

# Concrete

Lecture - 4

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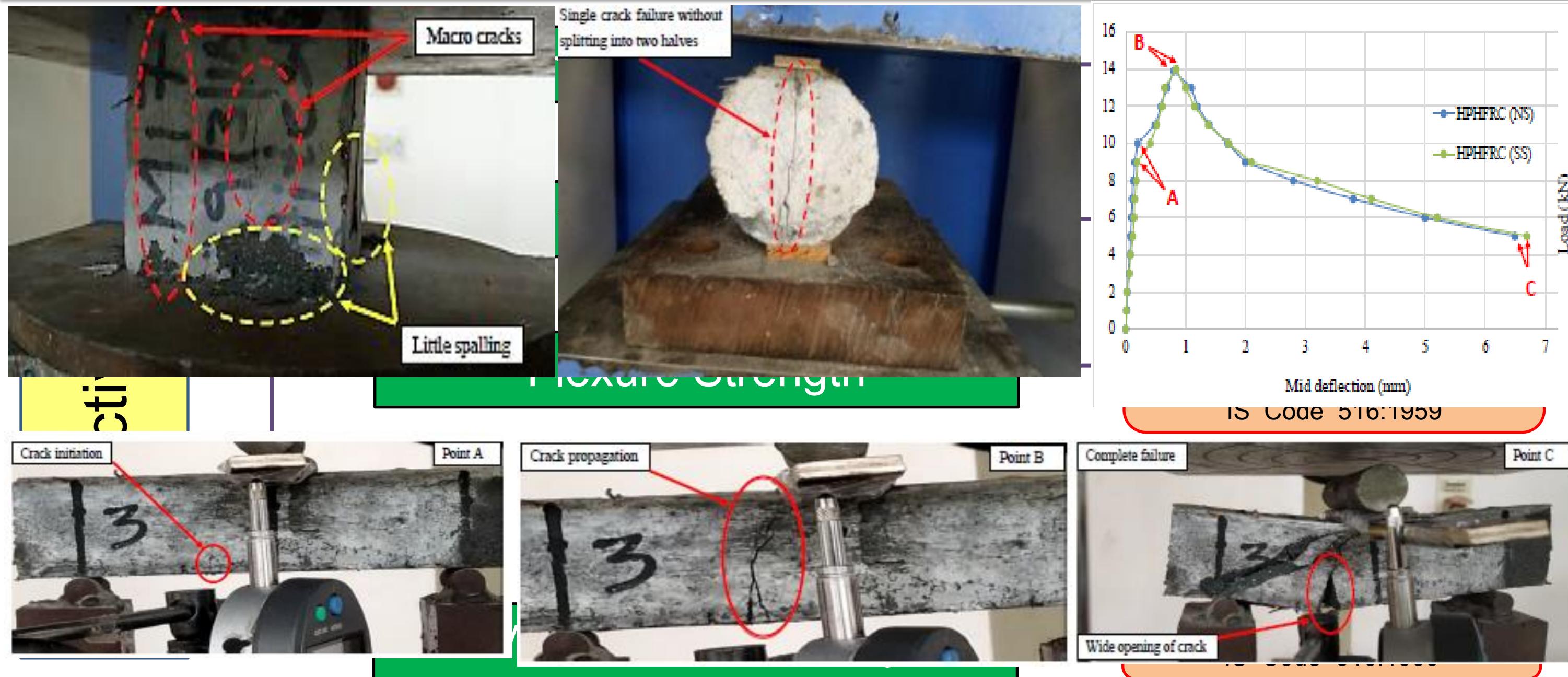
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**Shear Strength**



**Hardened  
Property Test**

# Properties of Concrete in hardened State



# Compressive Strength

*Indian Standard*  
**METHODS OF TESTS FOR  
STRENGTH OF CONCRETE**  
 (Incorporating Amendment Nos. 1 & 2)

UDC 666.97 : 620.17

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 NEW DELHI 110002

Price Group 6

7/27/2020

IS : 516 - 1959  
 (Reaffirmed 1999)  
 Edition 1.2  
 (1991-07)

## Clause 2.8

150 x 150 x 150 mm, if the Maxi. Agg. Size < 20mm, 10 cm Cube may be used as an alternative, Cylinder size specimen can be used (150 diameter x 300 mm length)

