MCE

University of Asia Pacific
Department of Civil Engineering
Mid Term Examination Fall 2016
Program: [redacted]. Engineering (Civil)

MCE

Course Title: Soil Mechanics I | Course Code: CE 6401
Time: 1 hour | Full Marks: 30

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1. Estimate the ultimate bearing capacity of a square isolated footing (2m x 2m) in compacted sand (having $\varphi = 32°$) that overlies loose sand (having $\varphi = 22°$). 7
Depth of foundation = 1.5 m; The thickness of layer-1= 3 m.
Assume that the saturated unit weights of dense sand and loose sand are 18 kN/m^3 and 15 kN/m^3. The water table is at 1.5 m below the GL.

2. Determine the allowable bearing capacity of a strip footing in sand (having $\varphi = 32°$) that overlies soft clay (having c = 20 kPa). 7
Depth of foundation = 2 m; The thickness of layer-1= 3 m.
Assume that the saturated unit weights of sand and soft clay are 18 kN/m^3 and 19.2 kN/m^3. The water table is at 1.5 m below the GL.

3. According to the soil exploration report, the upper layer is found homogeneous and extends up to 3 m below the ground level. The ground water table is located at 1.5 m below GL. The data of the soil layers is as follows: 7

   Given data: $\gamma_{sat} = 17.2$ kN/m^3;

   Layer-1: $\varphi_1 = 20°$

   Layer-2: $\varphi_2 = 33°$

   (a) Estimate the allowable bearing capacity of a 2 m wide strip footing, placed at a depth 1.5 m below the ground level. Provide a factor of safety equal 2. Use Terzaghi's bearing capacity equation and apply Hanna's design charts for modified bearing capacity factors.

   (b) Recalculate the allowable bearing capacity of the same footing if the foundation is placed at a depth of 2.6 m.

   Compare between the allowable bearing capacities obtained in (a) and (b).

4. (i) The structural distress is observed for the first time in the 12th year after construction due to some problem related to foundation. Detect the possible cause(s) of the problem. How can these problems be identified before construction? 2
(ii) In a standard penetration test, the recorded blow counts were 2/2/1 for three consecutive 150 mm penetration. Assess the soil strength. It was possible to collect undisturb sample from the standard sampler. 3

   (iii) In a standard penetration test, borehole diameter = 120 mm; sampling method (Standard); $\gamma_{sat} = 17.5$ kN/m^3; rod length = 4 m. Water table is at the ground level. 4

(a) Determine the hammer efficiency, if the recorded blow counts are 3/6/5 for three consecutive 150 mm penetrations and $(N)_{60} = 9$.

(b) Determine the missing blow count 'X' if the recorded blow counts are 4/X/7 for three consecutive 150 mm penetrations. The hammer efficiency is 0.55 and $(N)_{60} = 17$.

(c) At a depth of 5 m, the recorded blow counts are 4/6/6 for three consecutive 150 mm penetrations. Calculate $(N_1)_{60}$. Apply the hammer efficiency determined in (a).

Additional Information:

$S_c = 1 + 0.2\,(B/L)$
$S_q = 1 + 0.2\,(B/L)$
$S_\gamma = 1 + 0.4\,(B/L)$

$d_c = 1 + 0.2\,(D_f/B)$
$d_q = d_\gamma = 1 + 0.1\,D_f \tan(45° + \varphi/2)$

ϕ	N_c	N_q	N_γ
17	12.34	4.77	1.66
18	13.10	5.26	2.00
19	13.93	5.80	2.40
20	14.83	6.40	2.87
21	15.82	7.07	3.42
22	16.88	7.82	4.07
23	18.05	8.66	4.82
24	19.32	9.60	5.72
25	20.72	10.66	6.77
26	22.25	11.85	8.00
27	23.94	13.20	9.46
28	25.80	14.72	11.19
29	27.86	16.44	13.24
30	30.14	18.40	15.67
31	32.67	20.63	18.56
32	35.49	23.18	22.02
33	38.64	26.09	26.17

Factor	Equipment Variables	Value
Borehole diameter factor, C_B	65–115 mm (2.5–4.5 in)	1.00
	150 mm (6 in)	1.05
	200 mm (8 in)	1.15
Sampling method factor, C_S	Standard sampler	1.00
	Sampler without liner (not recommended)	1.20
Rod length factor, C_R	3–4 m (10–13 ft)	0.75
	4–6 m (13–20 ft)	0.85
	6–10 m (20–30 ft)	0.95
	>10 m (>30 ft)	1.00

