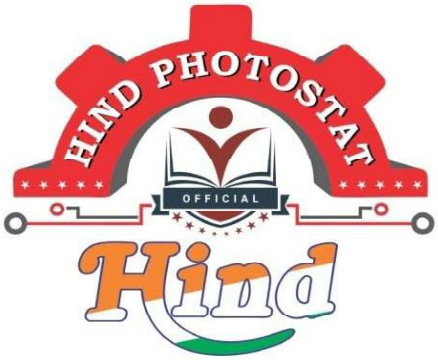

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R.C.C

- Theory BY-GHANSHYAM SIR
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Design of Concrete and Masonary structures (RCC & PSC)

By - Ghanshyam Nayak

: Content :

① Introduction
② working stress Method
③ Limit state Method.
④ Singly Reinforced.
⑤ Doubly Reinforcad.
⑥ T- beam
⑦ Design of shear
⑧ Design of torsion
⑨ Design of beam.
⑩ Design of one way slab
⑪ Design of two way slab
⑫ Design of column
⑬ Design of footing.
⑭ Design of Retaining walls
⑮ Design of stair case
⑯ Design of lintels
⑰ Design of water tank
⑱ Pre stressed Concrete.

Earthquak engineering

Introduction

1. Purpose of IS code :

(a) To ensure adequate structural safety by specifying minimum requirement (like minimum reinforcement).

(b) Similar charts and diagram.

(c) Consistency among designers.

(d) Some amount of legal validity.

2. Important publications :

(a) IS 456 : 2000 → Design of PCC & RCC structures (with amendment no. 5, July 2019).

(b) SP-16 → Design Aids to IS: 456: 2000

SP-34 → R/F detailing.

(SP → special publication)

PCC & RCC :

Basic components:

→ Cement

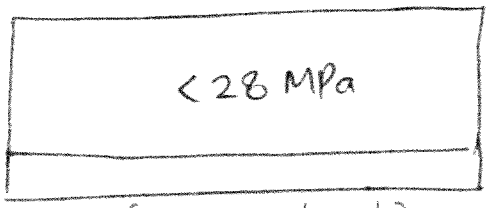
→ Fine aggregate (Sand)

→ Coarse aggregate (Gravel)

→ water

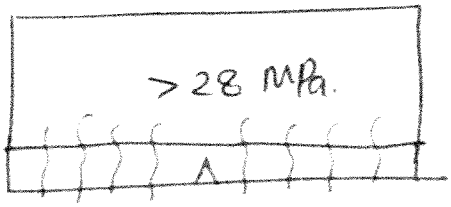
→ R/F

(Sometimes admixtures may be added).



(uncracked)

MOR_1



(crack)

MOR_2

$MOR_2 > MOR_1$

$$\text{Strain}_{(\text{Bottom Concrete})} = \frac{f_c}{E_c} = \frac{0.7\sqrt{f_{ck}}}{5000\sqrt{f_{ck}}} \Rightarrow f_s = \frac{0.7}{5000} \times 2 \times 10^5 = 28 \text{ MPa}$$

Plain Concrete :

- It is a mixture of cement, fine aggregate (sand), coarse aggregate (gravel) and water that results in a solid mass sometimes admixtures are also used.
- Generally used where significant tensile stresses does not develop
- like in case of dam, gravity retaining wall etc.
- Concrete is very strong in compression but weak in tension.
  It's tensile strength is approximately $\frac{1}{10^{th}}$ of compressive strength.

Note :

- Potable water shall be generally used in concrete mix and pH not less 6.
  (sea water shall not be used)
- for most concrete work, nominal maximum size of coarse aggregate is 20 mm.

