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REINFORCED CONCRETE DESIGN 1

Shear Design

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Lesson Outcome

At the end of this lesson, students should be able to:

- Identify section with and without shear reinforcement.
- Design for shear according to code of practice.
- Illustrate shear link detailing.

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Introduction

- Shear failure is another factor that has to be considered in the design process.
- The shear stress that comes with the changes in bending moment produces “corner/edge tension”
- The tensile stress causes cracks near the support of a beam.

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Shear Failure in a Reinforced Concrete Beam

The mechanism failure is complex and depends on the shear span av/d. The following three actions form the mechanism resisting shear in the beam:

1. Shear stresses in the compression zone with a parabolic distribution as set out above
2. Aggregate interlock along the cracks
3. Dowel action in the where the concrete between the cracks transmits shear forces to the bars

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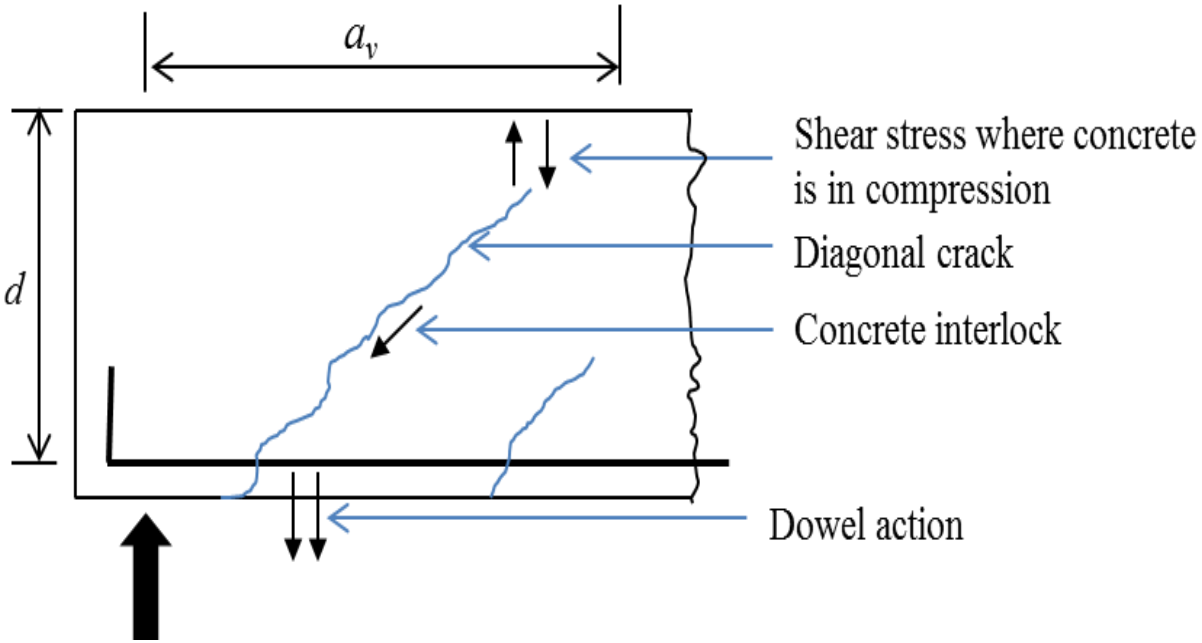
Shear Failure in a Reinforced Concrete Beam



Crack at beam due to shear force

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Shear Resistance

There are 3 methods to resist shear:

i. Provide vertical shear reinforcement (the most commonly used)

ii. Provide bent-up bars (inclined bars)

iii. Combination of both vertical shear reinforcement and bent-up bars

- Note: The shear reinforcement is also known as stirrups or links.

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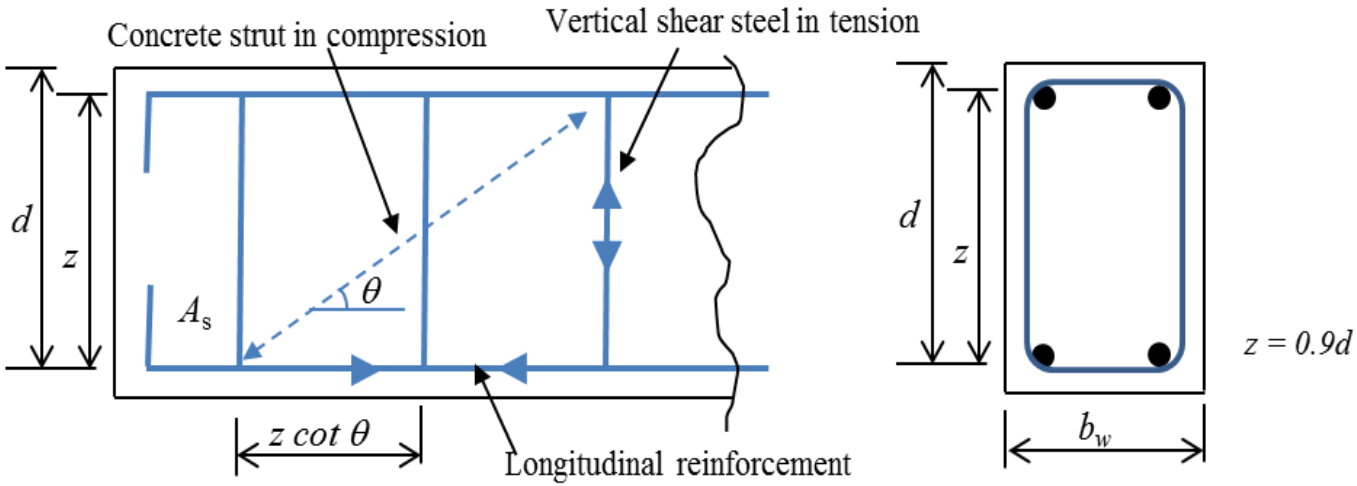
Shear Design Method: Variable Inclination Method

reinforced concrete beam in shear is represented by an analogous truss



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Shear Design Method: Variable Inclination Method

- The top concrete acts as the top compression and diagonal compression members inclined at angle θ to the horizontal.
- The bottom chord is the horizontal tension steel and the transverse tension members.
- The angle of concrete strut varies, depending on the shear force applied.

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Shear Design Method: Variable Inclination Method

Three important parameters need to be considered in the derivation of design equation:

1. the compressive strength of the diagonal concrete strut
2. the required shear reinforcement for vertical ties
3. the addition tension required in the bottom chord member.

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Transverse Shear Reinforcement

- Complementary shear stress also occurs in flanged.
- Transverse reinforcement should be provided over the flanged width with assumption that this reinforcement acts as ties combined with compressive struts in the concrete.
- It is necessary to check the possibility of failure by excessive compressive stresses in the struts and to provide sufficient steel area to prevent tensile failure in the ties.

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Design Procedure for Shear Reinforcement

- Member requiring shear reinforcement design
- Transverse shear reinforcement in flanged section
- Section not requiring shear reinforcement design

All designs are based on recommendation from Eurocode 2 (Section 6.2)

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Examples and Tutorial

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