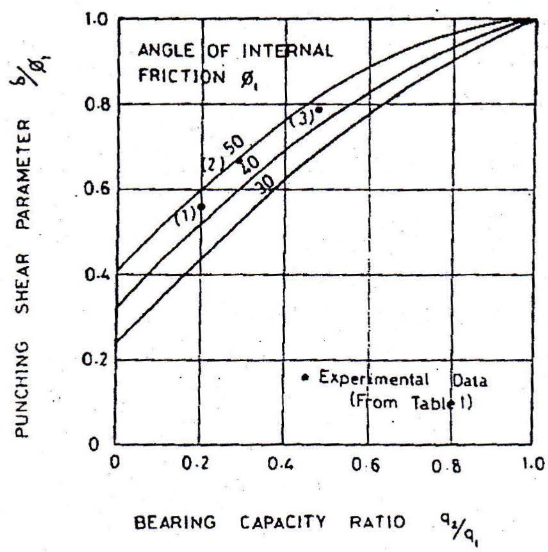


FIG. 3. Punching shear parameter.

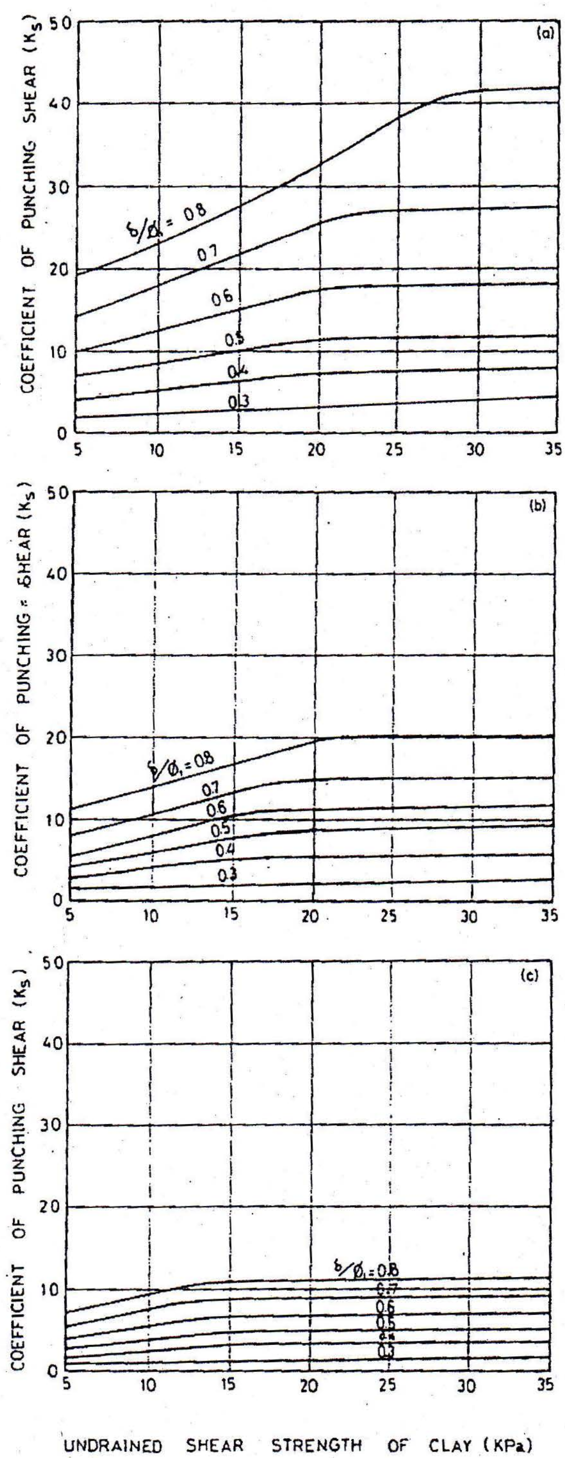
