# DDA JE 2023

ENGINEERS

## RCC

# COMPLETE REVISION

PART 2

## CIVIL ENGINEERING

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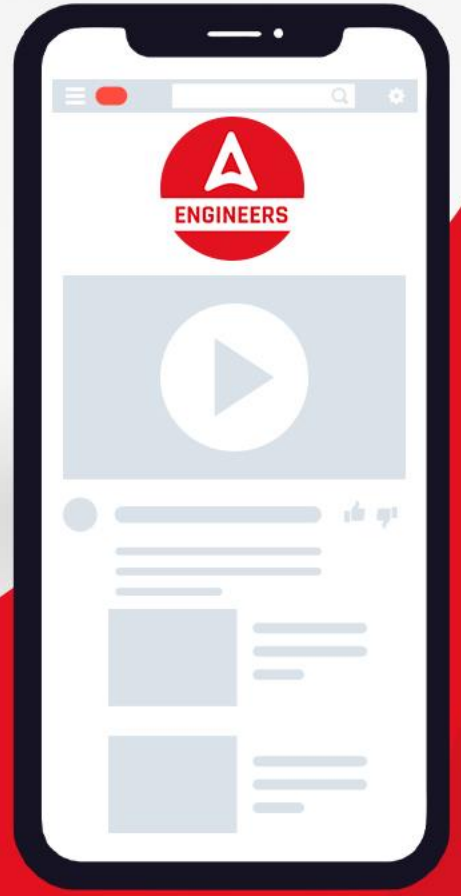


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**The minimum tension reinforcement in beam should not be less than _____.**

(a) $\frac{Ast}{bd} = \frac{0.85}{fy}$

(b) $\frac{0.47}{Ast} = \frac{fy}{\sqrt{3}\, fck}$

(c) $\frac{0.85}{Ast} = \frac{fy}{\sqrt{3}\, fck}$

(d) $\frac{0.45}{Ast} = \frac{fy}{\sqrt{3}\, fck}$

If the depth of actual neutral axis in a beam is more than the depth of critical neutral axis, the beam is called:

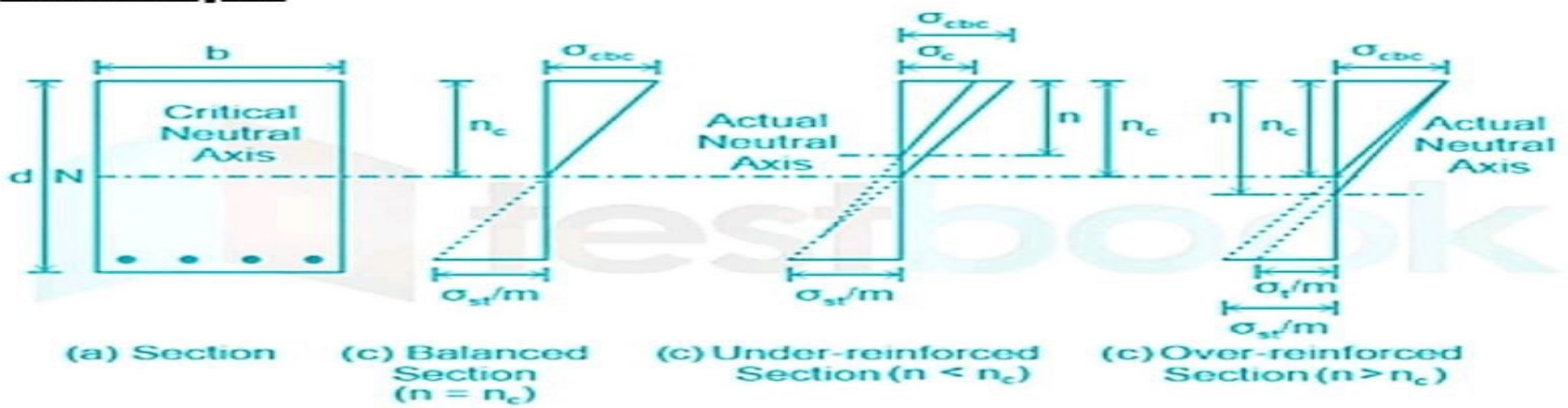
(a) Balanced beam

(b) Under reinforced beam

(c) Over reinforced beam

(d) None of the above

**Concept:**




**In case of doubly reinforced beam,**

a) If **the depth of the actual neutral axis (n) is lesser than the depth of the critical neutral axis ($n_c$)** then the section is called as **under reinforced section** and in this case, the steel in the tensile zone attains its maximum stress earlier than the concrete in the compressive zone.

