MUZAFFARPUR INSTITUTE OF TECHNOLOGY

DESIGN OF CONCRETE STRUCTURES-II (011726)

Date: 20/11/'18
Marks: 20.

SOLUTIONS TO MID-TERM PAPER.

Q1) (I) → $0.27\sqrt{f_{ck}}$ (b)

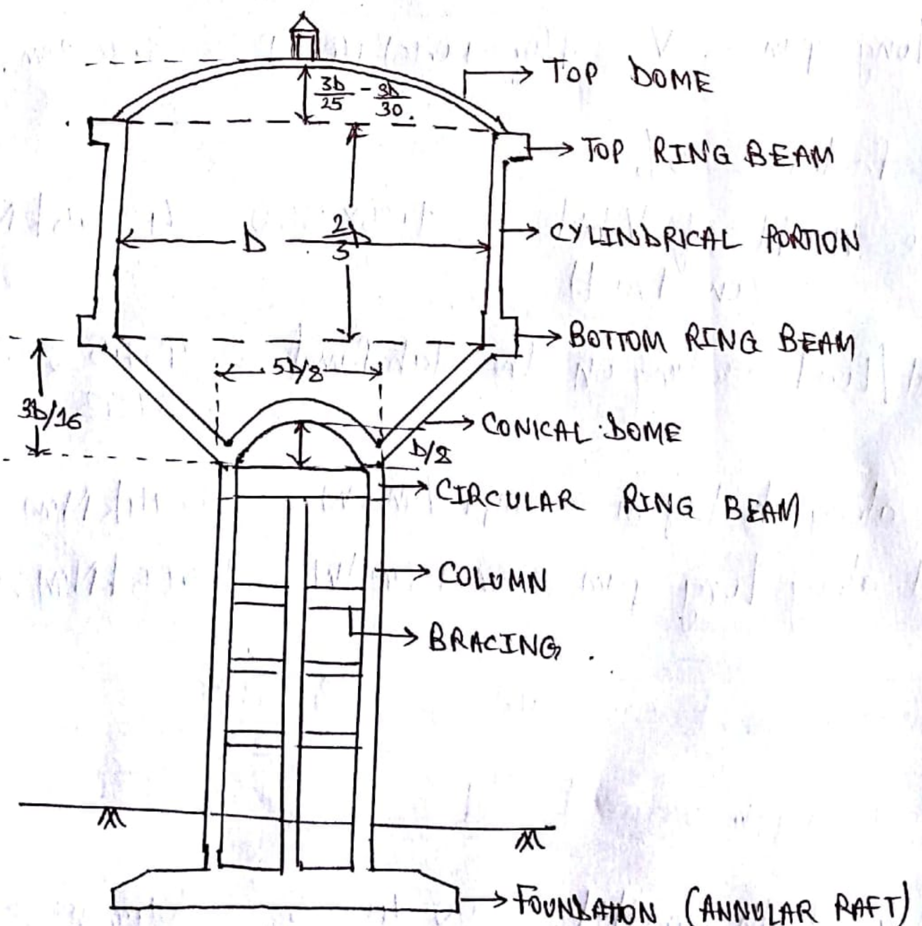
(II) → $0.37\sqrt{f_{ck}}$ (c)

(III) → Circular section (c)

(IV) → It fails suddenly (c)

(V) → 0.64% (a).

Q2)



NOTE: STUDENTS MUST BRIEFLY DISCUSS THE VARIOUS STRUCTURAL MEMBERS.

Scanned by CamScanner

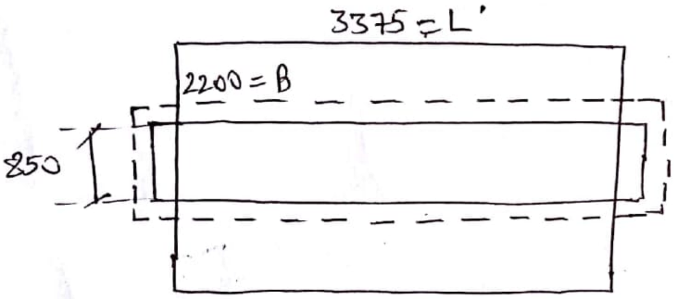
Q3) Clear distance b/w Longitudinal Girders = 2500−300 = 2200 mm.

