Day: MTWTFS

Date: __/__/__

IQRA NATIONAL UNIVERSITY

Mid Term Paper / summer 2020

Plain And Reinforced Concrete Design – II

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Section = "A"

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Q#01

A. What do you understand by the terms capacity and Demand on structures?

Concept of capacity and Demand.

=> **Demand:**

- Demand on a structure refers to all external actions.
- Gravity, wind, earthquake, snow are external actions.
- These actions when act on the structure will induce internal disturbance(s) in the structure in the form of stresses (such as compression, tension, bending, shear and torsion).

The internal stresses are also called load effects.

=> **Capacity:**

- The overall ability of a structure to carry an imposed demand.

Beam will resist the applied load up to its capacity and will fail when demand exceeds capacity.

B Briefly describe design methods.

=> **Working Stress Method:**

- In the working stress or allowable stress design method, the material strength is knowingly taken less than the actual e.g. half of the actual to provide a factor of safety equal to 2.0

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⇒ Strength design Method:

- In the strength design method, the increased loads and 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 and live loads increase.

- The factors of 1.2 and 1.6 used by ACI 318-14 (Building code requirement for structural concrete.

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

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• Factor of safety is strength design method is thus the combined effect of increased load and reducted strength, both modified based on a valid rationale.

c. Write short note on the effect of strength reduction factor on flexural strength.

Ans:- In the design of flexural strength, the strength reduction factor decreases from tension-controlled sections to compression-controlled sections to increase safety with decreasing ductitity.

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Q#2

Design slab and beam - - -
- - - - - - - - - - - Proper sketch

Given data:

→ Slab and beam of a 90' * 60' hall

→ Height of hall = 15 ft

→ Compressive strength (f'c) = 3 ksi

→ Yield strength (fy) = 40 ksi

→ Mud layer = 2 inch

→ Tile above slab = 2 inch

→ Take LL = 40 psf

* As Design Column and footing for the said problem at the end of each structural member design.