b) If **the depth of the actual neutral axis (n) is greater than the depth of the critical neutral axis ($n_c$)** then the section is called as **over-reinforced section** and in this case, the concrete in the compressive zone attains its maximum stress earlier than the steel in the tensile zone.

c) If **the depth of the actual neutral axis (n) is equal to the depth of the critical neutral axis ($n_c$)** then the section is called as **balanced**

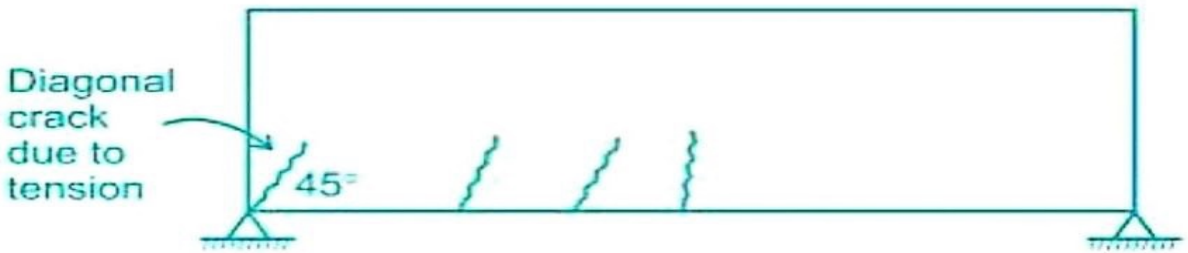
The diagonal tension failure in a concrete beam occurs due to

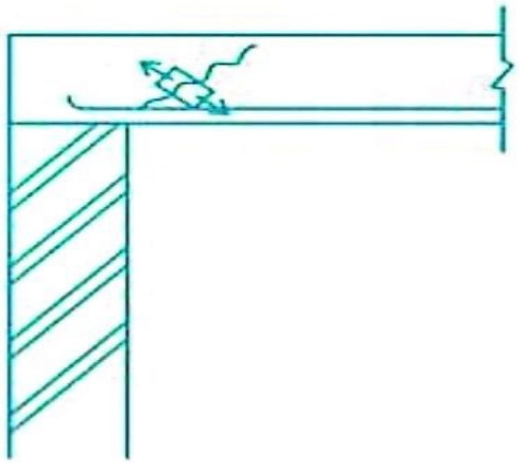
(a) Large shear force and less bending moment

(b) Large bending moment and less shear force

(c) Equal shear force and bending moment

(d) None of these



ccurs due to



It is diagonal tension which is responsible for crack formation near the supports. The shear force is quite high and the bending stresses are very small. Hence principal tensile stress is nearly equal to shear stress.

For such a failure to happen $\tau \gg \sigma$.

With usual notations the depth of the neutral axis of a balanced section, is given by