## Clause 5.3

Test Age  
 7 Days, 28 Days, 1 Year  
 if test at greater ages are required

## Clause 5.4

Number of Specimen  
 At least 3 specimen,  
 preferably from different  
 Batch

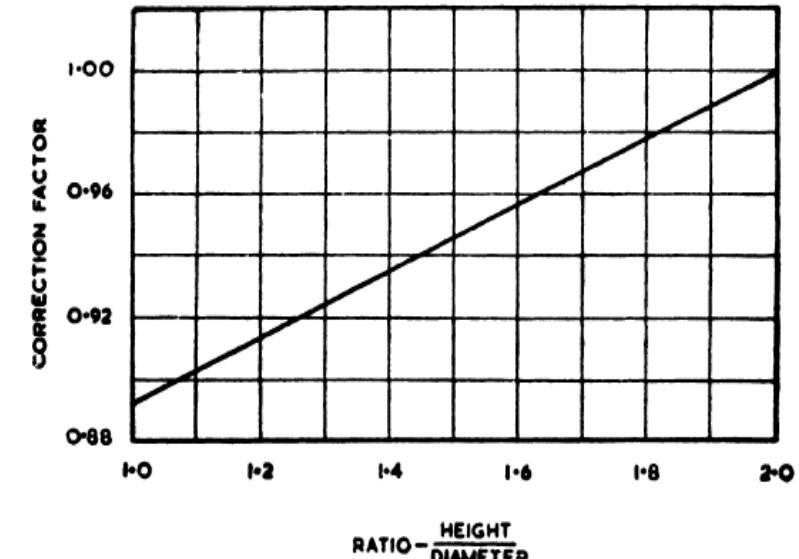
## Clause 5.5.1

Rate of loading 140 kg/sq  
 cm/min

## Clause 5.6

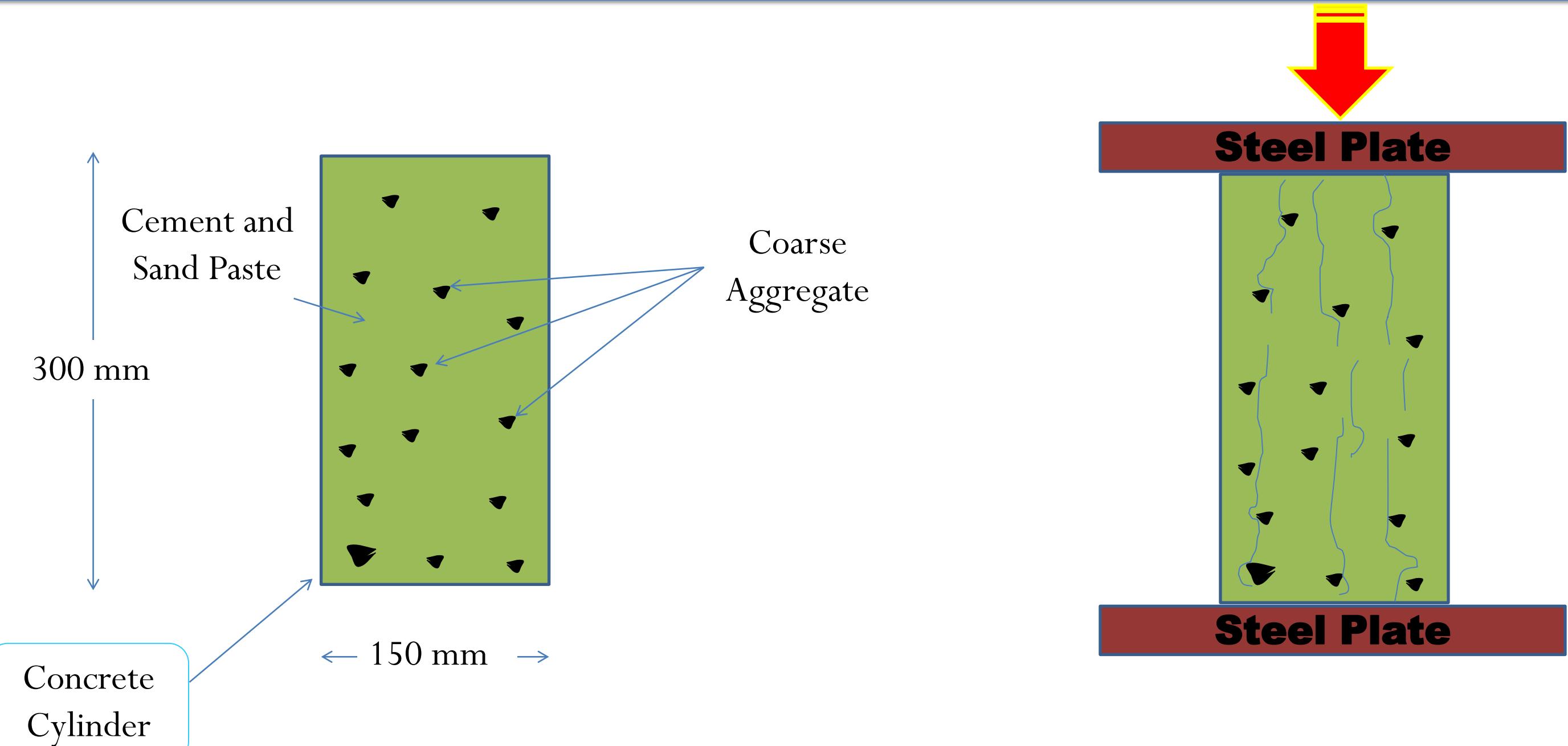
Calculation  
 Maximum Load/Cross-  
 section Area