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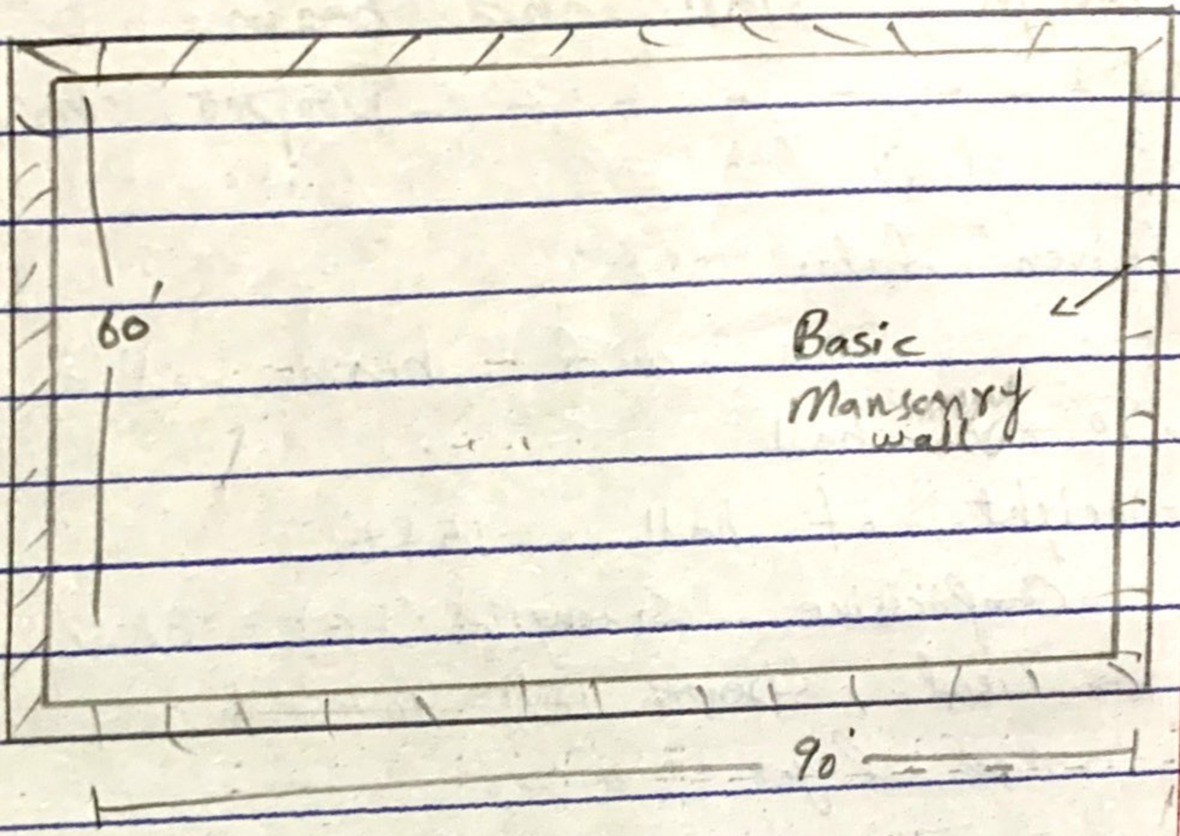
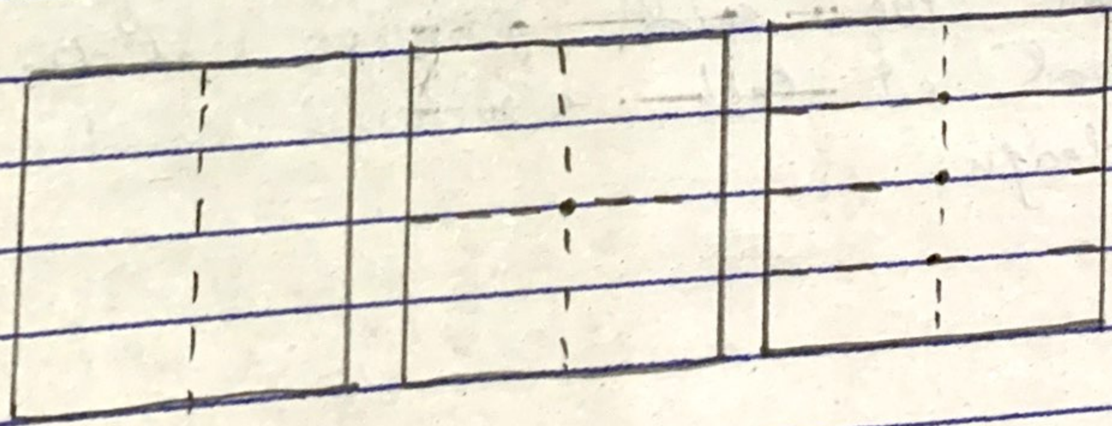


Structural Configuration



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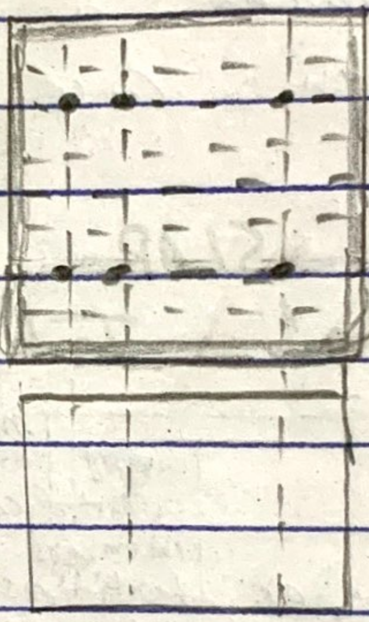
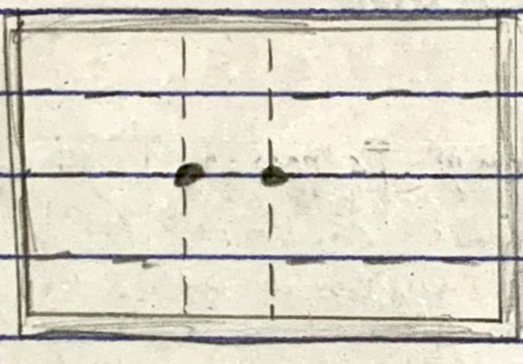
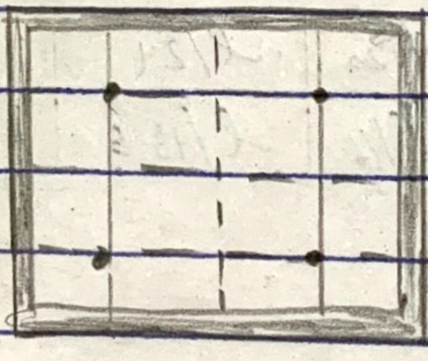
Assume St-Conf. Take Time to reach to a resonable arrangement of beams girders and columns it depend on Experience several alternatives are possible.



