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SECTION = A

SUBJECT # PRCD-II

DATE # 24/08/2020

TEACHER = Engr. Sir Fawad.

A1

A/1

Q#(01)

→ PART (A) :- What do you understand by the terms Capacity & Demand on Structures?

Answer → DEMAND

✓ Demand on a structure refers to all External Actions.

✓ Gravity, wind, Earthquake, Snow are ~~External~~ actions

✓ These actions when acts on the Structure In the form of stresses, such as Compression, Tension, bending, shear & Torsion.

The Internal stresses are also called load effects

* Capacity :- The ~~overal~~ overal ability of a structure to carry an imposed demand.

* Beam will the resist the applied load up to its capacity & will fail when demand Exceeds capacity.

part # @ End

9.1

B/1

* PART(B) Briefly Describe Design Methods:-

(01) * WORKING STRESS METHOD:-

① In the working stress or allowable stress Design Method the Material strength is knowingly taken less then the actual E.g:- Half of the actual to provide a factor of safety equal to (2.0).

(02) * STRENGTH DESIGN METHOD

① In the strength Design Method The increased load & the reduced

Strength of the Material are Considered but both based on scientific rationale. For Example, It is quite possible that during the life span of a Structure, dead & live loads Increase.

- The Factor of 1.2 & 1.6 used by ACI 318-14 Code requirement for Structural Concrete, American Concrete Institute Committee 318) as load amplification factors for dead load & live load respectively are based on probability best Research Studies.

Note:- we shall be following ACI-318-14 Throughout This Case

9.

B/3

✓ Similarly the Strength is not reduced arbitrarily but Considering the fact that variation is strength is possible due to imperfections age factor etc. Strength reduction factors are used for this purpose

✓ Factor of safety in Strength Design Method is thus the combined effect of increased load & reduced strength. Both modified based on a valid rationale.

Part #B
End

PART#C effect of Strength reduction Factor or Flexural Strength

Answer In the Design of Flexural Strength reduction Factor decreases from Tension-Controlled Sections to Compression-Controlled Sections to increase Safety with decreasing ductility.

Part#C End

Hi

2/1

Q #(02)

→ Data:→ slab & beam of
→ a 90' * 60' Hall

→ Height of hall = 15 ft.

