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SECTION A

SUBJECT PRCD-2

DATE 28/10/2020

TEACHER Sir- FAWAD

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No#01

@ Principale of & Advantages of Pre-Stressing?

→ Pre-Stressing results In the overall Improvement In Performance Of Structural Concrete used For Ordinary loads & Spans.

→ Pre Stressing Extends the range of application For beyond the limits For ordinary reinforced Concrete, leading not only the much longer spans with economical member

Cross sections than previously thought possible but permitting innovative new structural forms to be employed.

(B) Method of pre-stressing?

Pre-Tension Method.

In this method prestressing is induced the tendons are tensioned) before the concrete is placed. It is done in factories.

In this method, the tendons are

(1) pre-tensioned.

(2) post-tensioned.

member are
cast along the [illegible]

#1/3

① Pre-Tensioning:- In present practice anchorage & Jacking abutments may be as much as 800 ft apart.

- Cable depressions are often used with long-Line prestressing Just as with Individual members.

- The strands are tensioned over the full length of the casting bed at one time after which a number Individual member are cast along the stressed tension.

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Post-Tension: with the tendon anchored by special fittings at the far end of the member. it is streched & then anchored at the jacking end by similar fittings. & the jack removed.

The tension is gauged by measuring both the jacking pressure & the elongation of the steel.

The tendons are Normaly tensioned one at a time although each tendon may consist of many standard or wires.

a bridge. structures

Part#C

BRIDGE

(1) A bridge is a passage of Transportation (for People or Vehicles) over a large body of water or obstruction.

(2) Bridge are Constructed at a height more than 20 feet.

(3) A bridge spans from (6 meters (minor bridge) to more than 120 meters

(4) Piers & abutments are the supporting structures of a bridge.

CULVERT

(1) A Culvert is generally a tunnel like structure that allows water to pass under a roadway or railway.

(2) Culverts are built at less than 20 feet high over the obstruction.

(3) The length of Culverts is typically not more than 6 meters.

(4) Culverts are usually embedded in the soil which bears the major portion of the Culvert load.

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Dᵒ7 Loads for Bridge Designation

→ Two Categories:

(a) → **permanent Loads**

→ self weight of girders & deck, wearing surface, curbs & parapets & railings, utilities & luminaries & pressure from earth retainments.

Two Important dead loads

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- DC: Dead load of structural components & non structural attachments.

- DW: Dead load of wearing surface.

Exmp. P. L:-

- Material properties for pavement.

- $\gamma_{Bitumen} = 140 lb/ft$
- $\gamma_{Bitumen} = 150 lb/ft$

Load factor pavement D.L:-

⇒ The maximum load factor for DC = 1.25 & DW = 1.5

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TRANSIENT LOADS

Perm.
D

- Gravity (live) loads due to vehicular, railway & pedestrian Traffic

- The Automobile is one of the most Common vehicular ~~like~~ loads on most bridges; it is the force That Causes the Critical loads effects.

- Lateral loads due to water, wind, earthquake, & Ship Collisions of

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TRANSIENT LOADS

Effect Caused by following live load are also very Important & must be Considered In the Design of a bridge.

- Impact
- Braking
- Centrifugal forces
- The Effect of other Forces Simultaneously present.

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Particle	(S.M.R.F)	(O.M.R.F)
	It is a moment-resisting frame specially detailed to provide ductile behaviour & comply with the requirements given in IS-13920.	It is a moment resisting not meeting special detailing requirements for ductile behaviour.
	Used under moderate-high earthquakes.	Used in low earthquakes.
	Low Design base shear,	high design base shear.
	It is safe to Design a Structure with ductile detailing	It is not safe to Design a Structure without ductile detailing.

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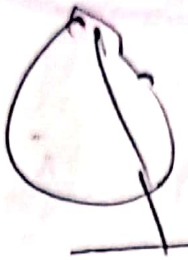


#02

SOLUTION

Step #01: (SIZES)

- Span length bridge $(S) = 35\,ft$ c/c
- Clear roadway width $(W) = 44\,ft$ (curb to curb)
- For a curb width of 15 inches total width of the bridge $(W_1) =$

$44 + (2 \times 15/12)$

$= 46.5\,ft$

#2/02

Minimum Thickness of bridge slab by formula.

$$h_{min} = 1.2(S+10)/30$$

$$= 1.2(35+10)/30$$

$$= 1.8 \text{ ft}$$

$$= 21.6''$$

$$= 22''$$

Solution:-

Example # Step # 02

Slab load (W_{DC}) = $h \gamma_{conc}$

$$= (22/12) \times 0.15$$

$$= 0.275 \text{ ksf}$$

#2/03

- Wearing surface (W_{DW}) = 1" wearing surface.

