COMBINED BANK

Post: Senior Officer (Civil)

Date: 2020

Exam Taker-AUST

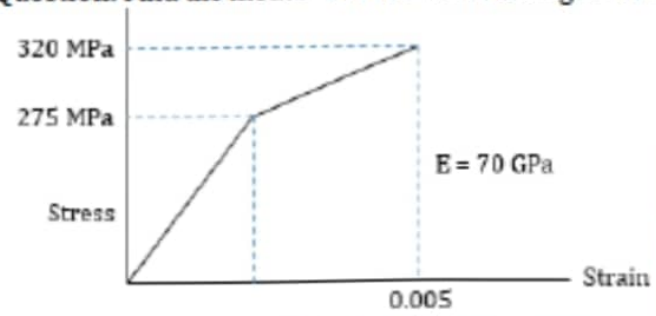
Question: The amount of BOD_5 in a sewage found 200 mg/L at temperature 20°C. If k = 0.22/day, then determine the ultimate BOD.

Solution:

$$BOD_5 = BOD_u\,(1 - e^{-k\,t})$$

$$BOD_u = \frac{BOD_5}{(1 - e^{-k\,t})} = \frac{200}{(1 - e^{-0.22\,x\,5})} = 299.79 \text{ mg/L}$$

Question: Find the modulus of resilience & toughness modulus from the following data.



Solution:

Strain at 275 MPa, $\varepsilon_{yield} = \frac{\sigma_{yield}}{E} = \frac{275\,x\,10^6}{70\,x\,10^9} = 0.00392$

Modulus of resilience $= \frac{1}{2}\,x\,\sigma_{yield}\,x\,\varepsilon_{yield} = \frac{1}{2}\,x\,275\,x\,10^6\,x\,0.00392 = 539000 \text{ J/m}^3$

Modulus of toughness $= \frac{1}{2}\,x\,275\,x\,0.00392 + \frac{275 + 320}{2}\,x\,(0.005 - 0.00392) = 0.86 \text{ MPa}$

Question: A rectangular channel is 10 ft width and 3 ft depth. Determine the velocity & rate of flow if manning's coefficient is, n = 0.015 and bed slope of the channel is, S = 0.003.

Solution:

Area, $A = b\,h = 10\,x\,3 = 30 \text{ ft}^2$

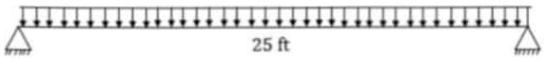
Wetted perimeter, $P = b + 2\,h = 10 + 2\,x\,3 = 16 \text{ ft}$

Hydraulic radius, $R = A/P = 30/16 = 1.875 \text{ ft}$

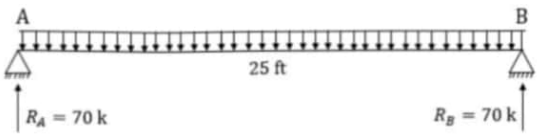
Velocity, $V = \frac{1}{n}\,R^{2/3}\,S^{1/2} = \frac{1}{0.015}\,x(1.875)^{2/3}(0.003)^{1/2} = 5.56 \text{ ft/s}$

Discharge, $Q = A\,V = 30\,x\,5.56 = 16.68 \text{ ft}^3/s$

Question: A rectangular beam of section 12" x 24" carries $DL = 2$ k/ft and $LL = 2$ k/ft. If the value of $f_c' = 4$ ksi, $f_y = 60$ ksi & $d' = 1.5$", design the reinforcement at 10 ft from the support for the following beam.



Solution:



Factored load, $W = 1.2\,DL + 1.6LL = 1.2 \times 2 + 1.6 \times 2 = 5.6$ k/ft

Moment at 10 ft from support, $M_u = 70 \times 10 - 5.6 \times 10 \times 5 = 420$ k − ft

$$M_u = \varphi A_s f_y \left(d - \frac{a}{2}\right)$$

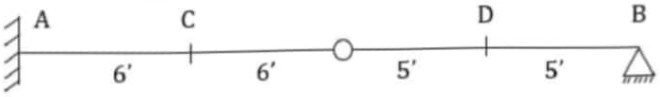
$$420 \times 12 = A_s \times 0.9 \times 60 \times \left(22.5 - \frac{7.28}{2}\right) \qquad [\text{Assume}, a = 7.28 \text{ in}]$$