(a) $mc/t = (d - n)/n$

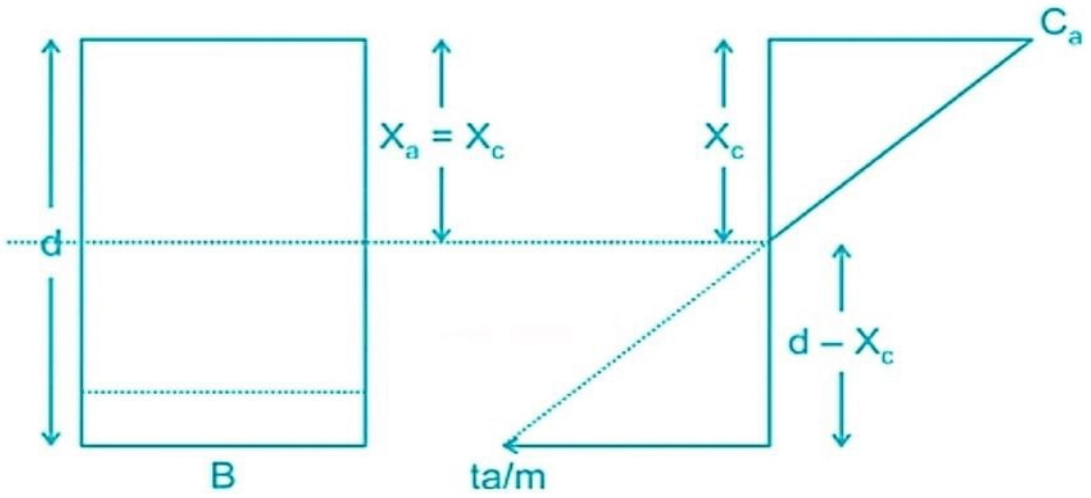
(b) $t/mc = n/(d + n)$

(c) $t/mc = (d + n)/n$

(d) $mc/t = n/(d - n)$

**ıtral axis of a balanced**






Using similar triangle property

$$\frac{C_a}{x_c} = \frac{t_a}{m(d-x_c)}$$

$$\frac{mC_a}{t_a} = \frac{x_c}{d-x_c}$$

Here $C_a = C$

$t_a = t$

$x_c = n$

So, $\frac{mC}{t} = \frac{n}{d-n}$

**In a beam, if the more number of thinner bars are increased in place of less number of thicker bars, keeping area same, the bond strength will:**

**(a) Increase**

**(b) Decrease**

**(c) Remain same**

**(d) Increase or decrease depending upon the percentage of steel**

The moment coefficients given in IS 456 for simply supported torsionally unrestrained slab are based on:

(a) Westergarrd method

(b) Rankine Grashoff theory

(c) Yield line theory

(d) Marcus method

Bottom bars under the columns are extended into the interior of the footing slab to a distance greater than

(a) 42 diameters from the center of the column

(b) 42 diameters from the inner edge of the column

(c) 42 diameters from the outer edge of the column

(d) 24 diameters from the center of the column

**Anchorage value of 135° bend is _____ times the diameter of the bar.**



**(a) 4**

**(b) 8**

**(c) 12**

**(d) 16**

As per Clause 26.2.2.1 b of IS 456-2000

| Anchorage Value of Bends & Hooks | | |
|---|---|---|
| Bends | 45° | 4ϕ |
| | 90° | 8ϕ |
| | 135° | 12ϕ |
| Hooks | U type Hook (180°) | 16ϕ |

**What is the trapezoidal footing used for?**

(a) Carry two columns of unequal loads

(b) Carry equal loads

(c) Carry load

(d) Carry two columns of equal loads

As per codal provisions of IS 3370, minimum grade of concrete for the RCC and PCC water tank are respectively

(a) M20, M30

(b) M30, M20

(c) M30, M25

(d) M25, M20

As per codal provisions of IS 3370:

- **Minimum grade of concrete for the R.C.C water tank is M30.**
- Maximum cement content is 400 kg/m³ to take care of shrinkage effect.
- Minimum cement content is 320 kg/m³.
- **Minimum grade of concrete for P.C.C water tank is M20.**
- Maximum w/c ratio is 0.45.
- Minimum nominal cover is 45 mm.
- Maximum allowed crack width is 0.2 mm in the LSM design.
- To reduce cracking due to temperature, shrinkage, and moisture loss at an early stage of concrete, curing should be done for at least 14 days.
- Permeability of concrete must be least so use leaser value of w/c ratio.
- No porous aggregate should be used.
- Part of structure retaining liquid and enclosing space above liquid should be taken under server exposure condition.
- All the structures to be designed shall be designed for both empty and full condition.
- Cracking of concrete can be controlled to some extent by maintaining a slope filling rate of 1 m in 24 hours at the first time of filling.

**de of concrete for**

Percentage of steel for balanced section of a singly reinforced rectangular section by limit state method does NOT depend on



(a) Characteristic strength of concrete

(b) Yield strength of concrete

(c) Modulus of elasticity of steel

(d) Geometry of the section

**The most economical type of the RCC beam**

(a) Singly reinforced rectangular beam

(b) Doubly reinforced T-beam

(c) Doubly reinforced rectangular beam

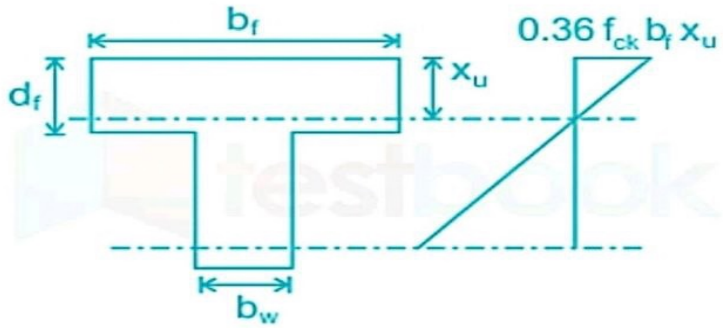
(d) Singly reinforced T-beam

**doubly reinforced beam.**

**T- Beam:**

It's simply a rectangular beam casted **monolithically** with the slab.

