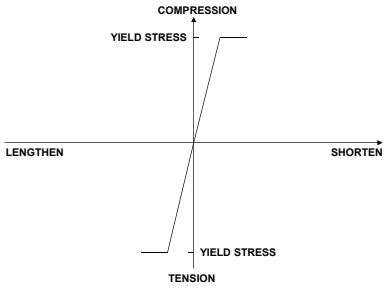
Continuous Span

Span Classification

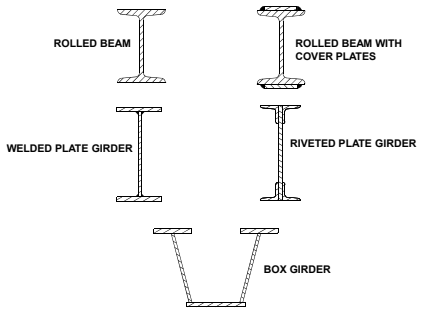


Cantilever

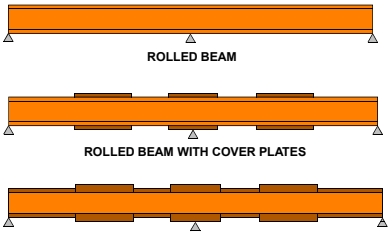
Stress in Steel



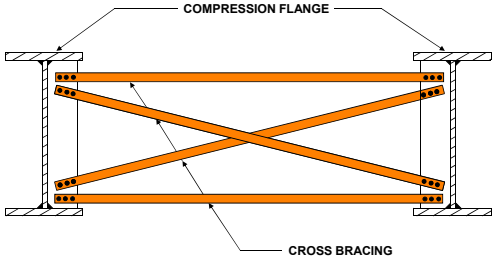
Steel Bridge Members



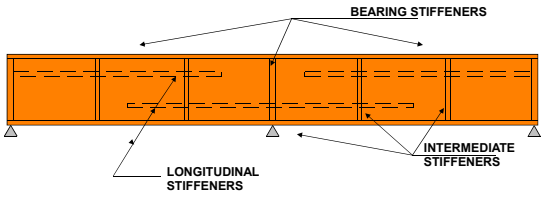
Steel Beams – Bending Stress



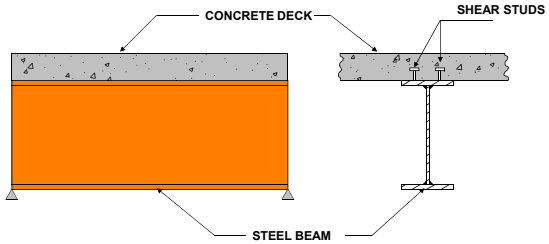
Steel Beams – Compression Stress



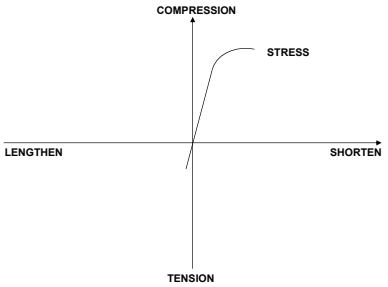
Steel Beams – Shear Stress



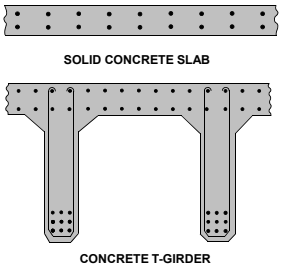
Composite Beam



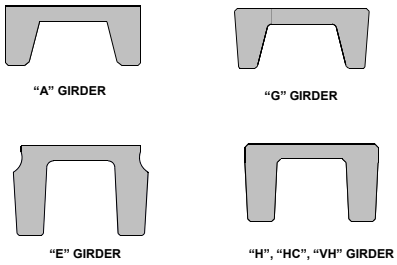
Stress in Concrete



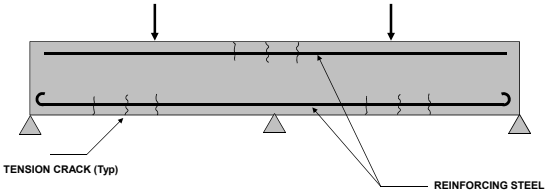
Concrete Bridge Members



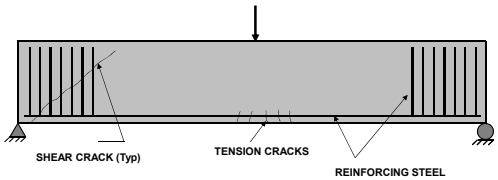
Concrete Bridge Members



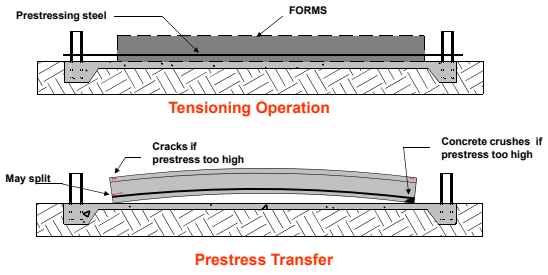