$$A_s = 4.94 \text{ in}^2$$

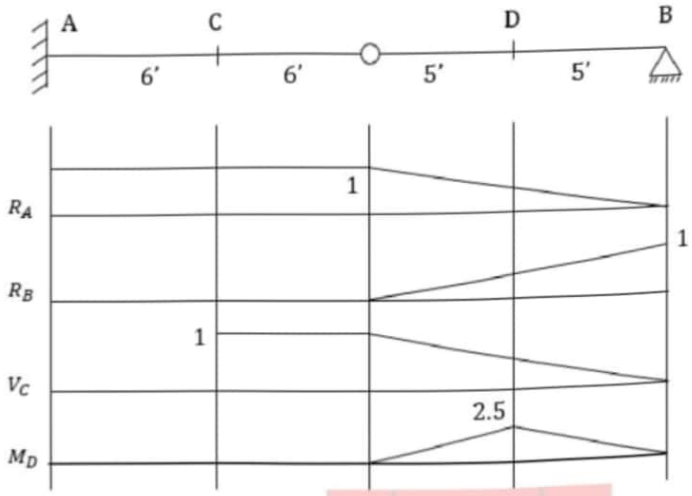
$$\text{Check, } a = \frac{A_s f_y}{0.85 f_c' b} = \frac{4.94 \times 60}{0.85 \times 4 \times 12} = 7.28 \text{ in} \rightarrow \text{as assumed (ok)}$$

Provide 5#9 bar as main reinforcement ($A_s = 5.00$ in^2)

Question: Draw influence line of reaction at A & B, shear at C & moment at D. What will be moment at D if 100 kip load act on the hinge.



Solution:



If 100 kip load act on the hinge the moment at D will be zero.

efine ductility. Why it is important in earthquake resistant structures?

Solution:

Ductility indicates the ability of a material to deform in the plastic range without breaking, which may be expressed as percent elongation or percent area reduction from a tensile test.

Ductility describes the extent to which a material or structure can undergo large deformations without failing. The term is used in earthquake engineering to designate how well a building will endure large lateral displacements imposed by ground shaking. In the simplest of terms, a ductile structure will bend and not break, which greatly reduces the risk of a catastrophic failure.

You can, however, have too much of a good thing. A structure that is too stiff (often referred to as *brittle*) will be prone to failure under relatively small deformation demands. An example of a brittle structure is an unreinforced masonry building, which will tolerate very little displacement before the onset of damage and failure.

A ductile structure's ability to contort and dissipate energy during an earthquake is, therefore, also advantageous as it will keep deforming without reaching ultimate failure or collapse. An example of a ductile structure is a properly detailed steel frame with a degree of elasticity that will enable it to undergo large deformations before the onset of failure.

Question: Specific gravity of cement, CA & FA are 2.9, 2.67 & 2.6. Air content is 2%.

(a) *Find the unit weight of CA,*

(b) *W/C ratio,*

(c) *Unit weight of concrete*

(d) *If water is increased what will be the effect on compressive strength and workability.*

Weight (kg)			
Water	*Cement*	*CA*	*FA*
187	*397*	-	*636*

Solution:

(a) Volume of water, $V_w = \frac{W_w}{G_s \gamma_w} = \frac{187}{1 \times 1000} = 0.187 \text{ m}^3$

Volume of cement, $V_c = \frac{W_c}{G_s \gamma_w} = \frac{397}{2.9 \times 1000} = 0.136 \text{ m}^3$

Volume of FA, $V_{FA} = \frac{W_{FA}}{G_s \gamma_w} = \frac{636}{2.6 \times 1000} = 0.245 \text{ m}^3$

Volume of CA, $V_{CA} = 1 - (0.187 + 0.136 + 0.245 + 0.02) = 0.412 \text{ m}^3$

Weight of CA, $W_{CA} = V_{CA} G_s \gamma_w = 0.412 \times 2.67 \times 1000 = 1100.04 \text{ kg}$

(b) Water cement ratio $= \frac{187}{397} = 0.47$

(c) Unit weight of concrete, $\gamma_c = \frac{W}{V} = \frac{187 + 397 + 636 + 1100.04}{0.187 + 0.136 + 0.245 + 0.412 + 0.02} = 2320.04 \text{ kg/m}^3$

(d) *If water is increased the concrete compressive strength will decrease and workability will increase.*

Discharge, $Q = A\,V = 30 \times 5.56 = 16.68\ ft^3/s$

Question: Show that shear stress of a rectangular beam along the section in neutral axis is 1.5 times of average shear stress.