RCC :

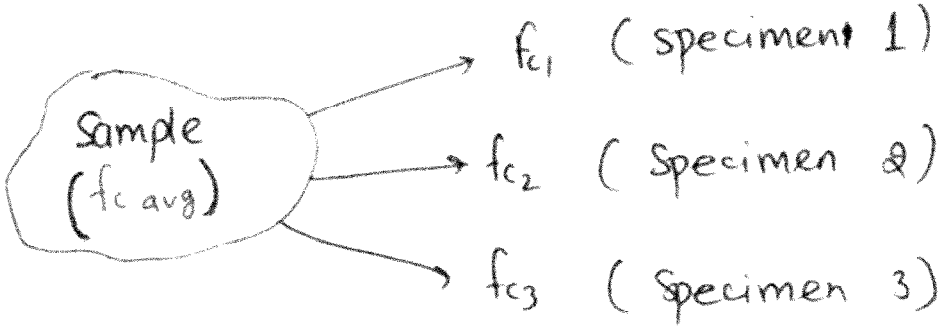
- A concrete with reinforcement embedded in it. The embedded reinforcement makes the section capable of resisting higher tensile stress.
- All of the tension is assumed to be taken by reinforcement. (in cracked section analysis). it is assumed that reinforcement is not separated from concrete.
- The bond between steel and surrounding concrete ensure strain compatibility. i.e the strain in the steel is equal to strain in the surrounding concrete.
- Reinforcement also imparts ductility to the concrete which otherwise is a brittle material.
- Ductility means large deflection and this is due to yielding of steel. Ductile member gives prior warning before impending collapse.

Note :

- we generally design cracked section in RCC to use the higher permissible stress of steel. Also the section required will be less in cracked section compare to uncraked section. However crack width shall not be high to avoid corrosion of reinforcement.
- Permissible crack width as per IS code:
  - (i) In general $\longrightarrow$ ≤ 0.3 mm
  - (ii) structure exposed to moisture or in contact with soil or ground water $\longrightarrow$ ≤ 0.2 mm
  - (iii) very sever or extreme weather condition $\longrightarrow$ ≤ 0.1 mm.

Compressive strength of Concrete :

- The most important property of concrete and can be easily tested.
- Many other properties like tensile strength, bond strength, shear strength, impermeability, durability, modulus of elasticity can be related to compressive strength.
- Strength of concrete in uniaxial compression is determined by loading the standard test cube (150 mm) to failure in compression testing machine
- The test specimen is generally tested 28 days after casting and continuous curing.
- 3 specimen of a sample are taken to report the strength and the compressive strength is the avg of the 3 - specimen.
- Individual variation in specimen strength shall not be more than ±15% of the avg. If the variation is more, the test result of the sample are invalid.

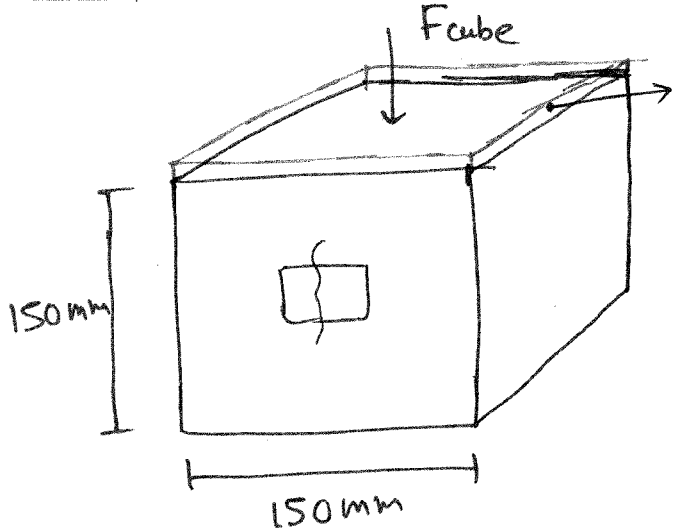


$$f_{c\,avg} = \frac{f_{c1} + f_{c2} + f_{c3}}{3}$$

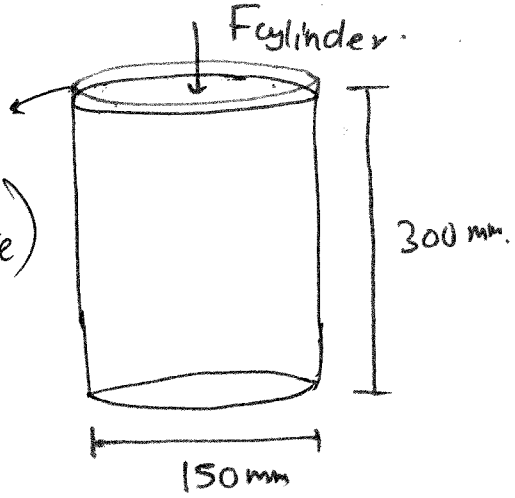
$$\frac{f_{ci} - f_{cavg}}{f_{c.avg}} \times 100 = \pm 15\%$$