T-Beam reduce the concrete volume & weight of the beam.




**Advantages :**

- Since the beam is casted monolithically with the slab, the flange also takes up the compressive stresses which means it will be more effective in resisting the sagging moment acting on the beam.
- Better head room, this is direct outcome of the first point since the depth of the beam can be considerably reduced.
- For larger spans, T beams are usually preferred rather than rectangular beam as the deflection is reduced to a good extent.

**eam**

**n**

2

**m**

**The maximum compressive strain in concrete at the limit state of collapse in compression to be considered for the design of axially loaded short column is _____**

**(a) 0.35**

**(b) 0.01**

**(c) 0.035**

**(d) 0.002**

**As per IS 10262: 2009, what is the assumed standard deviation in MPa of M30 concrete?**



(a) 5

(b) 4

(c) 3.5

(d) 6

- Table-1 Assumed Standard Deviation (Clauses 3.2.1.2, A-3 and B-3);

| Grade of Concrete | Assumed Standard Deviation ($N/mm^2$) |
|---|---|
| M 10 | 3.5 |
| M 15 | |
| M 20 | 4.0 |
| M 25 | |
| M 30 | 5.0 |
| M 35 | |
| M 40 | |
| M 45 | |
| M 50 | |
| M 55 | |

**In stress block diagram for A rectangular section of singly reinforced beam IN LIMIT STATE METHOD, the centroid of compressive force lies at a distance of _____ from the extreme compression fibre.**

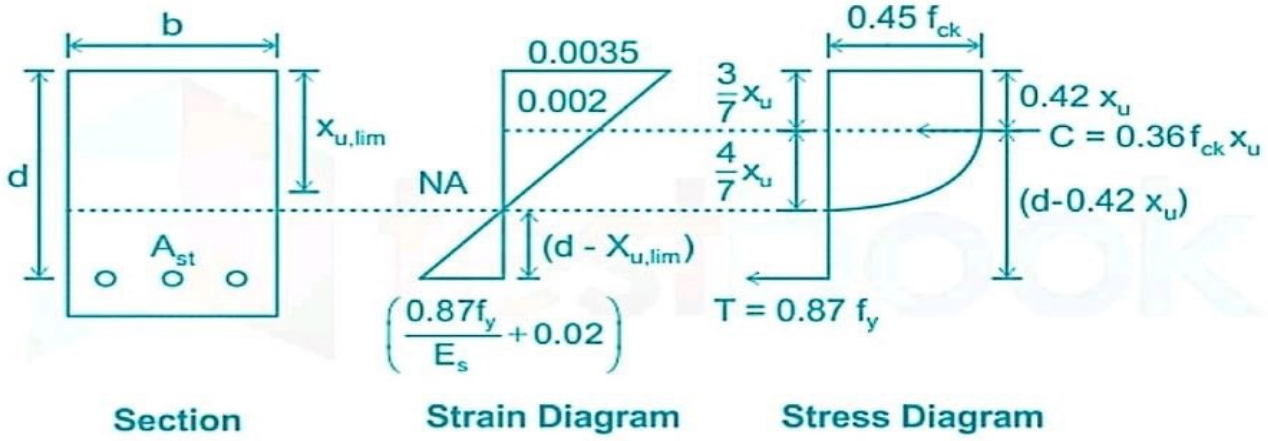
**(a) 0.5 Xu**

**(b) 0.42 Xu**

**(c) 0.36 Xu**

**(d) 0.45 Xu**

## Stress and Strain Diagram of a Singly Reinforced Beam in Limit State Method:




Where $X_u$ = Actual depth of neutral axis

$f_{ck}$ = Characteristic compressive strength of concrete

$f_y$ = Yield stress of steel

**The centroid of the compressive force is at a distance of $0.42X_u$ from the extreme compression fibre.**

**section of singly the centroid of from the extreme**

In limit state method, spacing of main reinforcement control primarily

(a) Durability

(b) Deflection

(c) Collapse

(d) Cracking

When HYSD bars are used in place of mild steel bars in a beam, the bond strength

(a) Become zero

(b) Decreases

(c) Increases

(d) Does not change

As per IS 456-2000, When HYSD bars are used, the minimum reinforcement in either direction of slabs, is