Solution:

Figure shows a rectangular section of a beam of width b and depth d. Let F is the shear force acting at the section. Consider a level EF at a distance y from the neutral axis.

The shear stress at this level, $\tau = \dfrac{A\,\bar{y}}{b \times I}$

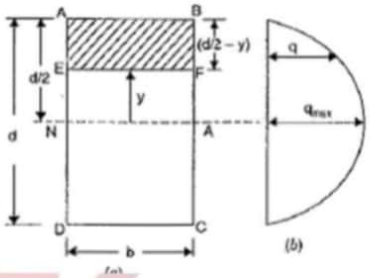
Where, A = area of the section above (shaded area $ABFE$) $= \left(\dfrac{d}{2} - y\right) b$

$\bar{y}$ = Distance of the C. G of area A from neutral axis

$$= y + \frac{1}{2}\left(\frac{d}{2} - y\right) = y + \frac{d}{4} - \frac{y}{2} = \frac{y}{2} + \frac{d}{4} = \frac{1}{2}\left(y + \frac{d}{2}\right)$$

b = Actual width of the section at the level EF

I = $M.O.I$ of the whole section at the level EF



Now, $\tau = \dfrac{F\left(\frac{d}{2} - y\right) \times b \times \frac{1}{2}\left(y + \frac{d}{2}\right)}{b \times I} = \dfrac{F}{2I}\left(\dfrac{d^2}{4} - y^2\right)$

we see that τ increases as y decreases, the variation of τ with respect to y is parabola.

At the top edge, $y = \dfrac{d}{2}, \tau = \dfrac{F}{2I}\left[\dfrac{d^2}{4} - \left(\dfrac{d}{2}\right)^2\right] = \dfrac{F}{2I} \times 0 = 0$

At the neutral axis, $y = 0, \tau = \dfrac{F}{2I}\left(\dfrac{d^2}{4} - 0\right) = \dfrac{F}{2I} \times \dfrac{d^2}{4} = \dfrac{F\,d^2}{8I}$

$$\tau = \frac{F\,d}{8 \times \frac{b\,d^3}{12}} = \frac{12}{8} \times \frac{F}{b\,d} = 1.5\,\frac{F}{b\,d}$$

Average shear stress, $\tau_{avg} = \dfrac{\text{Shear force}}{\text{Area of section}} = \dfrac{F}{b\,d}$

So, $\tau = 1.5\,\tau_{avg}$

Which gives the shear stress at the neutral axis where $y = 0$, this stress is also the maximum shear stress.

$\tau_{max} = 1.5\,\tau_{avg}$

Question: From a direct shear test, the value of normal stress of two sample is found 100 & 200 kip/ft² respectively. The value of shear stress of two sample is 80 & 120 kip/ft² respectively. What is the value of c & φ value?

Solution:

Here, $\sigma_1 = 100\ \text{kip/ft}^2, \sigma_2 = 200\ \text{kip/ft}^2, \tau_1 = 80\ \text{kip/ft}^2, \tau_2 = 120\ \text{kip/ft}^2$

Now, $\tau_1 = c + \sigma_1 \tan\varphi$

$80 = c + 100 \tan\varphi$

Again, $\tau_2 = c + \sigma_2 \tan\varphi$

$120 = c + 200 \tan\varphi$

Solving the two equations, $\varphi = 21.80^0$ & $c = 40\ \text{kip/ft}^2$

8. What do you mean by Flexible pavement, Rigid Pavement, Seat Coat, Prime Coat, Tack Coat? What are the difference between Flexible and Rigid Pavement?

9. Calculate the Ultimate load carrying capacity of pile 15ft length of 15" diameter. Given, Adhesion factor =0.5 and Unconfined compressive strength 30kip/in^2