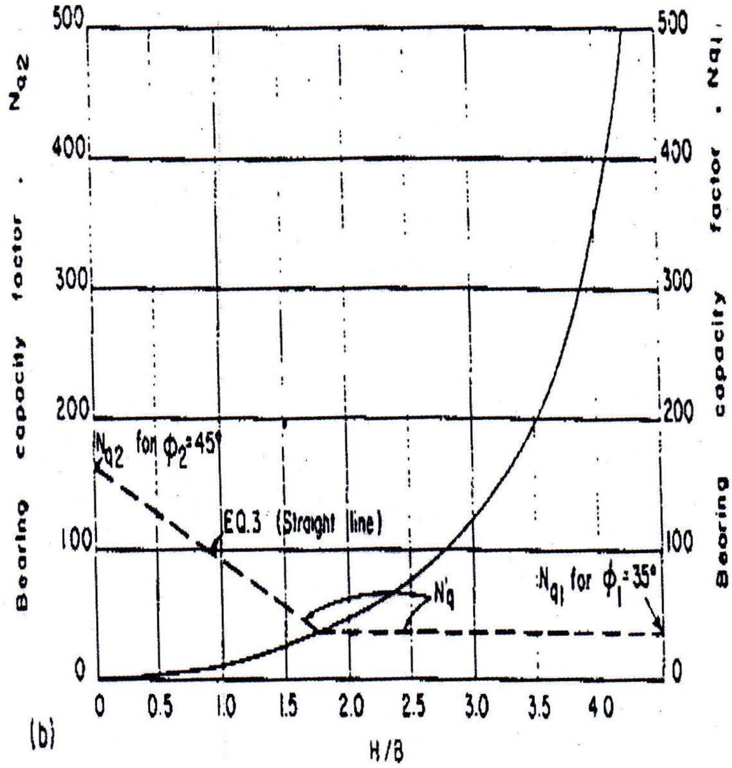
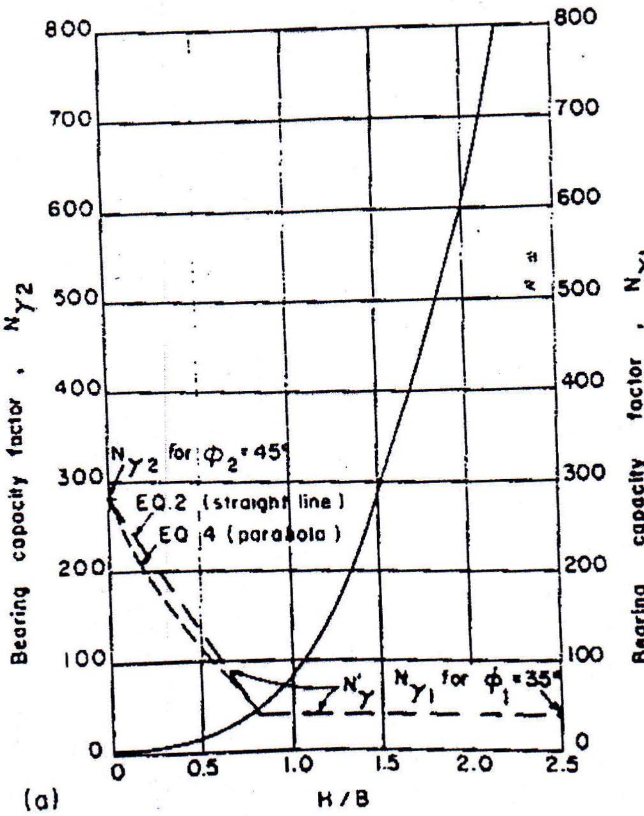