→ Compressive Strength (f'_c) = 3ksi

→ Yield Strength (f_y) = 40 ksi

→ Mud layer = 2 inch

→ Tile above slab = 2 inch

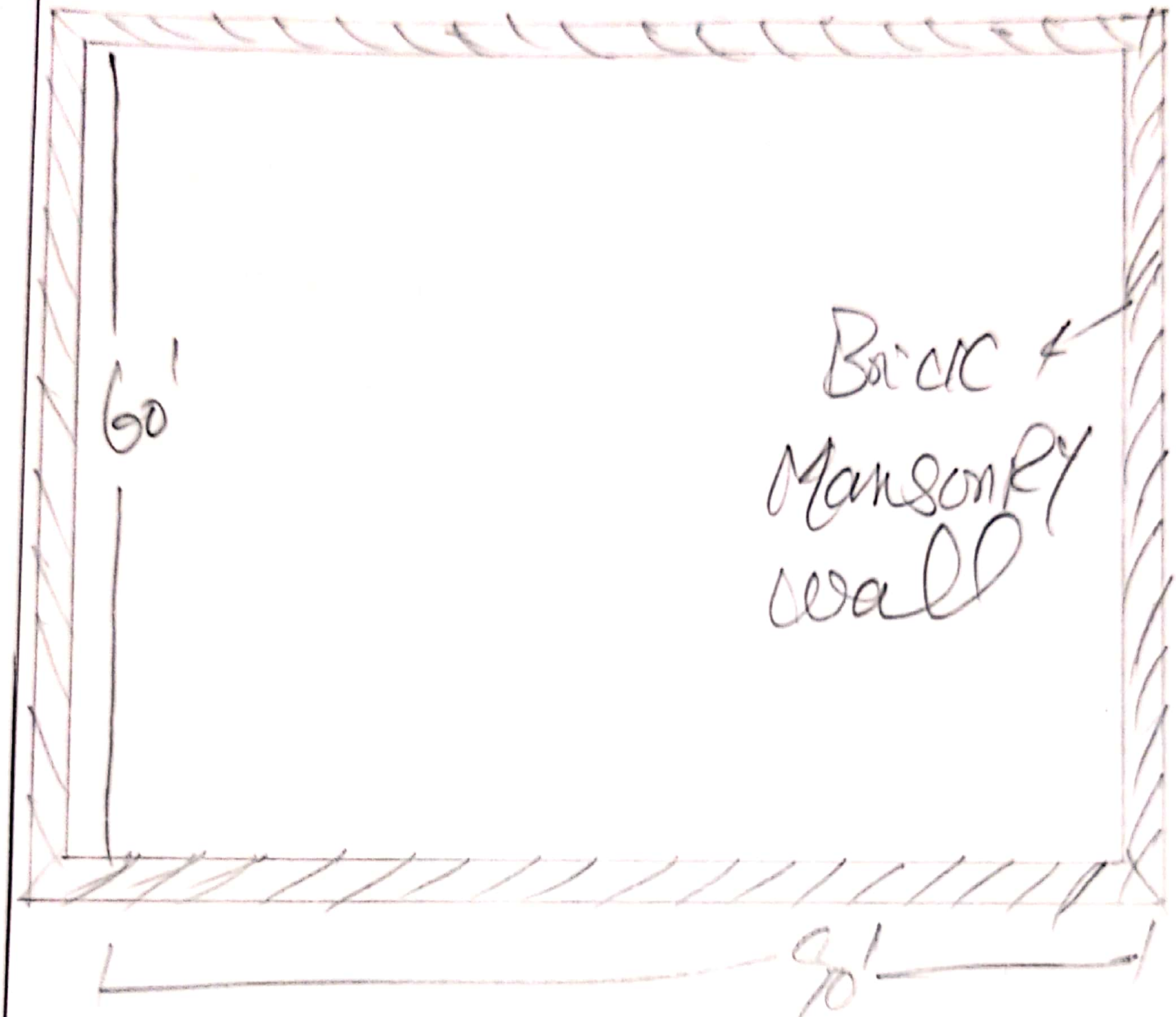
→ Take LL = 40 psf

→ As Design Coloum & Footing for the said problem at the end of each Structural Member Design.

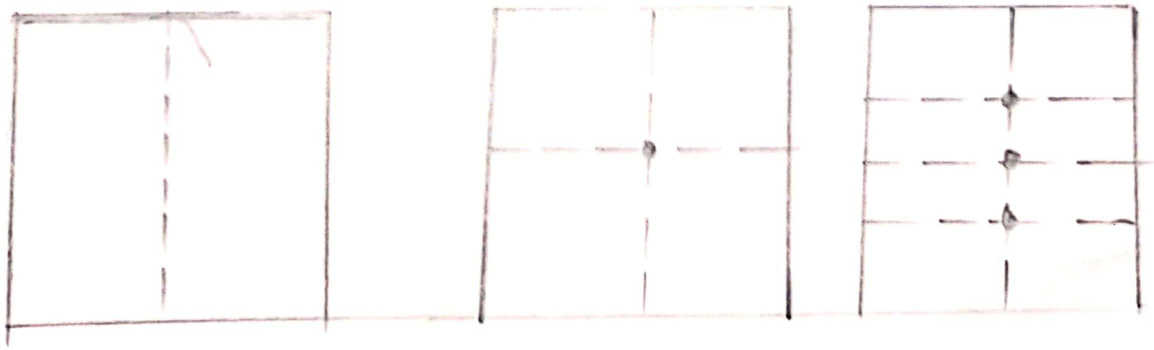
2/2

2/2

Draw a proper sketch.



STRUCTURAL CONFIGURATION



2/3

Assume St. Conf. Take Time to reach to a resonable arrangment of beams. Girders & Colomns it depend on Experience Several alternatives are possible.

→ Structural Configuration Selected for this problem:→ Note this is not the only option or the best option. just selected to make a one-way slab design case.

(SLAB DESIGN)

Step #01 Table
↳

	Minimum Thickness, h			
	Simply supported	one end continuous	Both End continuous	Cantilever
Member	Members Not supporting attach to partitions or other Construction likely demaged by large deflection.			
Slide one way Slabs	l/20	l/24	l/28	l/10
Beams or ribbed one way Slabs	l/16	l/18.5	l/21	l/8

2/5

- $h = l/24 \times (0.4 + fy/100000) = 3.8''$
- $h = l/28 \times (0.4 + fy/100000) = 3''.4$
- Take $(h) = 6''$

* (Minimum by ACI for end. Span)
  $[l = l_n = 9.05']$
* (Minimum by ACI for Interior Span)
  $[l = l_n = 9.8' \; 05']$

=> Effective Depth $(d) = h - 0.75 - (3/8)/2 = 5''$ for #3 main Bars.

($l = l_n$; for integral supports such as beams & columns with $l_n \leq 10'$.)