## Clause 5.6.1 Correction Factor

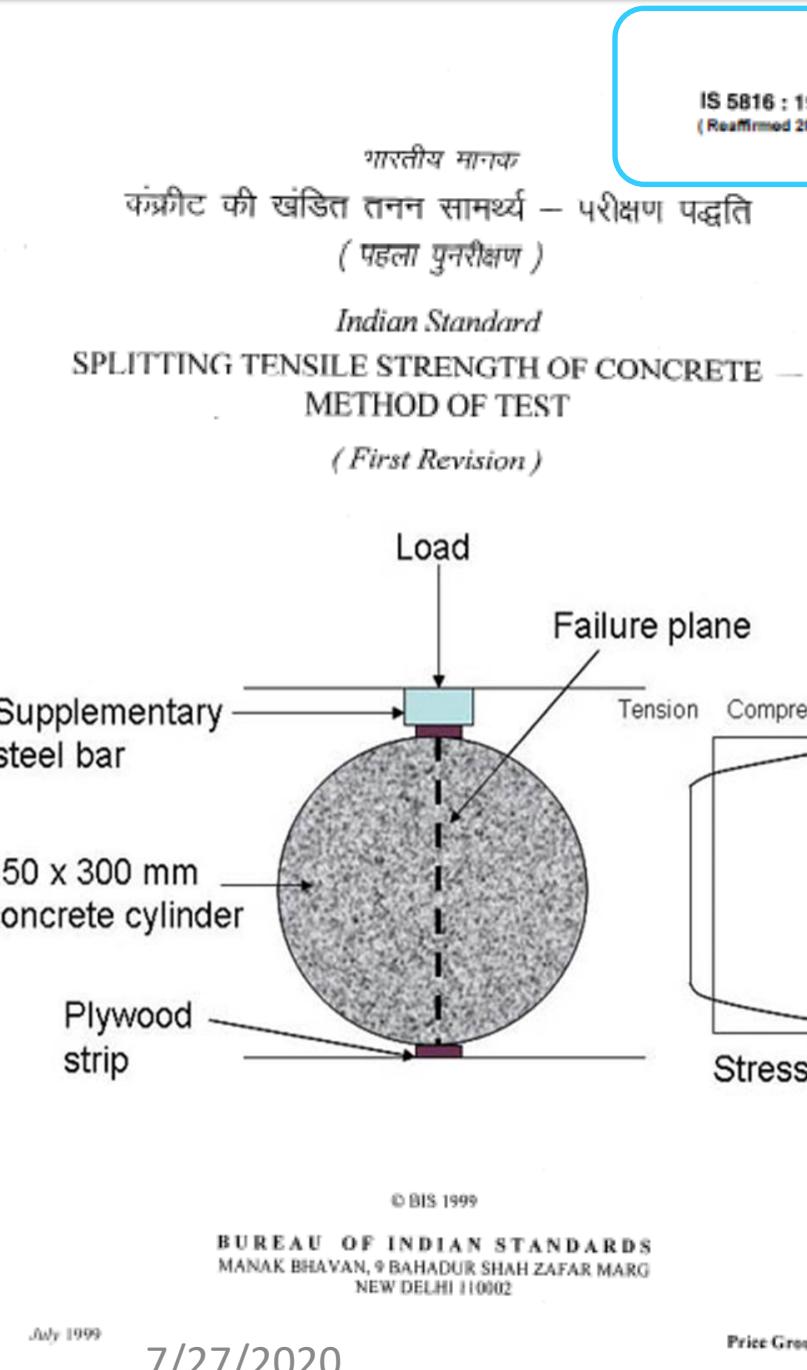


The product of this correction factor and the measured compressive strength shall be known as the corrected compressive strength, this being the equivalent strength of a cylinder having a height/diameter ratio of two. The equivalent cube strength of the concrete shall be determined by multiplying the corrected cylinder strength by 5/4.

# Failure in Concrete Cylinder



# Split Tensile Strength



## Clause 3.1

Cube specimen shall be of size not less than four times the maximum size of the coarse aggregate and not less than 150 mm.