FIG. 4. Coefficients of punching shear: (*a*) $\phi_1 = 50°$; (*b*) $\phi_1 = 45°$; (*c*) $\phi_1 = 40°$.



Bearing capacity factor , N_{q2}
Bearing capacity factor , N_{q1}
N_{q2} for $\phi_2 = 45°$
EQ.3 (Straight line)
N'_q
N_{q1} for $\phi_1 = 35°$
H/B
(b)



Bearing capacity factor , $N_{\gamma 2}$
Bearing capacity factor , $N_{\gamma 1}$
$N_{\gamma 2}$ for $\phi_2 = 45°$
EQ.2 (straight line)
EQ 4 (parabola)
N'_{γ}
$N_{\gamma 1}$ for $\phi_1 = 35°$
H / B
(a)

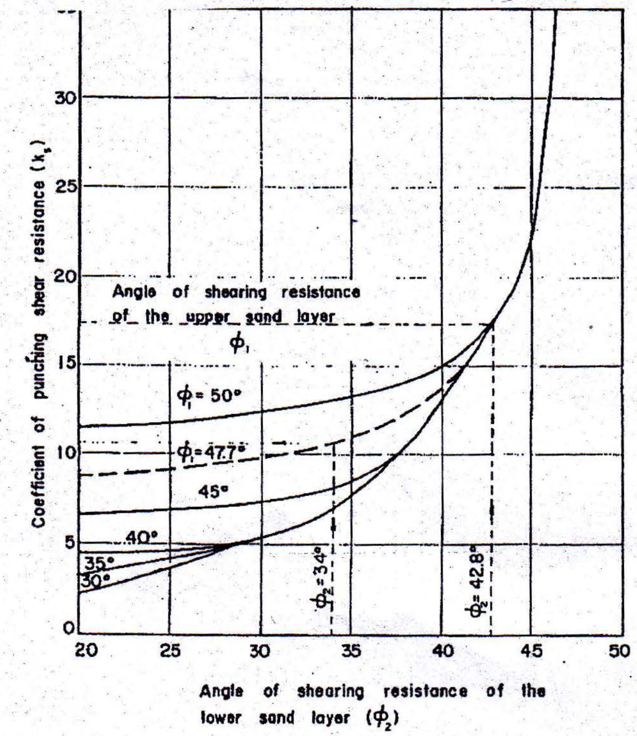


FIG. 8.—Design Chart for Determining Coefficient of Punching Shear Resistance, K_s

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Fall 2016
Program: MCE

Course No: CE 6301 | Course Title: Theory of Water Treatment
Full Marks: 60 | Time: 1.0 hour

There are **FOUR** questions. Answer any **THREE**.
[Assume reasonable value of missing data (if any)]

1. (a) Water pollution is all about quantity -- describe this statement. [05]
   (b) Derive Stokes' Law for Type I sedimentation. [15]

2. (a) What are the operational tests that should be performed during aeration process? [05]
   (b) Discuss with applications the different types of settling mechanisms of particles during sedimentation. [15]

3. (a) Mention the Camp's assumptions of an Ideal Sedimentation Basin. [05]
   (b) Discuss the aeration process of water treatment with its objectives. [15]

4. (a) Define adsorption, absorption, adsorbate, adsorbent. [10]
   (b) Mention the factors that affecting adsorption process in water treatment. [05]
   (c) Sleepy Hollow has an existing horizontal-flow sedimentation tank with an overflow rate of 20 $m^3/d*m^2$. What percentage removal should be expected for each of the following particle settling velocities in an ideal sedimentation tank: 0.1 mm/s, 0.2 mm/s, and 1 mm/s? [05]

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Fall 2016
Program: MCE

Course Title: Structural Design of Pavement | Course Code: CE 6505
Time: 1 Hour | Full Marks: 20

1. Answer any Five (5x2= 10)

A. Where do most critical stress, strain and deflection occur when the load is applied over a single circular loaded area of flexible pavement?

B. Write 2 assumptions for analysing flexible pavement based on Burmister Layered theory.

C. Name the factors upon which the stresses on two layer systems depend.

D. How will you compute stress and strain in asphalt layer by 2 layers pavement analysis if the pavement is composed of three layers (e.g., as asphalt surface course, a granular base course and a subgrade)?

E. How do daily and seasonal variations of temperature affect Rigid Pavement?

F. Define: Modulus of Subgrade Reaction and Radius of Relative Stiffness

G. Write the causes of stresses in Slab. What are the methods available for calculating wheel load stresses and deflections in Rigid Pavement?

2. Answer any One (10x1= 10)

A. i) A full-depth asphalt pavement *8* in. (*203* mm) thick subjected to a single-whee l load of *9000* lb (40 kN) having contact pressure *67.7 psi (467* kPa). If the elastic modulus of the asphalt layer *is* 150,000 *psi* (*1.04* GPa) and that of the subgrade *is 15,000* psi (*104* MPa), determine the critical tensile strain in the asphalt layer.

ii) Given a concrete pavement with a joint spacing of *25* ft (*7.6* m) and a coefficient of friction of *1.5*, determine the stress in concrete due to friction.
For the same pavement $\Delta T = 60°F\ (33°C)$, at=$5.5 \times 10^{-6}/°F\ (9.9 \times 10^{-6}/°C)$, $e = 1.0 \times 10^{-4}$, $C=0.65$, and the allowable joint openings for undoweled and doweled joints are *0.05* and *0.25* in. (*1.3 and 6.4* mm), respectively, determine the maximum allowable joint spacing.