(a) 0.35% of the total cross sectional area

(b) 0.12% of the total cross sectional area

(c) 0.80% of the total cross sectional area

(d) 0.25% of the total cross sectional area

**In case of two way slab the ratio of the long span to the short span is**

**(a) More than two**

**(b) Zero**

**(c) Five**

**(d) Less than two**

As per IS 456-2000, what is the maximum free water-to-cement ratio of an M40 grade of reinforced concrete under extreme exposure conditions?



(a) 0.40

(b) 0.55

(c) 0.5

(d) 0.60

| Reinforced concrete | | |
|---|---|---|
| Minimum cement content 9kg/m3) | Maximum free water-cement ratio | Minimum grade of concrete |
| **300** | 0.55 | M 20 |
| 300 | 0.50 | M 25 |
| 320 | 0.45 | M 30 |
| 340 | 0.45 | M 35 |
| **360** | **0.40** | **M 40** |

**water-to-cement**

**e under extreme**

**Maximum reinforcement provided in a beam section shall not exceed _____.**

**(a)** $\frac{0.85}{f_y}$ **(bd)**

**(b)** $\frac{0.87}{f_y}$ **(bd)**

**(c) 0.04 (bd)**

**(d) 0.04 (bD)**

**All columns shall be designed for minimum eccentricity I/500 + d/30 = 20 mm. where,**

**I = _____**

**d = _____**



**(a) Effective length of column, Depth of column**

**(b) Unsupported length of column, Lateral Dimension of column**

**(c) Effective length of column, Lateral dimension of column**

**(d) Unspoorted length of column, Depth of column**

As per IS 456-2000, The flexural tensile strength of concrete of grade M25 according to the 'limit state method' is:

(a) 3.0 $N/mm^2$

(b) 3.5 $N/mm^2$

(c) 5.0 $N/mm^2$

(d) 2.5 $N/mm^2$

Which limit states deals with strength, overturning, sliding, buckling, fatigue fracture, etc.?

(a) Ultimate limit states

(b) Strain limit state

(c) Stress state

(d) Serviceability limit states

**Limit State Method:**

Limit states are the acceptable limits for the **safety and serviceability requirements of the structure before failure occurs.** The design of structures by this method will thus ensure that they will not reach limit states and will not become unfit for the use for which they are intended. Limit State Design requires two principal criteria to be satisfied:

- The ultimate limit state (ULS)
- The serviceability limit state (SLS)

**Ultimate limit state(ULS):**

- It ensures that the **structure you are going to build is stable and strong** enough against any loads it is going to endure, such as dead loads, live loads, wind loads, earthquake loads, their combinations, and so on.
- Ultimate limit states deal with **strength, overturning, sliding, buckling, fatigue fracture, etc.**
- The ULS is a purely elastic condition.

**rturning, sliding,**

The ratio of the depth of the parabolic and rectangular portion block at the limiting state of collapse of a singly reinforced section is:

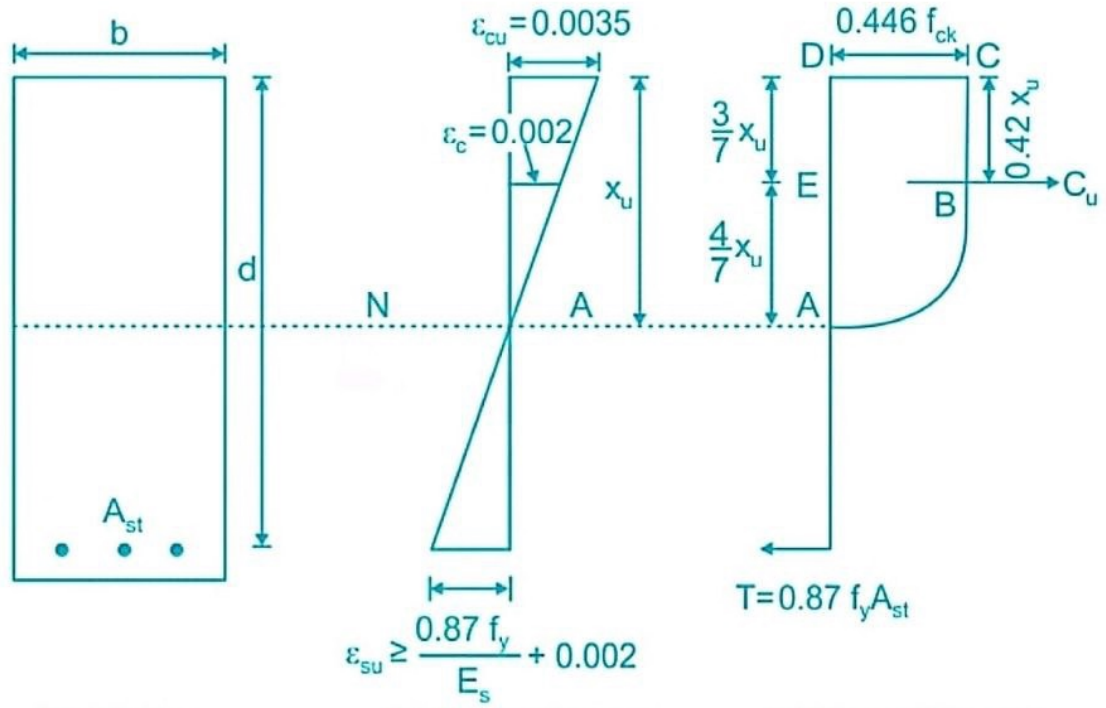
(a) 4 : 5

(b) 4 : 3

(c) 3 : 4

(d) 2 : 1

## Strain and Stress diagram of the beam




(a) Section (b) Strain diagram (c) Stress diagram

From the picture, the ratio of the depth of the parabolic and rectangular portion block = $4x_u / 7$