## Clause 3.2

- ☞ The cylindrical specimen shall have diameter not less than four times the maximum size of the coarse aggregate and not less than 150 mm
- ☞ The length of the specimens shall not be less than the diameter and not more than twice the diameter.
- ☞ e.g. 150 mm dia. × 300 mm length

## Clause 5

Test Age  
7 Days, 28 Days,

## Clause 6

Number of Specimen  
At least 3 specimen for each age of test

## Clause 7.6

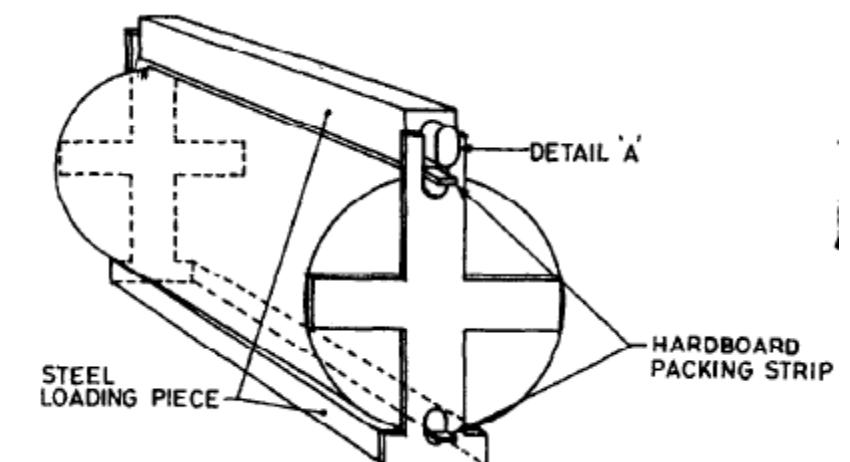
Rate of loading 1.2 N/(mm<sup>2</sup>/min) to 2.4 N/(mm<sup>2</sup>/min)

Rate of increase of load may be calculated from the formula:  
$$(1.2 \text{ to } 2.4) \times \pi/2 \times l \times d \text{ N/min}$$

## Clause 5.6

### Calculation

$$Fct = (2 \times P) / (\pi \times l \times d)$$



# Flexural Strength Test

*Indian Standard*  
**METHODS OF TESTS FOR  
STRENGTH OF CONCRETE**  
 (Incorporating Amendment Nos. 1 & 2)

UDC 666.97 : 620.17

If 'a' is < 170 mm for a 150 mm specimen, or less than 110 mm for a 100 mm specimen, the results of the test is discarded

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## Clause 7.2

150 x 150 x 700 mm. Alternatively if the Maxi. Agg. Size < 19 mm (100 x 100 x 500 mm) may be used

## Clause 8.3.1

### *Rate of loading*

400 kg/min for 150 mm size specimen  
 180 kg/min for 100 mm size specimen

## Clause 8.4

### Calculation

#### *Modulus of Rupture*

$$f_b = \frac{pxl}{bxd^2}$$

When 'a' > 200 mm for 150 mm specimen, or greater than 133 mm for a 100 mm specimen