A. i) Design size and spacing of dowel bars at an expansion joint of concrete pavement of thickness *25* cm. Given the radius of relative stiffness of *80* cm. design wheel load *5000* kg. Load capacity of the dowel system is *40* percent of design wheel load. Joint width is *2.0* cm and the permissible stress in shear, bending and bearing stress in dowel bars are *1000,1400* and *100* kg / cm^2 respectively.

ii) A homogeneous half-space subjected to two circular loads, each *10* in. (*254* mm) in diameter and spaced at *20* in. (*508* mm) on centers. The pressure on the circular area is *50* psi (*345* kPa). The half-space has elastic modulus *10,000* psi (*69* MPa) and Poisson ratio *0.5*. Determine the vertical stress, strain, and deflection at point A, which is located *10* in. (*254* mm) below the center of one circle.

Equations:

$$\sigma_c = \frac{\gamma_c L f_a}{2}$$

$$\Delta L = CL(\alpha_t \Delta T + \epsilon)$$

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Course Title: Structural Design of Pavement — Course Code: CE 6505
Time: 1 Hour — Full Marks: 20

$$\epsilon_z = \frac{1}{E}[\sigma_z - v(\sigma_r + \sigma_t)]$$

$$\epsilon_r = \frac{1}{E}[\sigma_r - v(\sigma_t + \sigma_z)]$$

$$L_d = 5d\sqrt{\frac{F_f}{F_b}\frac{(L_d + 1.5\delta)}{(L_d + 8.8\delta)}} \qquad \epsilon_t = \frac{1}{E}[\sigma_t - v(\sigma_z + \sigma_r)]$$

University of Asia Pacific
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Mid Semester Examination Fall 2016

Course No: CE 6204 **Time: 1 Hour**
Course Title: Repair and Strengthening of Concrete Structures **Full Marks: 60**

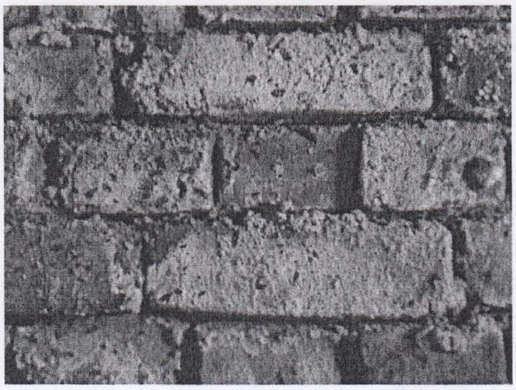
1. (a) Write short notes on the cracking due to: **(16)**

(i) Plastic shrinkage,
(ii) Chemical reaction,
(iii) Construction overload,
(iv) Design and detailing.

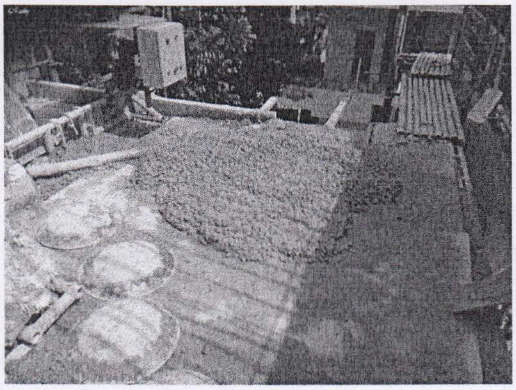
(b) Identify the problems from the images shown below: **(4)**

(i)

(ii)



(iii)



(iv)

2. (a) What do you understand by evaluation of cracking? Explain the process of crack sealing. **(6)**

(b) Describe the crack evaluation using ultrasonic pulse velocity technique. **(4)**

(c) What considerations needs to be taken during corrosion potential test? **(4)**

(d) Write short notes on (i) Mechanical movement indicator, (ii) Pachometer, (iii) Flexible shaft Fiberscope **(6)**

3. A 25 years old residential building slab has been cracked due to steel corrosion. It is necessary to identify the causes of crack. Determine the concrete failure probability of the slab due to the carbonation. Also determine the corrosion propagation time.