Steps #02 (LOADS)

=>

TABLES: DEAD LOADS

MATERIAL	THICKNESS (IN)	γ (KCF)	LOAD = THICKNESS × γ (KSF)
SLAB	6 in	0.15	6/12 × 0.15 = 0.075
MUD	2	0.08	2/12 × 0.08 = 0.013
TILE	2	0.12	2/12 × 0.12 = 0.02
	~~TOTAL~~	TOTAL	0.108 KSF

Factored load (w_u) = 1.2 D.L + 1.6 L = 1.2

1.2 × 0.108 + 1.6 × 0.04

0.1296 + 0.064

⇒ **0.1936 KSF**

⇒ Slab Designing

Step #03 Analysis

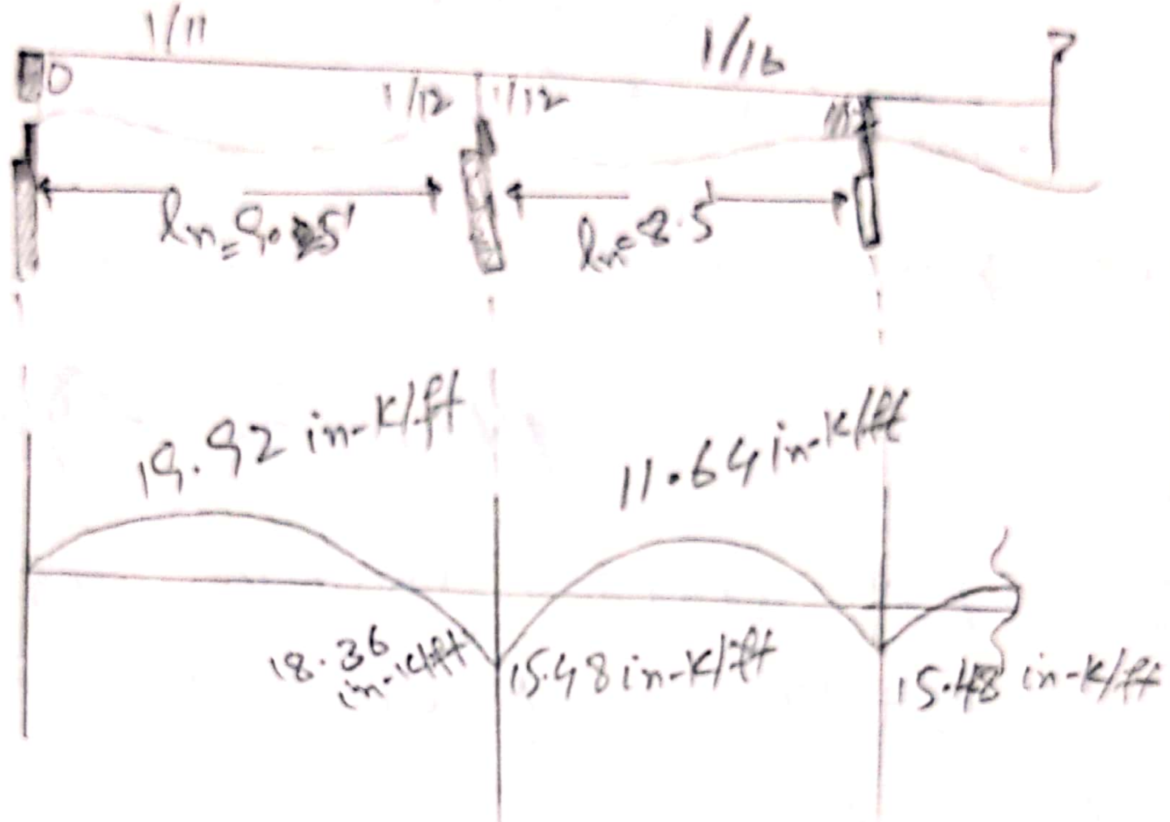
Bending Movement Diagrams ⇒

Assume beam width = 18"

Clear length's area shown in the figure:

⇒ 27

$M = \text{coefficient} \times w_u \times l_n^2$



S.D: Step #04. Calculate moment capacity provided minimum reinforcement in Slab:-

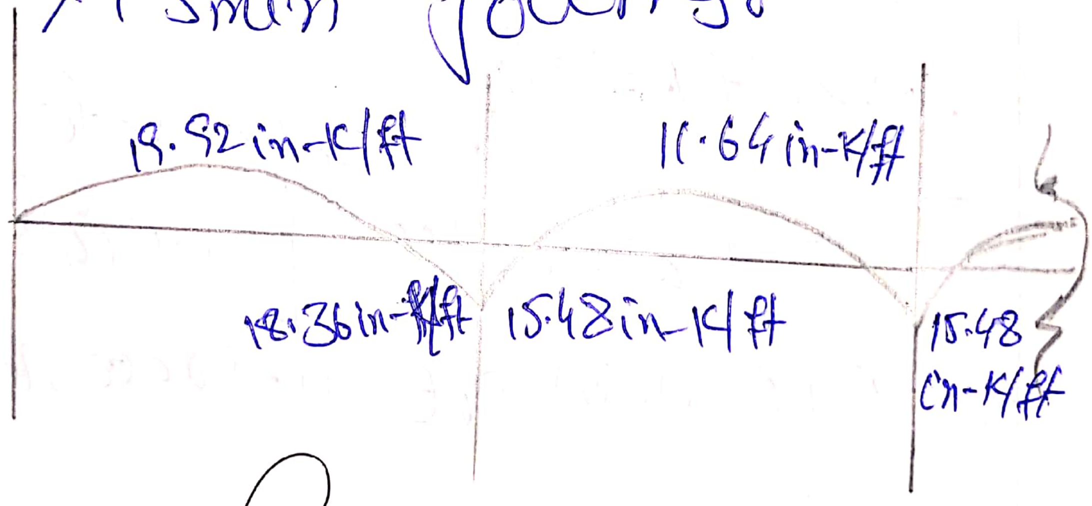
✓ $A_{s\,min} = 0.002bh_f = 0.002 \times 12 \times 6 = 0.144\ in^2/ft$