**Divided by $3x_u / 7 = 4/3$**

**nd rectangular portion ingly reinforced section**

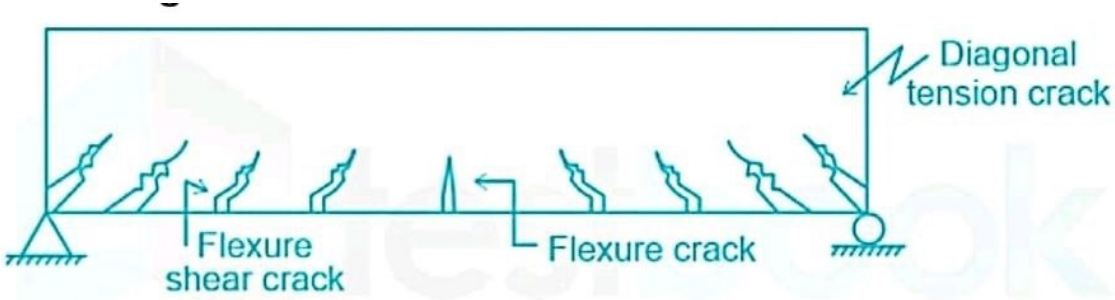
**Diagonal tension in beam _____**

(a) Is maximum at neutral axis

(b) Decreases below the neutral axis and increases above the neutral axis

(c) Increases below the neutral axis and decreases above the neutral axis

(d) Remains the same in both above and below the neutral axis



**The spacing of stirrups in a beam:**

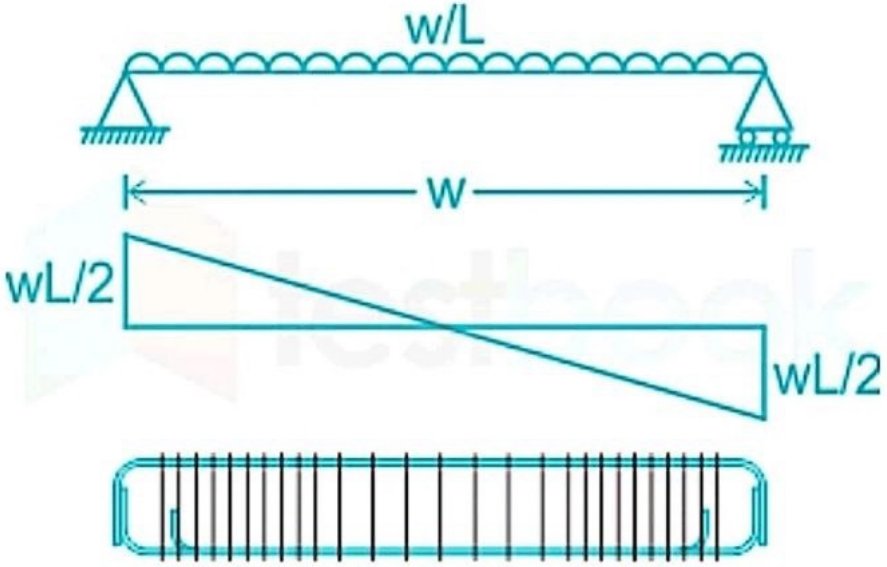
(a) Is the same everywhere

(b) Depends on the size of the beam

(c) Increases near the support

(d) Decreases near the support

As shear strength requirement is more at the supports than the center, the spacing of stirrups increases towards the center of the beam.



If design bond stress = 1.5 $N/mm^2$ is assumed, then the development length of an Fe 500 HYSD bar of nominal diameter 12 mm – Which is fully stressed in tension – will be:

(a) 544 mm

(b) 246 mm

(c) 634 mm

(d) 798 mm

The resistance offered to slipping of steel bars from concrete is due to:

i. Pure adhesion

ii. Frictional resistance

iii. Mechanical resistance

Which of these is/are correct?

(a) only i

(b) ii and iii

(c) i and iii

(d) i, ii and iii

**The diameter of transverse reinforcement of columns should be equal to one-fourth of the diameter of the main steel rods but not less than**

**(a) 4 mm**

**(b) 5 mm**

**(c) 6 mm**

**(d) 7 mm**

As per IS 456:2000, the design of transverse reinforcement is as:

**The diameter of transverse reinforcement:**

i) $\frac{1}{4}\ \phi_{main}$

ii) 6 mm

whichever is maximum,

Let us take 8 mm diameter bar as transverse reinforcement

Important Point

**The spacing of Transverse reinforcement:**

i) Least lateral dimension

ii) 16 times diameter of main reinforcement bar

iii) 300 mm

According to I.S. 456-1978, the thickness of reinforced concrete footing on piles at its edges is kept less than

(a) 5 cm

(b) 10 cm

(c) 15 cm

(d) 20 cm

**According to I.S. 456-1978, the thickness of reinforced concrete footing on piles at its edges is kept less than**

**(a) 5 cm**

**(b) 10 cm**

**(c) 15 cm**

**(d) 20 cm**



**As per IS 456: 2000, Clause 34.1.2,**

**Thickness at the Edge of Footing**

In reinforced and plain concrete footings, the thickness at the edge shall be not less than 150 mm for footings on soils.

For footings on piles, the thickness at the edge shall be not less than **300 mm (30 cm) above the tops of piles**.

**The foundation whose length is considerable greater than its width is:**

**(a) Footing**

**(b) Combined footing**

**(c) Strip foundation**

**(d) Raft foundation**

**Strip footing:**

A strip footing is another type of spread footing which is provided for a load-bearing wall. The length of strip footing is considerably greater than its width. A strip footing is also known as continuous footing.

**Mat or Raft foundation:**

It is a large slab supporting a number of columns and walls under an entire structure or a large part of the structure. It is used to cover the foundation of the whole building area.

**Pile foundation:**

A pile is basically a long cylinder of a strong material such as concrete that is pushed into the ground to act as steady support for structures built on top of it. It is also called a deep foundation. Depth of the pile is very much greater than that of its lateral dimension.

**Confusion Point:**

For pile foundation ⇒ Depth >>>>> Width

For strip footing ⇒ Length >> Width

**∴ Strip Footing is the correct answer.**

**rable greater than its**

**Width of RC rectangular beam is 205 mm, spacing of vertical stirrups provided is 435 mm ($f_y$ = 410 MPa). If shear capacity of a RC beam is more than shear force at a section; the minimum quantity of the stirrups to be provided as per codal provision is:**

**(a) 50 $mm^2$**

**(b) 75 $mm^2$**

**(c) 100 $mm^2$**

**(d) 250 $mm^2$**

**The load at which the column just buckles, is known as**

(a) Buckling load

(b) Critical load

(c) Crippling load

(d) Any one of these

As per IS 456-2000, the limiting value of the depth of neutral axis ($X_{umax}/d$) for fe415 grade steel is:

(a) 0.46

(b) 0.48

(c) 0.53

(d) 0.39

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