$= (3/12) \times 0.14$

$= \boxed{0.035 \text{ ksf}}$

Step #03 (ANALYSIS)

- Dead load moments:

Slab moments (M_{DC}) = $W_{DC} S^2/8$

$= 0.075 \times (35^2)/8$

$= 42$ ft-kip/ft

#09/004

- Wearing Surface Moment (M)

$(M_{DW}) = W_{DW} S^2/8$

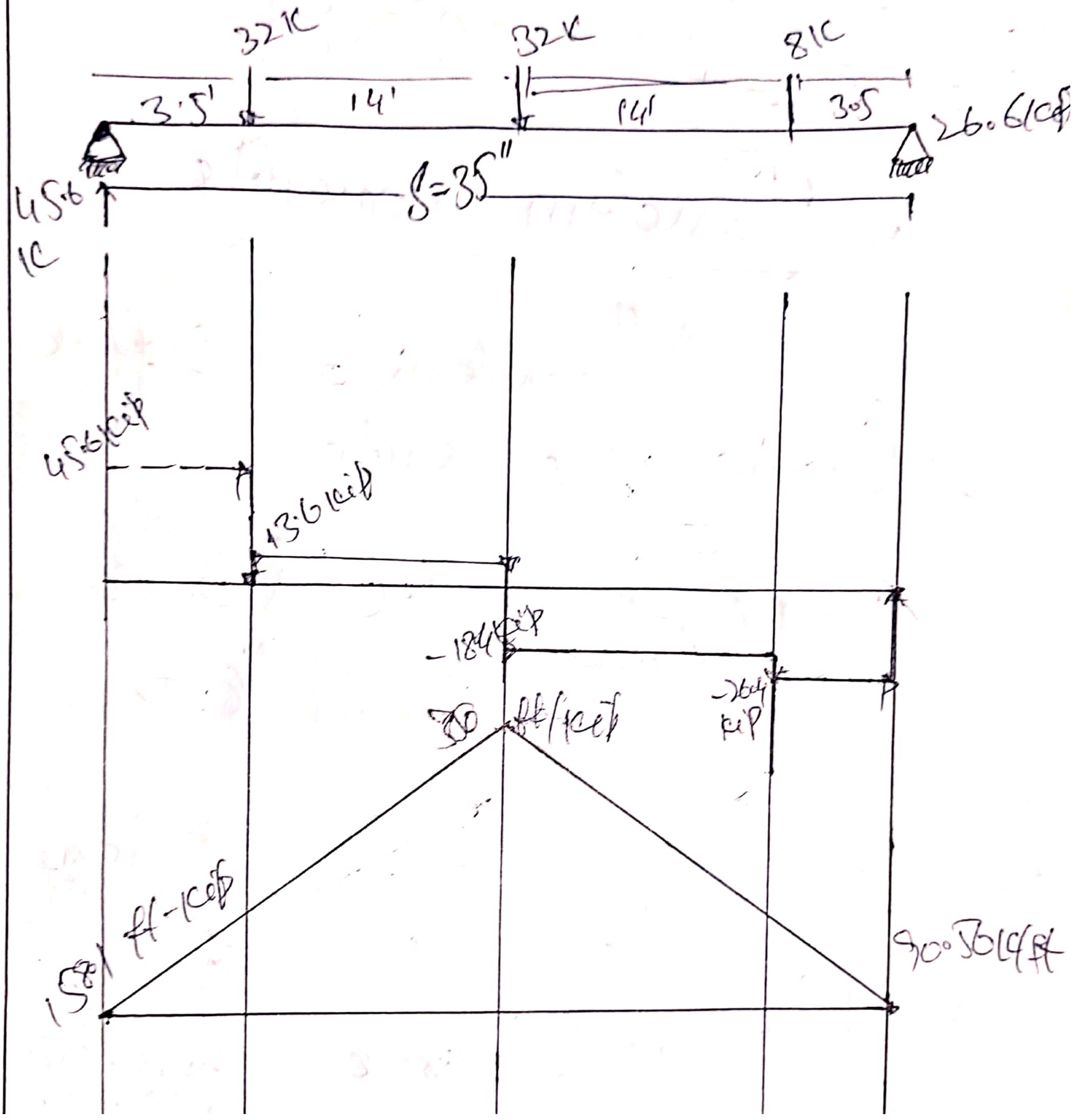
$= 0.035 \times 35^2/8$

$= 5.3$ ft- kip/ft.