✓ $\phi M_n = \phi A_{s\,min} f_y (d - a/2) = 0.9 \times 0.144 \times (5 - 0.188/2) = 25.4\ in\text{-}k/ft$

- ϕM_n Calculated from As_{min} is > all moments Calculated in Step No #03
- There fore $As = As_{min}$

$$= 0.144\ in^2/ft\ (\#3\ @\ 9.166''\ c/c)$$

- This will work for both positive & Negative steel as As_{min} governs.



MAIN Reinforcement S.D.

maximum spacing for main steel reinforcement in one way slab according to ACI

7.6.5 is minimum eq.

✓ $3h_f = 3 \times 6 = 18''$

$= 18''$

✓ Finaly use, #3@9" c/c

Shrinkage Steel S.D :-

✓ $A_{st} = 0.002bh_f$ $A_{st} = 0.002 \times 12 \times 6$

$= 0.144 in^2/ft$

✓ Shrinkage reinforcement is same as main reinforcement because

✓ $A_{st} = A_{smin} = 0.144 in^2$

✓ Maximum Spacing for Temp Steel reinforcement in one way slab according to ACI 7.12.2.2

is minimum of

- 5h$_f$ = 5x6 = 30" OR 18"
- Therefore 9" spacing is O.K.

Step #05 S.D & Drafting

- (main reinforcement = #3@9" c/c (Positive & negative)
- Shrinkage reinforcement = #3@9" c/c
- Supporting bars = #3@18" c/c

The END

SLAB DESIGN

Beam Design:-

S#01:- Sizes:-

- Minimum Thickness $h_{min} = l/16$
- l = clear span (l_n) + Depth of (Beam) ≤ c/c Distance B/w Supports.
- Let Depth = 5'

l_n + depth of beam = 60' + 5' = 65'

c/c distance B/w Beam Supports = 60 + 2 × (9/12) = 61.5'

- Therefore $l = 61.5'$

Depth (h) = (61.5/16) × (0.4 + fy/100000) × 12 = 36.9" (minimum by ACI (9.5.2.1))

- Take $h = 5' = 60"$

$d = h - 3 = 57"$

2/12

Step #02 **LOADS** – Load on beam will be equal to

– Factored load on beam from slab + Factored self weight of beam & slab

– Factored load on slab = 0.214 ksf

– load on beam from slab =

$= 0.214 \text{ ksf} \times 10 = 2.14 \text{ K/ft}$

– Factored self load of beam & slab =

– $= 1.2 \times (54 \times 18/144) \times 0.15 = 1.215$ K/ft

– Total load on beam $= 2.14 + 1.215$

$\Rightarrow$ **3.355 K/ft**

Step#03 B.D

Analysis

✓ $V_u = 84.71$ Kip

✓ $M_u = 19034$ in-Kip

Step#04 Design for Flexure B.D

(Step a) According to ACI 8,12,beff To T-beam is minimum of.

✓ $16h_f + b_w = 16 \times 6 + 18 = 114''$

✓ (C/C Span of beam)/4 = (61.5/4) x12 ⇒ 184.5''

✓ (C/C Spacing B/w beams = 10' x 12 = 120''

So $b_{eff} = 114''$

Other Checks

Check 97 " $\phi V_s \leq \phi 4\sqrt{f'_c}\, b_w d$ " (ACI 11.4.5.3)

97 " $\phi V_s \leq \phi 4\sqrt{f'_c}\, b_w d$ " the maximum spacing (S_{max}) is O.K. Otherwise reduce spacing by one half

$\phi 4\sqrt{f'_c}\, b_w d = 0.75 \times 4 \times \sqrt{3000} \times 18 \times 57/1000$

$= 168.58K$

$\phi V_s = (\phi A_v f_y d)/S_d$

$= (0.75 \times 0.22 \times 40 \times 57)/8.5 = 39.6K$

$39.6K < 168.58K$, O.K.

The End of paper