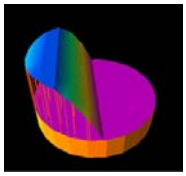
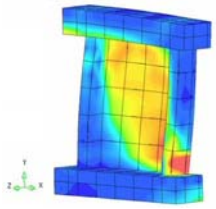
Reinforced Concrete Beams

Mathematical modeling of reinforced concrete is essential to civil engineering



Concrete as a material



Concrete in a structure

Reinforced Concrete Beams

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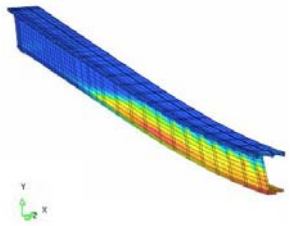

Stress distribution in a reinforced concrete beam

Reinforced Concrete Beams

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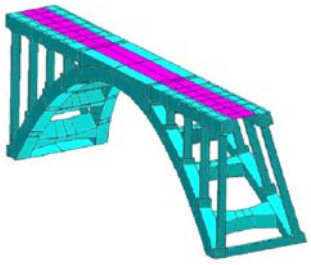

Geometric model a reinforced concrete bridge

Reinforced Concrete Beams

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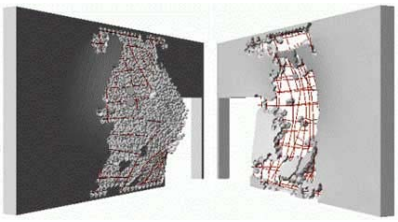
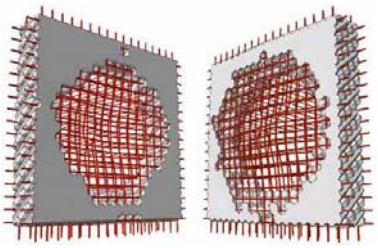


Blast failure of a reinforced concrete wall

Reinforced Concrete Beams

Mathematical modeling of reinforced concrete is essential to civil engineering



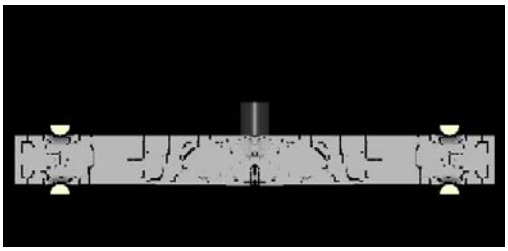
Blast failure of a reinforced concrete wall

Reinforced Concrete Beams

Mathematical model for failure in an unreinforced concrete beam

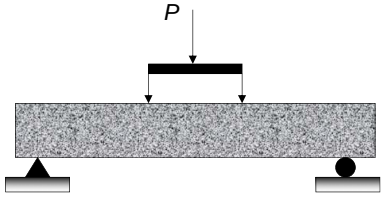
Reinforced Concrete Beams

Mathematical model for failure in an reinforced concrete beam



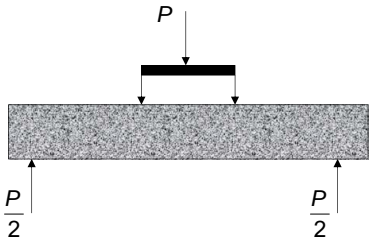
Reinforced Concrete Beams

In the reinforced concrete beam project, there are three different failure mode we need to investigate



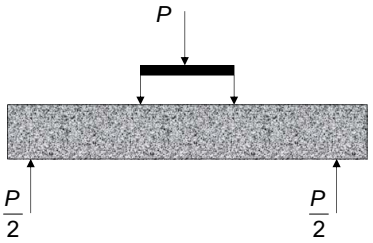
Reinforced Concrete Beams

First, lets consider the loading of the beam



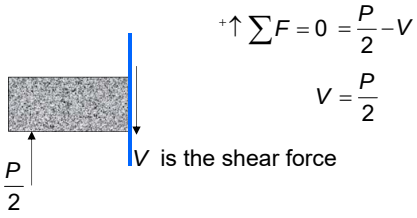
Reinforced Concrete Beams

The purpose of RC is the reinforcement of areas in concrete that are weak in tension



Reinforced Concrete Beams

Let's look at the internal forces acting on the beam and locate the tension zones

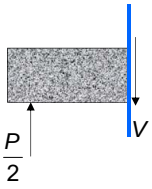


$$+\uparrow \sum F = 0 = \frac{P}{2} - V$$

$$V = \frac{P}{2}$$

Reinforced Concrete Beams

The shear between the applied load and the support is constant $V = P/2$



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Reinforced Concrete Beams

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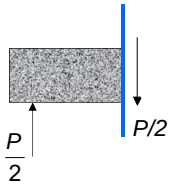

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Reinforced Concrete Beams

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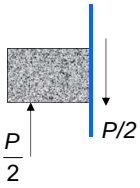

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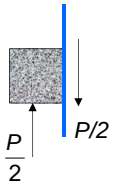
Reinforced Concrete Beams

The shear between the applied load and the support is constant $V = P/2$



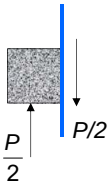
$$+\uparrow \sum F = 0 = \frac{P}{2} - V$$

$$V = \frac{P}{2}$$

Reinforced Concrete Beams

The shear between the applied load and the support is constant $V = P/2$

The shear force $V = P/2$ is constant between the applied load and the support



$$+\uparrow \sum F = 0 = \frac{P}{2} - V$$

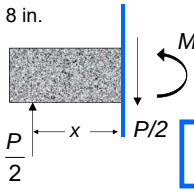
$$V = \frac{P}{2}$$

Reinforced Concrete Beams

Let's look at the internal moment at section between the supports and applied load

$$\circlearrowleft^{+} \sum M = \frac{P}{2} x$$

X_{max} = 8 in.



