

# POSTAL Book Package

# 2023

## CIVIL ENGINEERING

### RCC & Prestressed Concrete

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# Fundamentals of RCC

## (Introduction)

**Q.1** Consider the following statements regarding concrete mix constituents as given in IS 456:2000:

1. Total water-soluble sulphate content of concrete mix, expressed as  $\text{SO}_3$ , should not exceed 8% by mass of cement in the mix.
2. Use of super sulphated cement is generally restricted where the prevailing temperature is above  $40^\circ\text{C}$ .
3. Cement content not including fly ash and ground granulated blast furnace slag in excess of  $450 \text{ kg/m}^3$  should be used.

Which of the above statement(s) is(are) CORRECT?

- (a) 1 and 2                      (b) 2 only  
(c) 1 and 3                      (d) 3 only

**Q.2** Consider the following statements regarding testing of concrete:

1. The mean strength determined from any group of four consecutive test results should be more than or equal to  $f_{ck} + 1.65\sigma$ .
2. Minimum 30 samples are required to be tested for the establishment of value of standard deviation.
3. Individual test results should not fall below  $f_{ck} - 3$ .

Which of the above statements are CORRECT?

- (a) 1 and 2                      (b) 2 and 3  
(c) 1 and 3                      (d) 1, 2 and 3

**Q.3** Consider the following statements regarding various exposure conditions:

1. Concrete surfaces exposed to sea water spray is *extreme* environment exposure.
2. Minimum cement content for reinforced concrete in *very severe* exposure condition should be  $340 \text{ kg/m}^3$ .
3. Maximum grade of concrete exposed to *extreme* environment should be M40.

4. Maximum free water-cement ratio can go upto 0.55 for reinforced concrete in *mild* exposure.

Which of the above statements are INCORRECT?

- (a) 2 and 4                      (b) 1 and 3  
(c) 1 and 2                      (d) 3 and 4

**Q.4** The characteristic strength of concrete is

- (a) higher than the average cube strength  
(b) lower than the average cube strength  
(c) the same as the average cube strength  
(d) higher than 90% of the average cube strength

**Q.5** Stress-strain curve of concrete is

- (a) A perfect straight line upto failure  
(b) Straight line upto 0.002 strain value and then parabolic upto failure.  
(c) Nearly parabolic upto 0.002 strain value and then a straight line upto failure  
(d) Hyperbolic upto 0.002 strain value and then a straight line upto failure

**Q.6** The target mean strength of M25 grade concrete which shows standard deviation of  $4 \text{ N/mm}^2$  is equal to \_\_\_\_\_  $\text{N/mm}^2$ .

**Q.7** Creep in concrete increases when

- (a) relative humidity is high  
(b) temperature is high  
(c) size of member is large  
(d) loading is sustained over a short period

**Q.8** For under water concrete, water cement ratio should not exceed

- (a) 0.45                      (b) 0.50  
(c) 0.55                      (d) 0.60

**Q.9** Which of the following statements refer to correct purposes as regards testing of concrete by ultrasonic pulse velocity method?

1. To assess the quality of concrete in-situ.

2. To determine the dynamic modulus of elasticity of concrete.
  3. To locate the presence of cracks in it.
- (a) 1 and 2 only      (b) 1 and 3 only  
(c) 2 and 3 only      (d) 1, 2 and 3

**Q.10** Consider the following statements:

1. In reinforced cement concrete, modular ratio is defined by the ratio (modulus of elasticity of steel)/(Modulus of elasticity of concrete).
2. Modulus of rupture of cement concrete is a function of its characteristic compressive strength.
3. The characteristic compressive strength of M 20 grade cement concrete at 7 days is  $20\text{N/mm}^2$ .

Which of these statements are correct?

- (a) 1, 2 and 3      (b) 1 and 2 only  
(c) 2 and 3 only      (d) 1 and 3 only

**Q.11** The target mean strength  $f_{cm}$  for concrete mix design obtained from the characteristic strength  $f_{ck}$  and standard deviation  $\sigma$ , as defined in **IS 456 : 2000**, is

- (a)  $f_{ck} + 1.35 \sigma$       (b)  $f_{ck} + 1.45 \sigma$   
(c)  $f_{ck} + 1.55 \sigma$       (d)  $f_{ck} + 1.65 \sigma$

**Q.12** Let the characteristic strength be defined as that value, below which not more than 50% of the results are expected to fall. Assuming a standard deviation of 4 MPa, the target mean strength (in MPa) to be considered in the mix design of a M25 concrete would be

- (a) 18.42      (b) 21.00  
(c) 25.00      (d) 31.58

**Q.13** The flexural tensile strength of M25 grade of concrete, in  $\text{N/mm}^2$ , as per **IS 456 : 2000** is \_\_\_\_\_.