$$f_b = \frac{3pxa}{bxd^2}$$

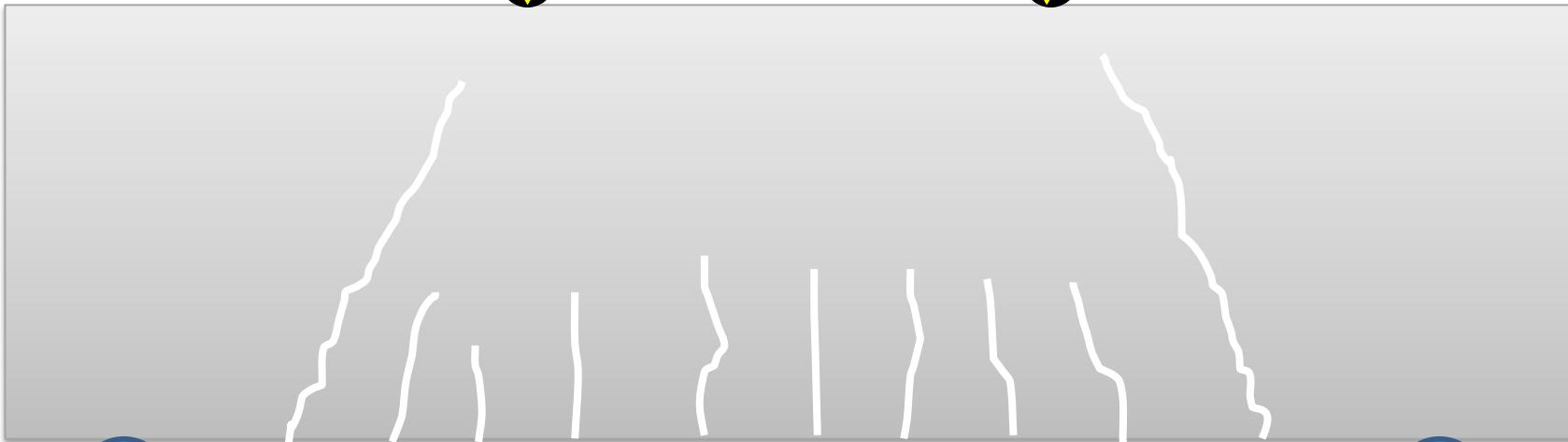
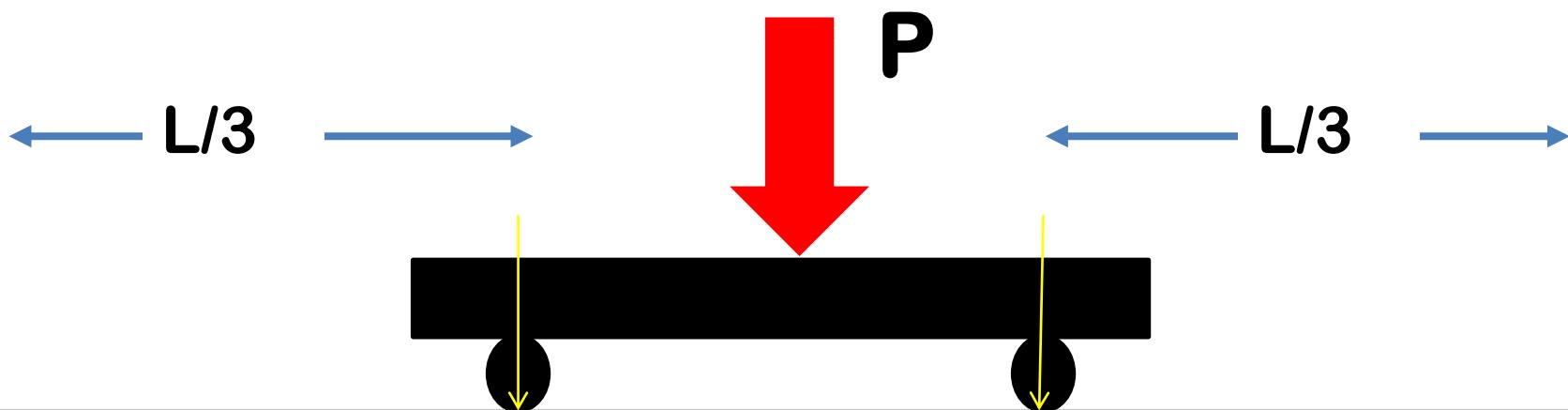
When 'a' < 200 mm but > 170 mm for 150 mm specimen, or less than 133 mm but > 110 mm for a 100 mm specimen