S.C:-





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Structural Configuration selected for this Problem.

Not 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 Tickness. h			
	Simply supported	one, end continous	Both end continous	Cantilever
Member	Members not supporting attach to partitions or other construction likely damaged 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

$h = l/24 \times (0.4 + fy/100000) = 3.8''$

$h = l/28 \times (0.4 + fy/100000) = 3''$

Take $(h) = 6''$

* (Minimum by ACI for end Span) [$l = l_n = 9.5'$]

* (Minimum by ACI for Interior Span) [$l = l_n = 9.5'$]

=> Effective Depth $(d) = hf - 0.75 - (3/8)/2 = 5''$

for # 3 main bar.

($l = l_n$; for Integral supports Such as beams and columns with $l_n \leq 10'$)

Step # 02

LOADS

Table : Dead LOADS			
MATERIAL	THICKNESS (IN)	γ (KCF)	Load (KSF)
SLAB	6 in	0.15	6/12 x 0.15 = 0.075
MUD	2	0.08	2/12 x 0.08 = 0.013
TILE	2	0.12	2/12 x 0.12 = 0.02
		Total	0.108 ksf

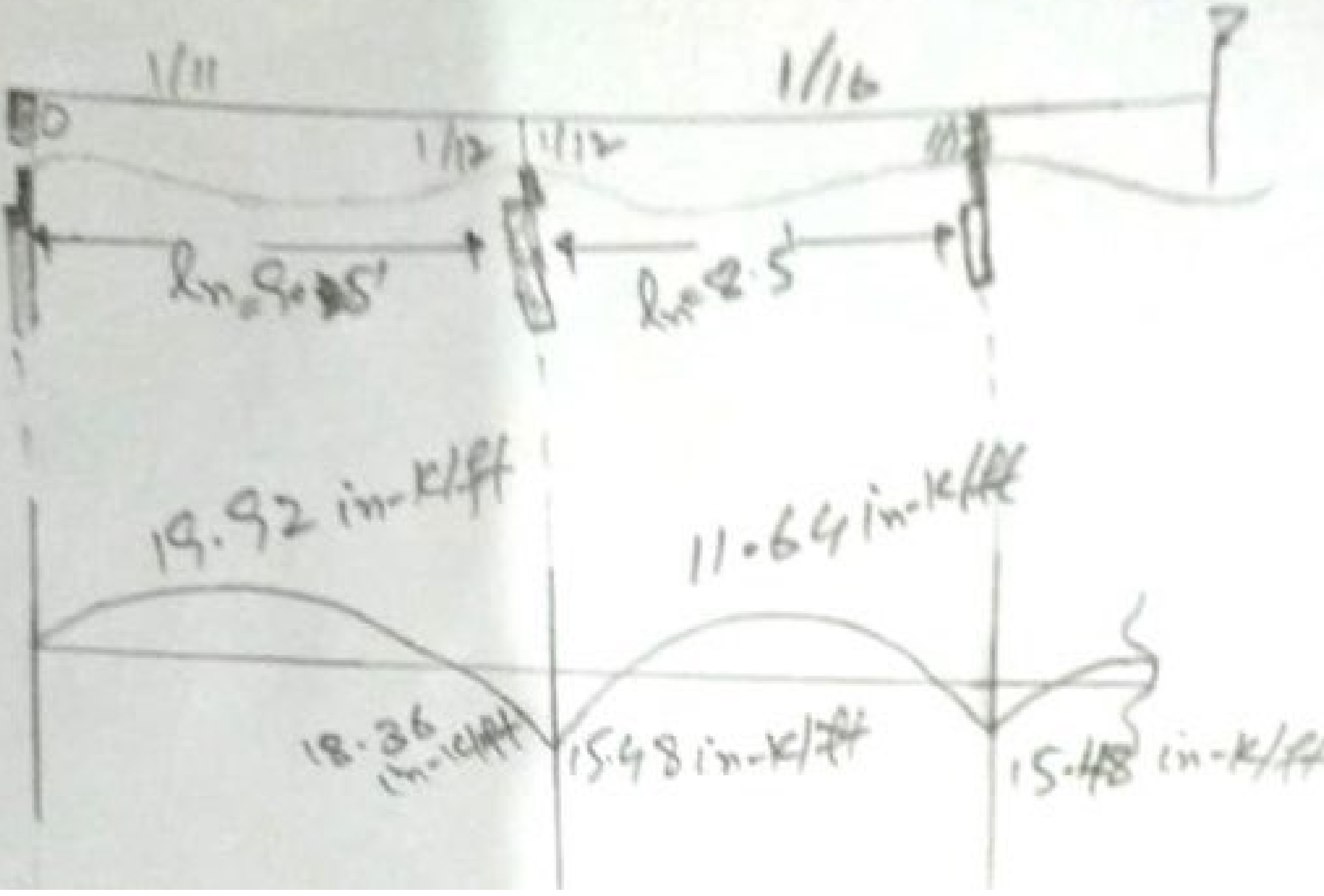
Factored load (w_u) = 1.2 D.L + 1.6 L=L

1.2 x 0.108 + 1.6 x 0.4

0.1296 + 0.064

=> **0.1936 ksf**

$M = coefficient \times w_u \times l_n^2$



S.D: Step #04:

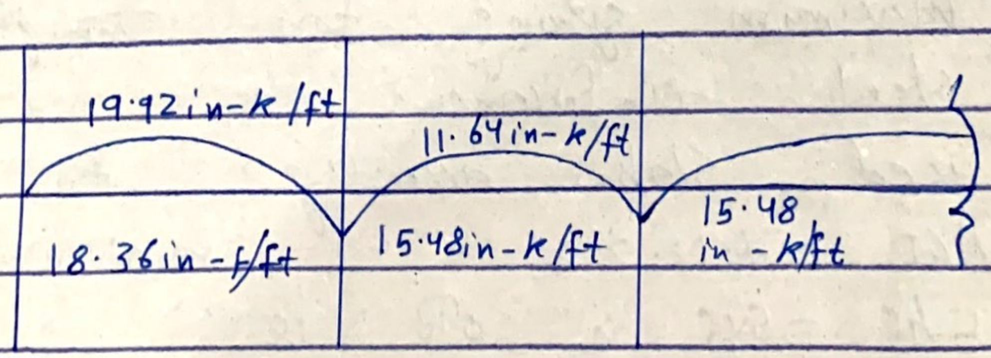
Calculate moment capacity provided minimum reinforcement in slab:

$$A_{s\,min} = 0.002bh$$

ϕM_n calculated from $A_{s\,min}$ is > all moments calculated in step No #3

Therefore $A_s = A_{s\,min}$
$= 0.144\ in^2/ft$ (#3) @ 9.166 c/c)