**Q.14** Modulus of rupture for M40 grade concrete is approximately

- (a) 4.43 MPa      (b) 3.56 MPa  
(c) 4.0 MPa      (d) 3.32 MPa

**Q.15** If elastic deformation of a concrete member is 8 mm then, assuming that member is loaded after 7 days of casting, ultimate creep deformation will be

- (a) 8.8 mm      (b) 12.8 mm  
(c) 17.6 mm      (d) 10.8 mm

**Q.16** What should be the minimum grade of reinforced concrete in and around sea coast construction?

- (a) M 35      (b) M 30  
(c) M 25      (d) M 20

**Q.17** The modulus of elasticity,  $E = 5000\sqrt{f_{ck}}$  where

$f_{ck}$  is the characteristic compressive strength of concrete, specified in **IS 456 : 2000** is based on

- (a) tangent modulus  
(b) initial tangent modulus  
(c) secant modulus  
(d) chord modulus

**Q.18** For computing the 'instantaneous' elastic deflection, which one of the following will be useful?

- (a) long-term static modulus of elasticity.  
(b) short-term static modulus of elasticity.  
(c) dynamic modulus of elasticity.  
(d) None of these

**Q.19** The slope of the line joining any point on stress-strain curve of concrete to the origin is known as

- (a) Initial tangent modulus of elasticity  
(b) Tangent modulus of elasticity  
(c) Secant modulus of elasticity  
(d) Long term modulus of elasticity

**Q.20** Statistically, the variation in concrete strength is studied in terms of standard deviation and coefficient of variation, where the later is given by

- (a)  $\frac{\text{Mean strength}}{\text{Standard deviation}}$   
(b)  $\frac{\text{Standard deviation}}{\text{Mean strength}}$   
(c)  $\frac{\text{Characteristic strength}}{\text{Mean strength}}$   
(d)  $\frac{\text{Characteristic strength}}{\text{Standard deviation}}$

**Q.21** The long-term static modulus of elasticity as per **IS 456:2000 Code** for M40 grade concrete having creep coefficient of 1.8 is

- (a) 5647 MPa      (b) 8470 MPa  
(c) 11294 MPa      (d) 16941 MPa

**Q.22** Consider the following statements regarding Test Results of Samples:

1. The test results of the sample shall be the average of the strength of three specimens.

**Q.33** Which of the following statement(s) is/are correct?

- (a) Modulus of elasticity of concrete increases with increase in workability
- (b) Maximum compressive strength of structural concrete is taken as approximately 0.8375 times the strength of cylindrical specimen.

- (c) Target mean strength is always greater than characteristic strength.
- (d) The strength of concrete under biaxial compression is greater than uniaxial compression.

■■■■

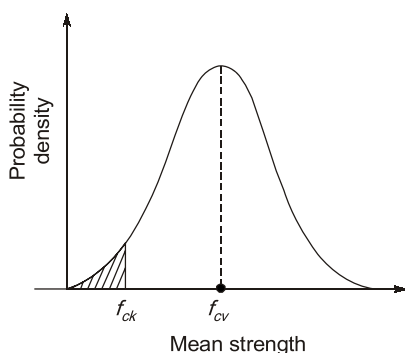
**Answers Fundamentals of RCC (Introduction)**

1. (b) 2. (b) 3. (b) 4. (b) 5. (c) 6. 31.6 7. (b) 8. (d) 9. (d) 10. (b)  
11. (d) 12. (c) 13. 3.5 14. (a) 15. (c) 16. (b) 17. (c) 18. (b) 19. (c) 20. (b)  
21. (c) 22. (c) 23. (a) 24. 0 25. (c) 26. (c) 27. (a) 28. (b) 29. (a) 30. (a)  
31. (c) 32. (b, d) 33. (b, c, d)

**Explanations Fundamentals of RCC (Introduction)**

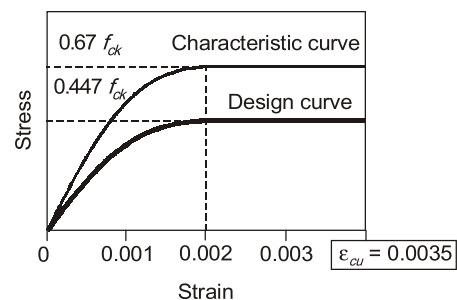
1. (b)  
Refer clause 8.2.4.2, clause 8.2.5.3 and Table 4 of IS-456 : 2000.
2. (b)  
Refer Clause 16.2 and Table 11 of IS 456 : 2000.
3. (b)  
Concrete surfaces exposed to sea water spray is said to be in very severe exposure condition. Minimum grade of concrete exposed to extreme environment for RCC should be M40.