10. Find the allowable axial load in the column section 12"*12" with 8 Nos. #3/4. Given, f'c=4ksi and fy=60ksi

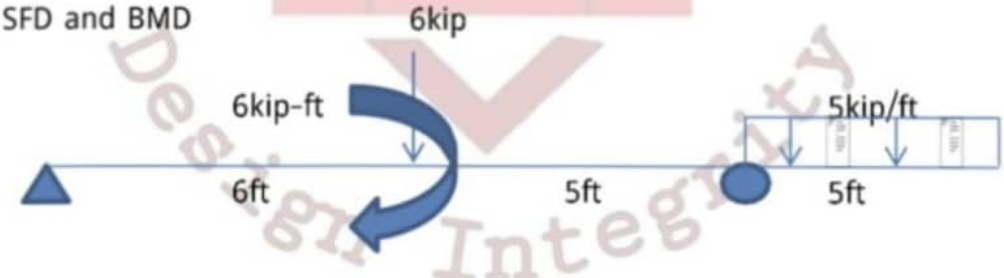
11.In half brick test maximum compressive load 15 tons and area of brick 21.5 in^2. Determine Compressive Strength and classify of brick.

12. Write the Constitutions of the Cement.

13. Short Notes

i. Slump
ii. Segregation
iii. Water cement Ratio
iv. Damp Proof Course (DPC)
v. Flash Point
vi. Fire Poin

14. Sketch SFD and BMD



3. Choose the correct Appropriate Preposition: (1*5=5)

i. Industry is the key..... the Success
ii. He was invested ....my company.
iii. He takes pride .. his wealth
iv. The Police was accused . the criminal
v. He occupied……writing a book

4. Write a short paragraph about "**Empowerment of Women in Bangladesh**" 5

5. সাধারণ জ্ঞান (1*10=10)

i. বাংলাদেশ সংবিধানের মোট তফসিল কয়টি?
ii. বাংলাদেশে প্রধানমন্ত্রী হওয়ার ন্যূনতম বয়স কত?
iii. প্রজাতন্ত্রের নির্বাহী ক্ষমতা কার হাতে?
iv. মুক্তিযুদ্ধে নো-বাহিনী কত নম্বর সেক্টর অধীন ছিল?
v. সদ্য নিউজিল্যান্ডের সঙ্গে বাংলাদেশ ম্যাচে বাংলাদেশী কোন বলার সবচেয়ে বেশি উইকেট পান?
vi. ২০১৭-২০১৮ অর্থ বছরে রপ্তানি পণ্যর উপরে বেপজা কত ভাগ অবদান রাখে?
vii. বাংলাদেশে সুবর্ণ জয়ন্তী কবে পালন করা হবে?
viii. ছয় দফা দাবি পেশ করা হয় ১৯৬৬ সালের কোন মাসে?

Departmental: 60 Marks

6. What do you mean by "stirrup"? Write down the purpose of shear/web Reinforcement?

7. Design a simply supported rectangular beam with the moment capacity of 1440kip-in by WSD method. (Given f'c=3500psi, fy= 60000psi, n=9 and d=2b)

BEPZA Question

Assistant Engineer (Civil)- 2019

Exam Taker- BEPZA

Venue- BEPZA School

Total Mark- 100 ,Time- 2hour

General Question: 40

1. বাংলা **(1*15=15)**
   - i. প্রাচীন যুগে চর্যাপদের আবিষ্কারক কে?
   - ii. "সবার উপরে মানুষ সত্য তাহার উপরে নাই" উক্তিটি কার?
   - iii. "ঈশ্বর" কবিতাটি কাজী নজরুল ইসলামের কোন কাব্য গ্রন্থ থেকে নেওয়া হয়েছে?
   - iv. "অহর্নিশ" শব্দের অর্থ কি?
   - v. "হৃদয় আমার নাচে রে আজকে" কোন কারকে কোন বিভক্তি?
   - vi. "স্বতন্ত্র" শব্দের বিপরীত শব্দ কি?
   - vii. সমোচ্চরিত দ্বিরুক্ত শব্দের অর্থগত পার্থক্য কি- সাক্ষর, স্বাক্ষর ।
   - viii. "ঠোঁট কাটা" বাগধারাটির অর্থ কি?
   - ix. "উন্নয়ন" সন্ধি বিচ্ছেদ কি?
   - x. তৎসম উপসর্গ কয়টি ?
   - xi. বিরামচিহ্ন কোলন (:) কত সময় থামতে হয়?
   - xii. "সম্মুখে অগ্রসর হয়ে অভ্যর্থনা" সংক্ষেপণ কি হবে?
   - xiii. "জীবনস্মৃতি" কার আত্মজীবনী ?

2. **Correct the Following Sentence: (1*5=5)**
   - i. He has a lot of works to do
   - ii. Some people have no faith on God
   - iii. Please give me some rices
   - iv. He was died yesterday