Concrete Beams – Bending Stress



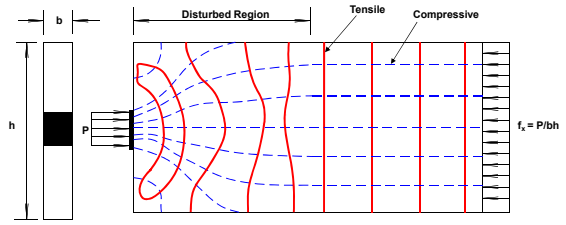
Concrete Beams – Shear Stress



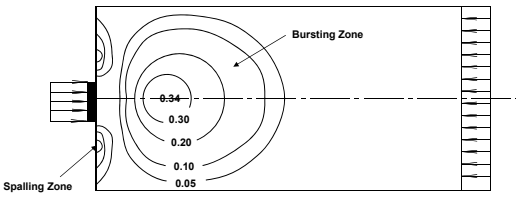
Prestressed Concrete



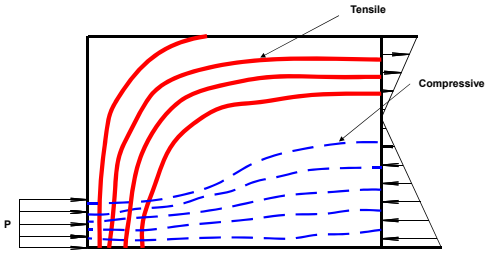
Anchorage Stress



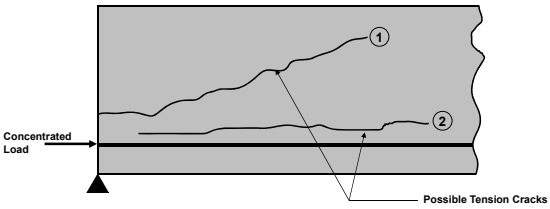
Anchorage Stress



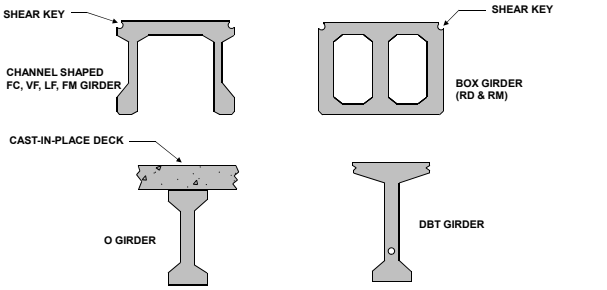
Anchorage Stress



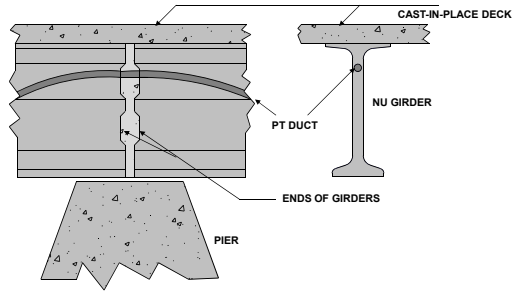
Anchorage Stress



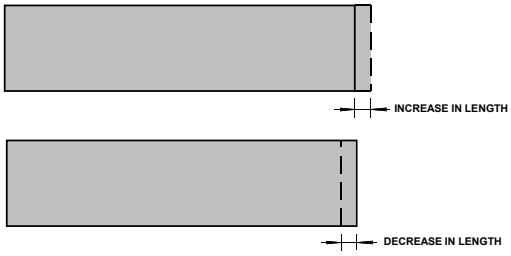
Prestressed Concrete Bridge Members



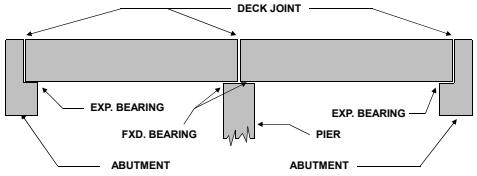
Prestressed Concrete Bridge Members



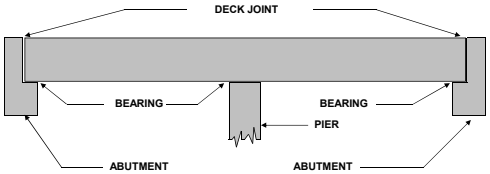
Thermal Stress



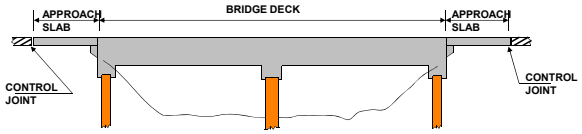
Thermal Stress



Thermal Stress



Stress in Concrete



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