4. (b)  
Characteristics strength =  $f_{ck}$   
 $f_{av} = f_{ck} + 1.65\sigma$   
 $\therefore f_{ck} < f_{av}$



5. (c)  
The characteristic and design stress-strain curves specified by the Code for concrete in flexural

compression are depicted in Figure below. The maximum stress in the concrete in the structure is restricted to  $0.67 f_{ck}$ . The curves consist of a parabola in the initial region up to a strain of 0.002 (where the slope becomes zero), and a straight line thereafter, at a constant stress level up to an ultimate strain of 0.0035.



6. 31.6(31 to 32)  
Target mean strength,  
 $f_{cm} = f_{ck} + 1.65\sigma$   
 $= 25 + 1.65 \times 4$   
 $= 31.6 \text{ N/mm}^2$

7. (b)  
Creep increases when
- 1. cement content is high
  - 2. w/c ratio is high
  - 3. aggregate content is low
  - 4. air entrainment is high
  - 5. relative humidity is low

6. temperature (causing moisture loss) is high
7. size/thickness of the member is small
8. loading is sustained over a long period

8. (d)

Refer clause 14.2.2 of **IS-456:2000**

9. (d)

Ultrasonic pulse velocity test is an in-situ test of hardened concrete when it is already acting as a structural member.

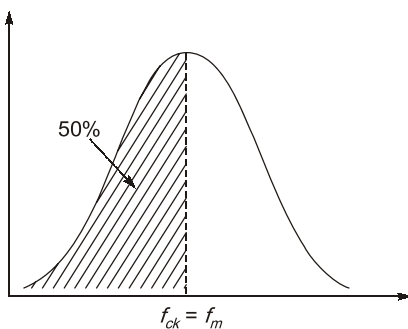
This test is based on the principle that the velocity of sound in a solid material is a function of the square root of the ratio of its modulus of elasticity  $E$  to its density,  $\rho$ .

Higher the velocity of pulses greater is the strength of concrete.

10. (b)

The characteristic compressive strength is measured at 28 days.

12. (c)



If  $f_{ck}$  is the value below which not more than 50% of test results are expected then,

$$f_m = f_{ck}$$

[Mean strength = Characteristics strength]

So target mean strength of concrete to be considered in design mix.

= Mean strength

$$= f_m = f_{ck} = 25 \text{ MPa}$$

13. (3.5)

$$\text{Flexural strength} = 0.7\sqrt{f_{ck}} = 3.5 \text{ N/mm}^2$$

14. (a)

As per **Clause 6.2.2** of **IS 456:2000**, modulus of rupture,  $f_{cr}$  is given as

$$f_{cr} = 0.7\sqrt{f_{ck}} = 0.7\sqrt{40} = 4.43 \text{ MPa}$$

15. (c)

Ultimate creep deformation =  $\theta \times$  elastic deformation

where  $\theta$  = creep coefficient

$\theta = 2.2$  for loading after 7 days

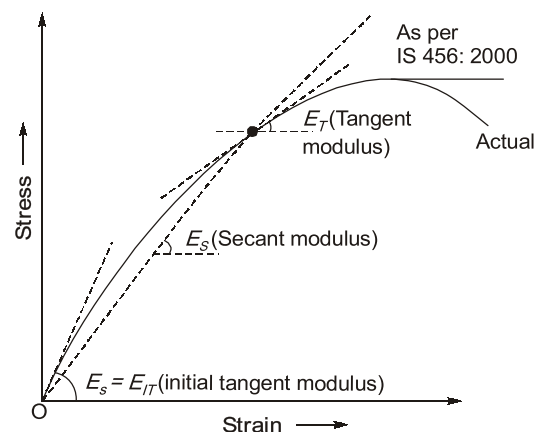
$$\text{So, ultimate creep deformation} = 2.2 \times 8 = 17.6 \text{ mm}$$

16. (b)

Exposure	Minimum grade of plain concrete	Minimum grade of reinforced concrete
(i) Mild	—	M20
(ii) Moderate	M15	M25
(iii) Severe	M20	M30
(iv) Very severe	M20	M35
(v) Extreme	M25	M40

Concrete in sea water or exposed directly along the sea coast shall be at least **M20** grade in the case of plain concrete and **M30** in case of reinforced concrete. The use of slag or pozzolana cement is advantageous under such conditions.

19. (c)



21. (c)

Long-term static modulus of elasticity is given by

$$E_\theta = \frac{E_c}{1 + \theta} = \frac{5000\sqrt{f_{ck}}}{1 + \theta}$$

$$= \frac{5000\sqrt{40}}{1 + 1.8} \simeq 11294 \text{ MPa}$$

22. (c)

If the variation is found more than  $\pm 15\%$ , the test results of the sample are invalid.

Refer **IS 456:2000, Clause 15.4**