M is the bending moment

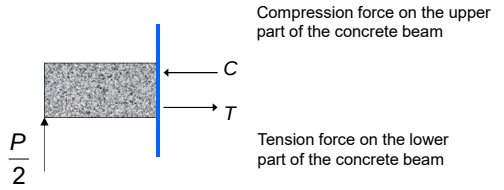
$$M = 4P \text{ (lb.-in.)}$$

Reinforced Concrete Beams

- Let's look at the internal moment at section between the supports and applied load
- The bending moment is the internal reaction to forces which cause a beam to bend.
- Bending moment can also be referred to as torque

Reinforced Concrete Beams

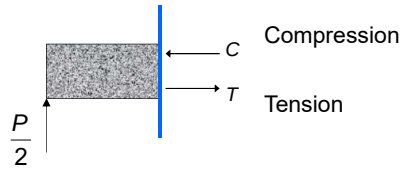
The top of the beam is in compression and the bottom of the beam is in tension



Reinforced Concrete Beams

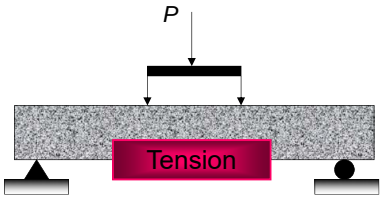
To model the behavior of a reinforced concrete beam we will need to understand three distinct regions in the beam.

Two are illustrated below; the third is called shear.



Reinforced Concrete Beams

We need models to help us with compression, tension, and shear failures in concrete



Reinforced Concrete Beams

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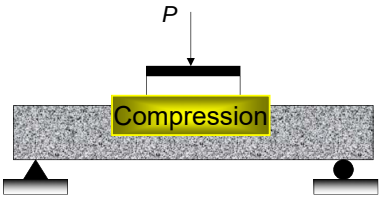

Reinforced Concrete Beams

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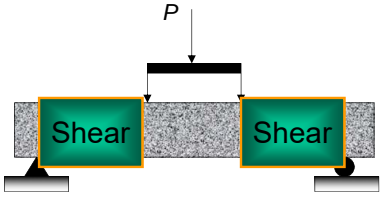

Reinforced Concrete Beams

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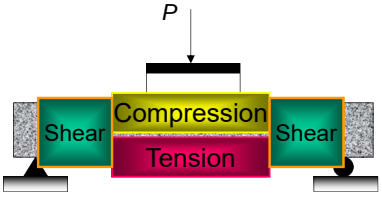
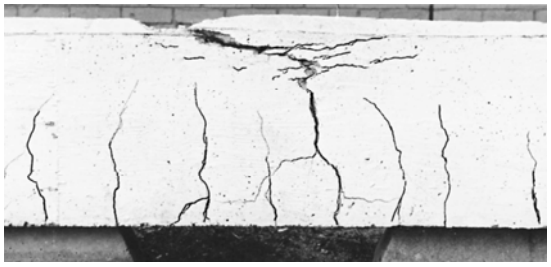


Reinforced Concrete Beams

Compression and tension failures in a reinforced concrete beam

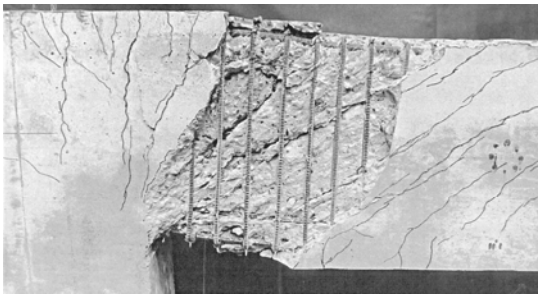
Reinforced Concrete Beams

Compression and tension failures in a reinforced concrete beam



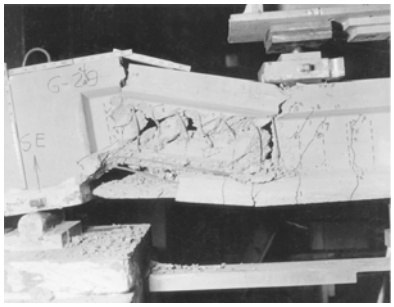
Reinforced Concrete Beams

Shear failure in a reinforced concrete beam



Reinforced Concrete Beams

Shear failure in a reinforced concrete beam



Reinforced Concrete Beams

Questions?