[Given: CO_2 content in the atmosphere is 0.035%, cement content = 340 kg/m^3, water content = 170 kg/m^3 aggregate to cement ratio= 4.5, $\rho_c = 94 lb/ft^3$, $\rho_a = 89 lb/ft^3$, n =2.5. Slab was cured for seven days. The measurement was taken in July 2016] **(20)**

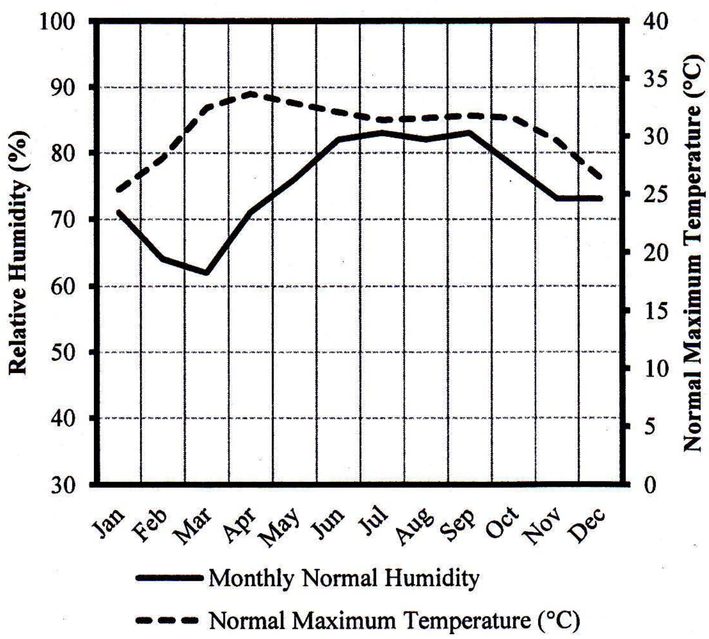


Figure 1. Monthly relative humidity and temperature of Dhaka city

Structural Element Type	Clear cover (mm) (ACI 318)
Slab	19
Beam	37.5
Column	37.5

$$k_{con} = 350 \frac{\rho_c}{\rho_w} \left(\frac{\frac{w}{c} - 0.30}{1 + \frac{\rho_c}{\rho_w} \frac{w}{c}} \right) \sqrt{1 + \frac{\rho_c}{\rho_w} \frac{w}{c} + \frac{\rho_c}{\rho_a} \frac{a}{c}}$$

University of Asia Pacific
Department of Civil Engineering
Mid-term Examination Fall 2016

Course Code: CE 6110 | Time: 1 (One) Hour
Course Title: Advance Theory and Design of Steel Structure | Full Marks: 50

There are 2 questions in this section. Answer all the questions.
Assume reasonable values for any missing data

1. (a) Why is the true maximum stress in a steel tension coupon higher than the engineering stress near rupture 2

(b) What do the coefficients "U" and "0.6" represent in the block shear equation in AISC (be specific)? 3

(c) Compute the yield moment and plastic moment capacities and shape factor for major axis bending of the section shown in Fig. 1. Given $F_y = 42$ ksi 7

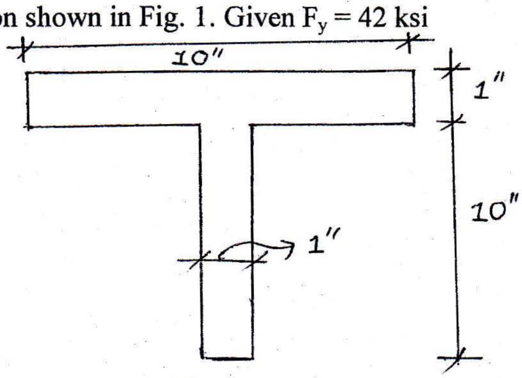


Fig: 1

(d) Select the lightest W section of A992 (Fy= 50 ksi) steel to serve a column 25' long to carry an axial compression load of 115 kips dead load and 150 kips live load in a braced structure, as shown in Fig. 2. Use ASD approach. 13

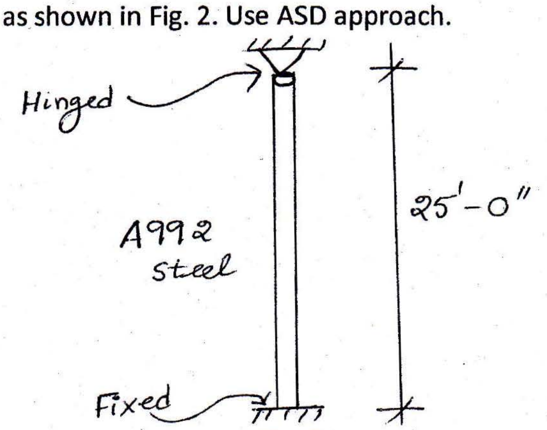


Fig: 2