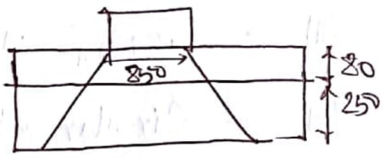
Clear distance b/w cross Girders = 3625 − 250 = 3375 mm

Deck Slab thickness = 250 mm

Wearing Course thickness = 80 mm.

M25, Fe415, $m_1 = 0.0775$, $m_2 = 0.0268$





Effective Width of Dispersion =

Along short span = $u = \sqrt{(850+2\times 80)^2 + (250)^2} = 1.040\,m$

Along Long span = $V = \sqrt{(3.6+0.16)^2 + (0.25)^2} = 3.768\,m.$

1 Mark

Impact factor = 25%

Effective Weight of Vehicle (one track) = 1.25 × 350 = 437.5 kN.

Weight/Load acting on the slab Panel = $\frac{437.5}{3768} \times 3375 = 391.86\,kN$

Moment along short span = $(m_1 + \nu m_2)W = 31.94\,kNm$ (M_1)

Moment along Long span = $(m_2 + \nu m_1)W = 15.05\,kNm$ (M_2).

Maximum moment = 31.94 kNm ≈ 32 kNm

1 Mark

Effective depth required = $d = \sqrt{\left(\frac{M}{Qb}\right)} = 170.56\,mm.$

Effective depth provided = 250 − 40 − 6 = 204 mm > $d_{required}$

Hence OK

$\sigma_{cb} = 8.3 MPa$

$\sigma_{st} = 200 MPa$; $j = 0.9$, $d = 204$.

Area of Main Reinforcement $= \frac{32 \times 10^6 \times 1}{200 \times 0.9 \times 204} = 871.45$

$(\sigma_{st} A_{st_1} j d = M_1)$ $\simeq 872 \, mm^2/m$.

Adopt 12mm ϕ bars.

spacing $= \frac{113}{872} \times 1000 = 130$ mm c/c.

Area of Secondary Reinforcement (in Longitudinal Direction)

$\sigma_{st} A_{st_2} j d_2 = M_2$

$\Rightarrow A_{st_2} = \frac{M_2}{\sigma_{st} j d_2} = ?$

* $\rightarrow$ d_2 = effective depth in other direction.

As. secondary Reinforcement will be placed above main reinforcement therefore its ~~area will d~~ d_{eff} will reduce

$d_2 = 204 - 6 - 6 = 192$

$A_{st_2} = \frac{15.05 \times 10^6}{200 \times 0.9 \times 192} = 435.47 \, mm^2/m$.

Adopt ϕ 12mm bars @ 250c/c.

1.5 mark
- Main Reinforcement (in Transverse dir) = ϕ 12mm @ 130c/c giving 872mm²/m
- Secondary Reinforcement (in longitudinal) = ϕ 12mm @ 250c/c.

for detailing → 1.5 marks

OR

In this part the Marks will be awarded on the following criterion.

(a) ~~Define~~ the one way & two ~~action~~ way action of slabs. on bridges

(b). the effect of concentrated load & ~~if~~ necessary calculations for one-way & two-way slab action

(c) ~~fo~~ Effective width of dispersion of the wheel load formula.

(d) for two-way slabs., step by step method to compute moments using M. Pigeaud's curve should be discussed.

Q4) Volume = 600×10^3 l. $= 600 m^3$.

Effective height $= 5 - 0.2 = 4.8 m = H'$

$\sigma_{ct} = 1.3 MPa$.

$\sigma_{st} = 130 MPa$.

Equating the Volume.

$$\frac{\pi D^2}{4} \times H' = 600 \Rightarrow D = 12.6 m$$

Assume $D = 13m$.