b = measured width of the specimen

D = measured depth of the specimen at the point of failure

L = length of the span on which the specimen was supported

P = maximum load in kg applied to the specimen



$$P/2$$

$$P/2$$



$$\uparrow R = P/2$$

$$\uparrow R = P/2$$



$$\begin{matrix} \uparrow \\ V = P/2 \\ \downarrow \end{matrix}$$

+ve

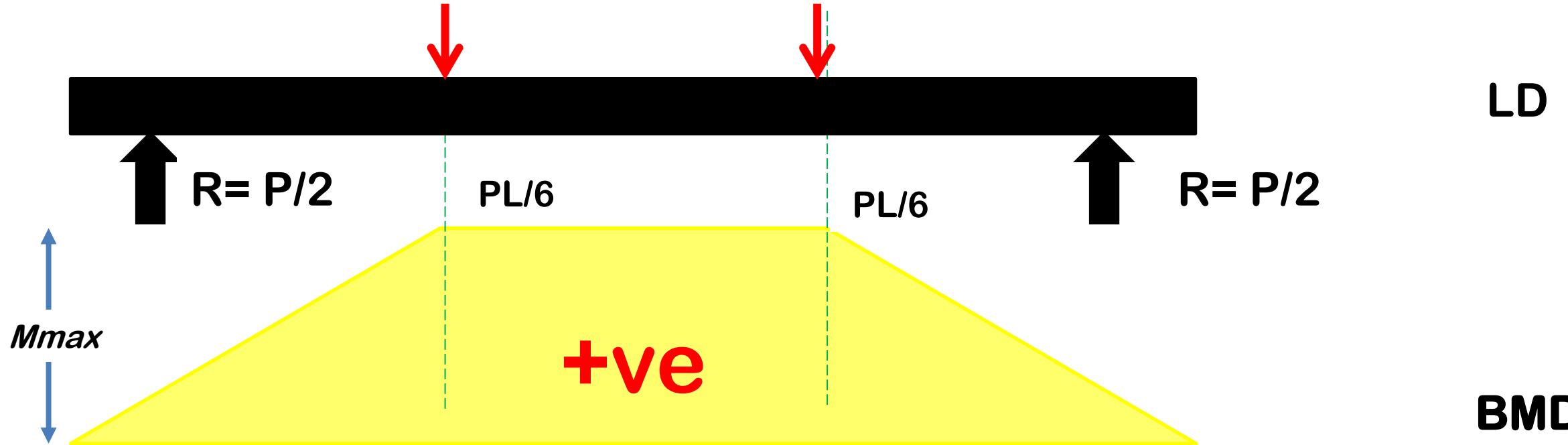
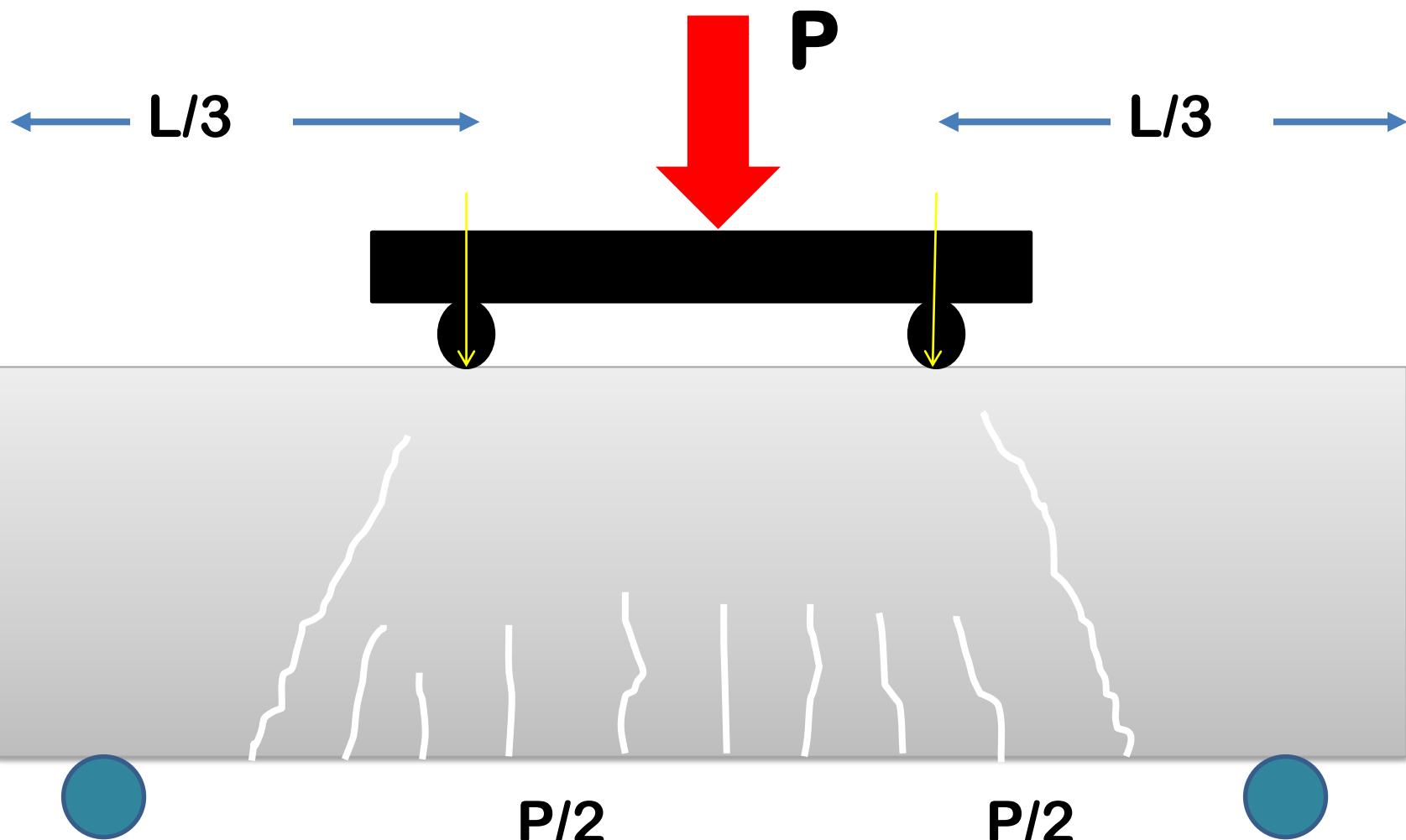
**Shear**

-ve

$$\begin{matrix} \uparrow \\ V = P/2 \\ \downarrow \end{matrix}$$

LD

SFD



# Bond Strength

When concrete surrounds steel as in the case of reinforced concrete, it firmly grips the steel. This property of adhesion between steel and concrete is called Bond Strength. The bond strength can be increased by using deformed bars instead of plain bars in concrete mix and decreasing water-cement ratio. On an average bond strength is taken approximately as 10% of compressive strength.