This will work for both positive & negative steel as $A_{s\,min}$ governing.



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MAIN Reinforcement S.D:-

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

7.6.5 is minimum 9.

$3h_f = 3 \times 6 = 18''$
$= 18''$

Finally use, #3 @ 9" c/c

Shrinkage steel S.D:-

$Ast = 0.002\, b h_f$ $Ast = 0.002 \times 12 \times 6$
$= 0.144\, in^2/ft$

Shrinkage reinforcement is same as main reinforcement because

$Ast = As_{min} = 0.144\, in^2$

maximum spacing for Temp steel reinforcement in one used slab according to ACI 7.12.2.2 is minimum of

$5h_f = 5 \times 6 = 30''$ OR $18''$

Therefore 9" spacing is OK

Checked By:

Step # 5 S.D: Drafting

- (main reinforcement # 3@9 c/c Positive
  neg(-)

- Shrinkage reinforcement = # 3@9"c/c

- Supporting bars = # 3@18"c/c

Slab Design the
END

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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 support = 60 + 18 (9/12) = 61.5'

✓ Therefore $l = 61.5'$

Depth (h) = (61.5) × (0.4 + fy (100000))

× 12 = 36.9" (minimum by ACI 9.5.2.2)

Step # 2 Loads:

Loads on beam will be equal to

- factored load on beam from slab factored self weight of beam slab.

- Load on beam from slab =

= 0.214 KSF × 10 = 2.41 k/ft

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- 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 3 B.D

Analysis:

$V_u = 84.71$ kip

$M_u = 19034$ in kip

Step 4 Design for B.D

According to ACI 8.12, —

To T-beam is minimum of