i.e $$0.85\, f_{cavg} \leq f_{ci} \leq 1.15\, f_{cavg}$$

Comparision of strength of cube & cylinder

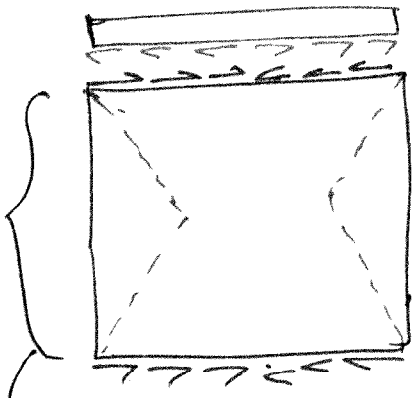


Capping (with neat cement paste)

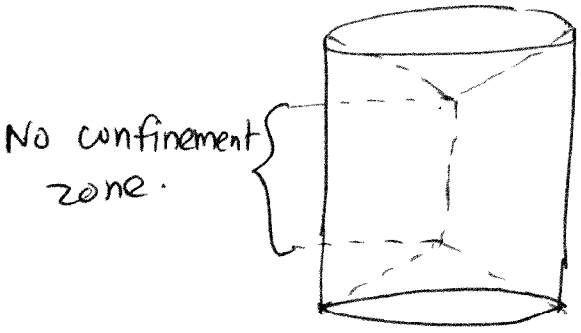


$$f_{cube} = \frac{F_{cube}}{D^2}$$

$$f_{cylinder} = \frac{F_{cylinder}}{\frac{\pi}{4} D^2}$$



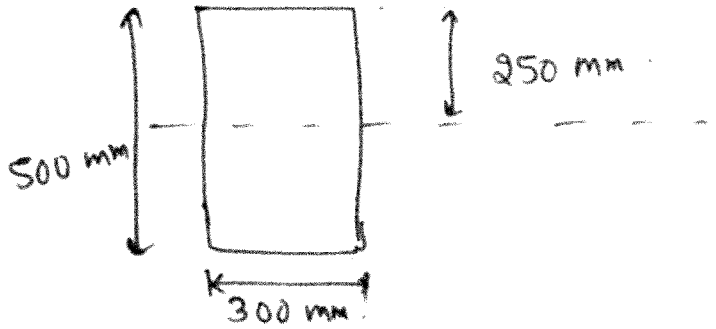
entire height is subjected to confinement.



Thus, $f_{cube} > f_{cylinder}$.

$$f_{cylinder} = 0.8\, f_{cube}$$

Q find out the max^m MOR of the following C/s. The material is linear elastic and assume no crack condition. (given permissible stress in compression = 8.5 MPa & permissible bending stress in tension = 3.5 MPa).



Soln $\frac{M}{I} = \frac{\sigma}{y} \Rightarrow M = \frac{\sigma I}{y}$

for compression.

$$MOR_C = \frac{\sigma I}{y} = \frac{8.5 \times 300 \times 500^3}{12 \times 250} = 106.25 \text{ kNm}$$

for tension

$$MOR_T = \frac{\sigma I}{y} = \frac{3.5 \times 300 \times 500^3}{12 \times 250} = 43.75 \text{ kNm}$$

Thus the moment of resistance of section

MOR = 43.75 kNm

Q During the compression testing of the cube just fails at a compressive force of 450 kN. then the cylinder will just fail with a force of nearly

(a) 450 kN (b) 360 kN

(c) 283 kN (d) 353 kN

Soln $f_{cube} = \frac{450 \times 10^3}{\pi D^2}$