Step #3 Live load moment:

$M_{max} = 350$ ft/kip

-02/05



32K
32K
8K
3.5'
14'
14'
3.5
26.6Kip
45.6
K
S=35"
45.6Kip
13.6Kip
-18.4Kip
-26.4
Kip
300 ft/kip
158 ft-kip
90.3Kip/ft

#02/06

Sol # **Live Load .M**

✓ **Tandem moments**

$M_{Tandem} = 372$ ft/kip

✓ **Lane moments**

$M_{lane} = 0.64 \times 85^2/8$
$= 98$ ft/kip

Live Load Moments:-

✓ $M_{tandem} > M_{truck}$ Therefore we will use M_{tandem}.

✓ M_{LL+IM} (Including Impact) =
$= 1.33 M_{tandem} + M_{lane}$

✓ $1.33 \times 372 + 98$
$= 593$ kip/ft.

To Convert M_{LL+IM} to moment/ft

Double M_{LL+IM} by "E"

Design lane width.

Design Lane width (E)

For Single lane loaded:

E (inches) = 10.0 + 5.0 $\sqrt{L_1 W_1}$

L_1 (Modified Span length = minimum of (S = 35 ft) & 60 ft = 35 ft.

W_1 = Modified edge to edge width = minimum of (W_1 = 46.5 ft) or 30 ft = 30 ft.

[redacted]

#02/08

Therefore, $E = 10.00 + 5.0\sqrt{(85 \times 30.00)}$

(P) = 1729 m

= 14.3 ft

For Multilane loaded

- $E\ (\text{inches}) = 84 + 1.44\sqrt{(L_1 W_1)} \leq$ W_1/N_L
- $L_1 = 35$ ft

W_1 = minimum of ($w_1 = 46.5$ ft or 60 ft)

N_L = No of Design Lanes.

$INT(w/12) = INT(44/12) = 3$

$E = 84 + 1.44\sqrt{(35 \times 46.5)} \leq 46.5/3$

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$= 142$ Inches or 11.84 ft

15.5

∴ Therefore, E, 11.84 ft (least of all)

Moment (per foot)

M_{LL+IM} per foot $= 593/11.84$

$= 50$ ft/kip

Now

$M_{12} = 1.05\,[1.25 M_{DC} + 1.5 M_{DW} + 1.75\, M_{LL+IM}$ (per foot)$]$

$M_{12} = 1.05\,(1.25 \times 42 + 1.5 \times 5.83 + 1.75 \times 50)$

$M_{12} = 1.553$ ft-kip/feet $= 18636$ in-kip/ft

Step#04 Design

@ Moment (M_a) = 155.3 ft-kip/ft
= 1863.6 in-kip/ft

- Effective depth of bridge slab (d) = h - Cover - $\frac{1}{2}$ x Dia of bar used.

- Using #8 bar effective depth as bottom cover for slab is taken to 1".

- $d = 22 - 1 - \frac{1}{2} \times 1 = 20.5$ inch

- $A_{min} = 0.0018 \times 12 \times 22 = 0.47 \, in^2$

- $A_s = M_u / \{\Phi f_y (d - a/2)\}$

- ~~After~~ trials, $A_s = 1.80 \, in^2$, (#8 @ 4 inches c/c)

Q4:- (b) Distribution of reinforcement

Bottom Transverse reinforcement

Maximum Spacing for Temp Steel Reinforcement in one way Slab according to ACI: 7.7.6.2 is minimum of

- 5h = 5x22 = 110

- 18"

Therefor #05@ 89 inches c/c is OK.

#04 (c) Shrinkage & Temp Reinforcement is top face of (Slab Long & Transverse) both for grade 60 Steel.

$A_{st} = 0.0018 A_g = 0.0018 \times 12 \times 12 \times 22$

$= 0.47 \, in^2$ (#5 @ 8 inches c/c)

— Finally use #05 @ 8 inches c/c

#Final Recomendation 87

✓ Main Steel (bottom) = #8 @ 4" c/c

✓ Transverse bottom reinforcement = #5 @ 8" c/c throughout.

✓ Top Steel (Long & Transverse) = #5 @ 8" c/c.