Since the tank has a flexible base therefore it will be only subjected to direct tension ~~with~~ which will cause hoop stress.

Tension at the base

$$T = \left(\frac{\gamma_w H D}{2}\right) = \frac{9.81 \times 4.8 \times 13}{2} = 306.1 kN.$$

1.5 Marks.

Area of steel required

$$A_{st} = \left(\frac{T}{\sigma_{st}}\right) = 2354.6 mm^2/m.$$

Approx. Wall thickness $= (30H + 50) = 200 mm$

Take Wall thickness as = ~~240 mm~~ . 240 mm.

Provide ϕ 18mm bars @ 105c/c.

Maximum spacing Min $\begin{cases} 240m. \\ 300 mm \end{cases}$

$S_{Adopted} < S_{max}$ Hence **OK**

Actual Steel provided @ spacing 105 mm.

$$(A_{st})_{Actual} = \left(\frac{254}{105} \times 1000\right) = 2419 \, mm^2/m$$

Check for tensile stress

** Must be done.

$$\sigma_{ct} = \left(\frac{T}{1000t + (m-1)A_{st}}\right) = \left(\frac{306.1 \times 10^3}{1000 \times 240 + 10 \times 2419}\right) = 1.15 \, MPa$$

$$< (\sigma_{ct})_{permissible}$$

Hence OK

∵ thickness of Wall > 200 mm therefore provide ~~Two layers of Reinforcement~~, Reinforcement on both face.

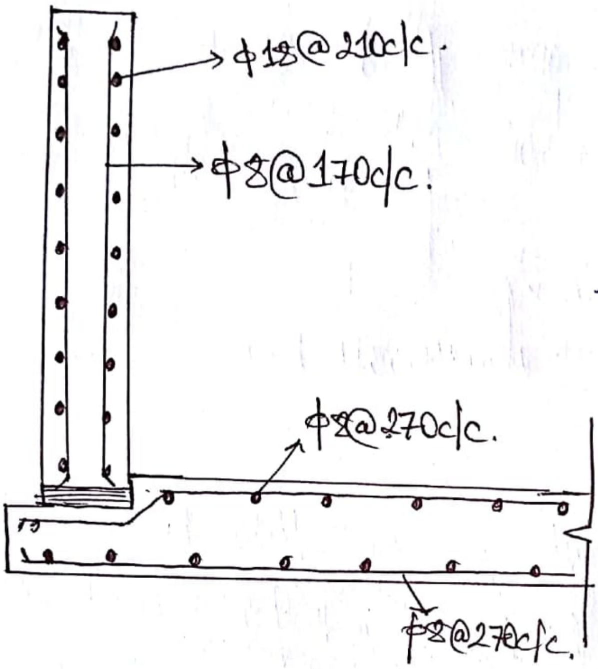
Minimum steel required $= \left(\frac{0.24 \times 240 \times 1000}{100}\right) = 576 \, mm^2/m$.

∴ final

Horizontal Reinforcement $= 2419 \, mm^2/m$, $\phi 18mm$ distributed on both face.

Vertical Reinforcement $= 576 \, mm^2/m$ distributed on both faces.

∵ the tank is resting on ground, provide nominal thickness of 150 mm for base slab & give minimum Reinforcement.



→ 1.5 Marks.

NOTE: for doing necessary curtailment, marks shall be awarded.

Bunker	Silo
1. It is a shallow structure	1. It is a tall structure
2. The plane of rupture of the stored material meets the surface of the stored material before meeting the opposite side of the structure	2. The plane of rupture meet the opposite face.
3. In this whole weight act on the floor of the structure. because no friction between wall and material.	3. Entire wt. of material stored will not act on the floor of the structure. A considerable part of this load is resisted by friction b/w the material stored and the wall
4. In this $h \le b\tan\left(\frac{90+\phi}{2}\right)$	4. In this $h > b\tan\left(\frac{90+\phi}{2}\right)$
5. In this usually large size material like coal, coke etc are kept	5. In this usually fine grained material like wheat, cement etc are kept.