IS : 2770 ( Part I ) - 1967  
( Reaffirmed 2007)

*Indian Standard*  
METHODS OF TESTING BOND IN  
REINFORCED CONCRETE  
PART 1 PULL-OUT TEST  
(Sixth Reprint MAY 2001)

REAFFIRMED 2007

UDC 666.982 : 620.172.21

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Gr 3

January 1968  
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# Bond Strength

## Clause 3.1

Size of cube is 100mm to test the bond strength up to and including 12 mm diameter reinforcement

Size of cube is 150mm to test the bond strength over 12 mm up to and including 25 mm diameter reinforcement

Size of cube is 225mm over 25 mm diameter reinforcement

## Clause 3.3

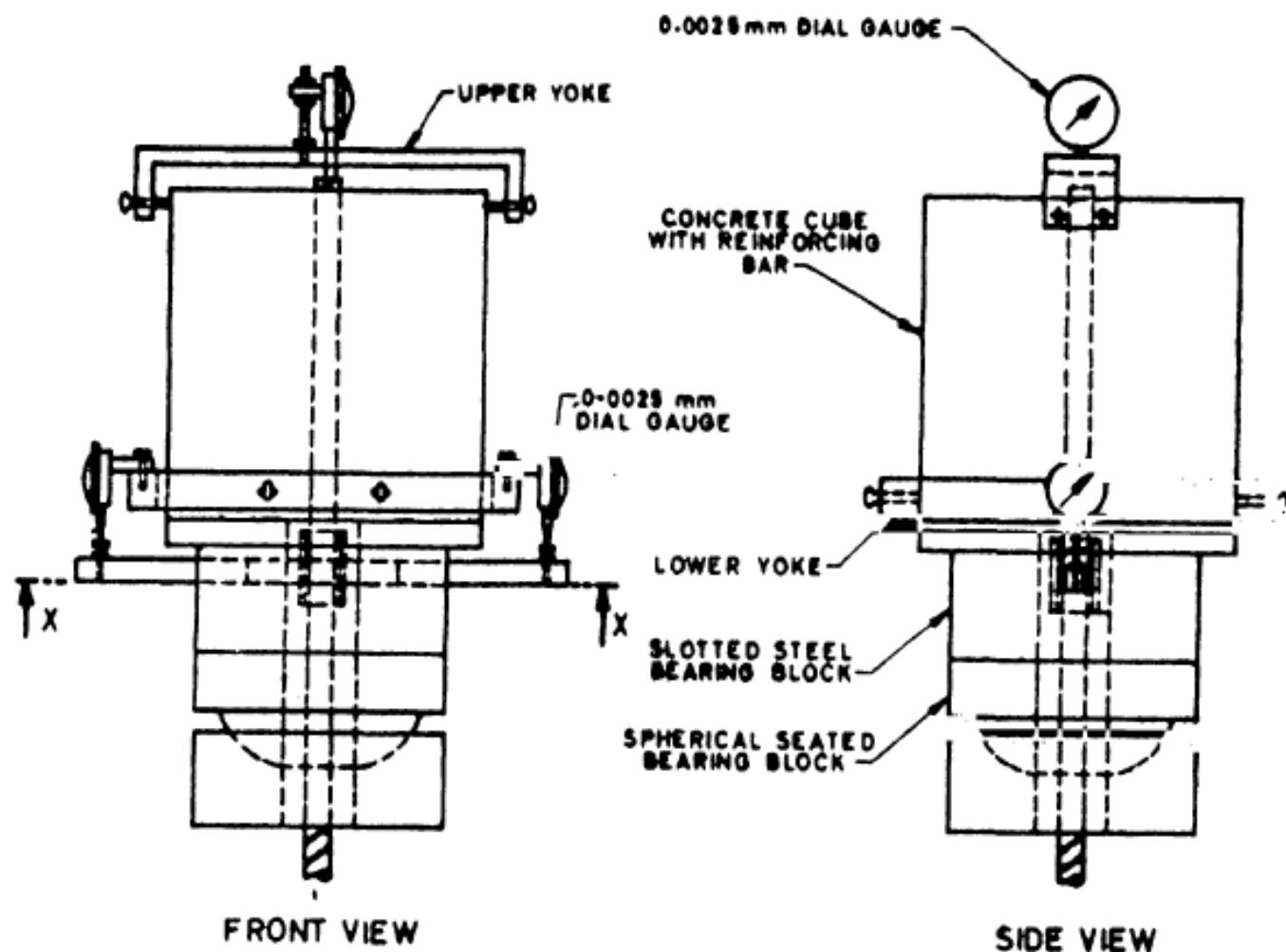
Number of Specimen

At lease 3 specimen of  
deformed bars

And 3 for plain bars for the  
comparison

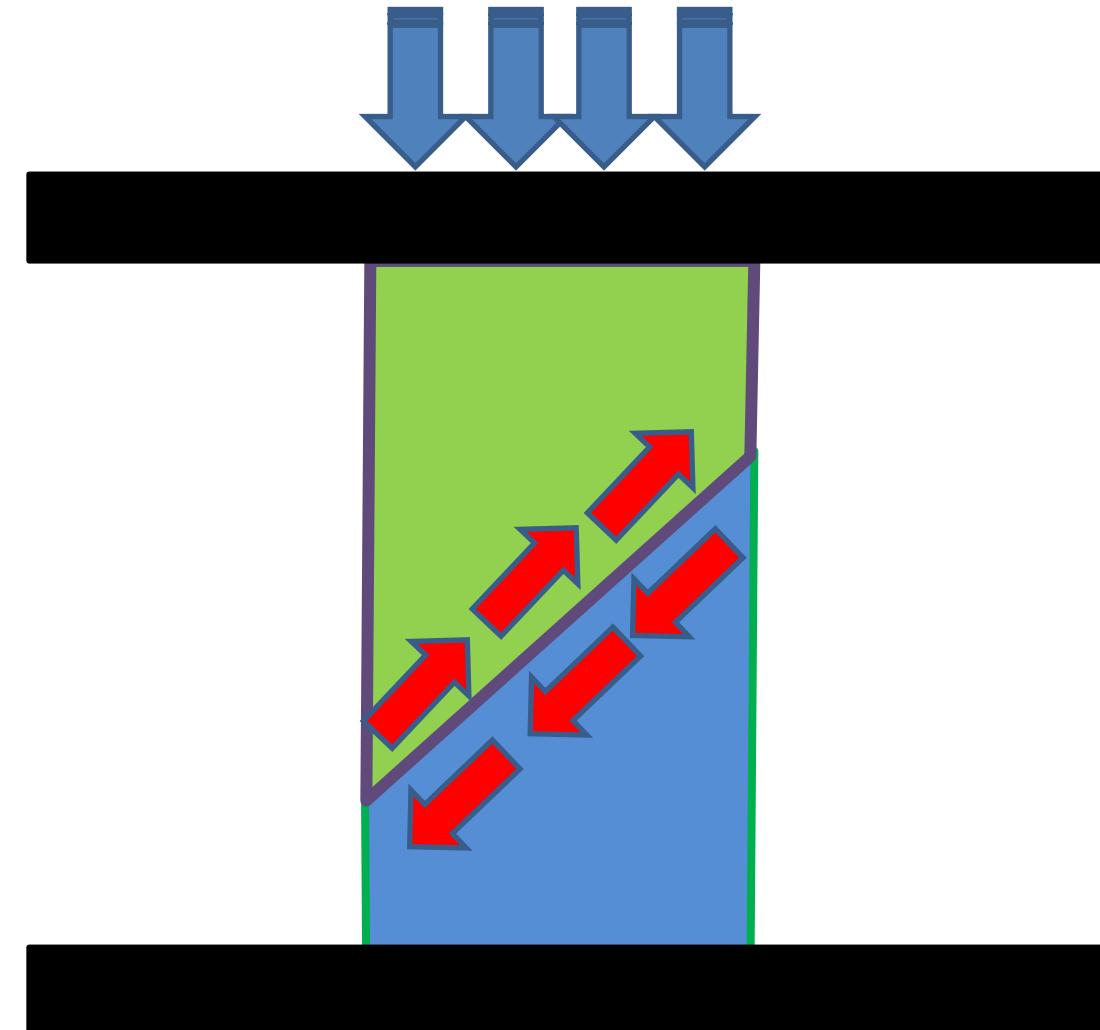
## Clause 4.4.2

Rate of loading 2250  
kg/min



# Shear Strength

The shear strength of concrete is always accompanied by tension and compression due to bending. Shear strength is 10 to 12% of compressive strength. Concrete fails in shear due to diagonal tension.



# Summary

☞ *Compressive Strength Test*

☞ *Split Tensile Strength Test*

☞ *Flexural Strength Test*

☞ *Bond Strength*

☞ *Shear Strength*

# **THANK YOU**