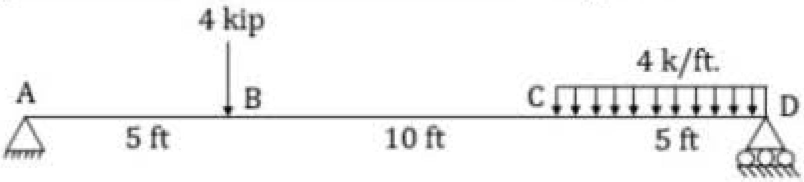
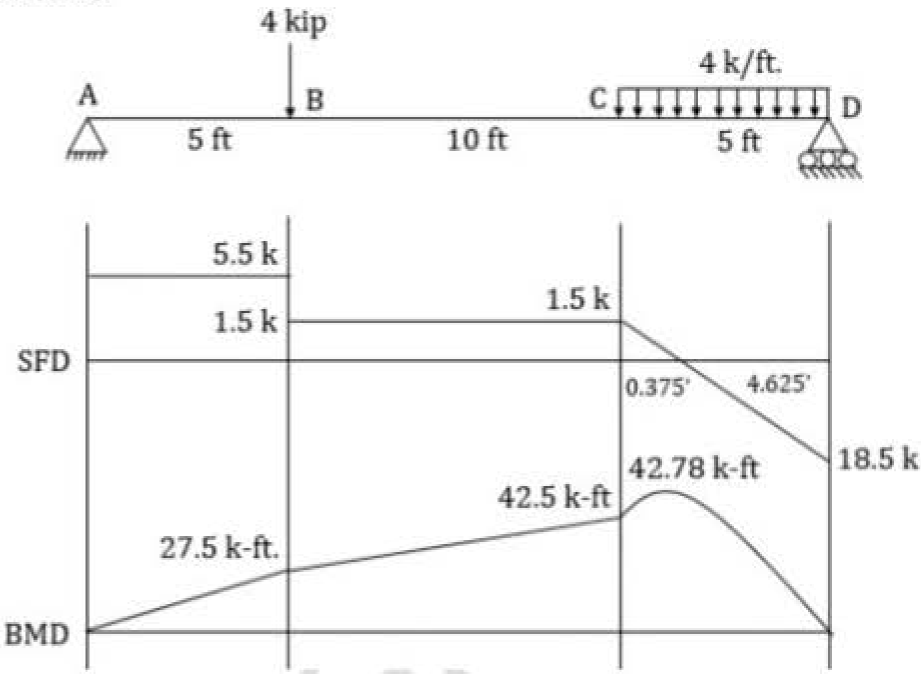
DSCC – 2021
Post: Assistant Engineer (Civil)

Question: Draw SFD and BMD for the following beam.



Solution:



Question: Design flexural reinforcement of the beam given in question no. 1. Assume $f_c' = 3{,}000$ psi and $f_y = 60{,}000$ psi. For architectural reasons, section is fixed at b = 12″ & h = 21″.

Solution:

Effective depth, d = 21 – 1.5 = 19.5″ and $M_u = 42.78 \text{ k} - \text{ft}$

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

$42.78 \times 12 = A_s \times 0.9 \times 60 \times \left(19.5 - \frac{0.98}{2}\right)$ [Assume, $a = 0.98$ in & $\varphi = 0.9$]

$A_s = 0.50 \text{ in}^2$

Check, $a = \frac{A_s f_y}{0.85 f_c' b} = \frac{0.5 \times 60}{0.85 \times 3 \times 12} = 0.98$ in → as assumed (ok)

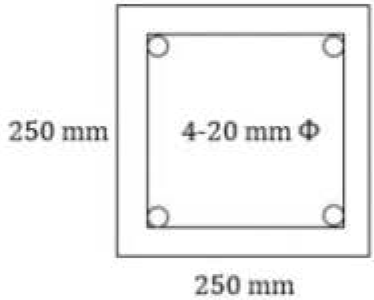
$c = \frac{a}{\beta_1} = \frac{0.98}{0.85} = 1.15 \text{ in}$

$\varepsilon_t = \frac{d - c}{c}(0.003) = \frac{19.5 - 1.15}{1.15}(0.003) = 0.047 > 0.005 \rightarrow \varphi = 0.9$ as assumed (ok)

Minimum reinforcement, $A_{s,min} = \frac{200\, b_w\, d}{f_y} = \frac{200 \text{ x } 12 \text{ x } 19.5}{60{,}000} = 0.78 \text{ in}^2$

Provide 3#5 bar as flexural reinforcement ($A_s = 0.93 \text{ in}^2$)

Question: Determine axial load capacity (kN) for the below column. Assume f_c = 3.5 N/mm² and f_s = 130 N/mm²



Solution:

$f_c = 0.45\, f_c'$

$f_c' = \frac{3.5}{0.45} = 7.78 \text{ N/mm}^2$

$f_s = 130 \text{ N/mm}^2$

$A_g = 250 \text{ x } 250 = 62500 \text{ mm}^2$

$A_{st} = 4 \text{ x } \frac{\pi}{4} \text{ x } 20^2 = 1256.64 \text{ mm}^2$

$P = 0.85\left(0.25\, f_c'\, A_g + f_s\, A_s\right)$

$P = 0.85\,(0.25 \text{ x } 7.78 \text{ x } 62500 + 130 \text{ x } 1256.64)$

$P = 242186.84 \text{ N} = 242.186 \text{ kN}$

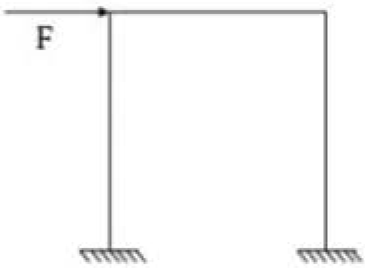
Question: In a 1500m long pipe of 150 mm diameter, water flows at 5 m/s. Calculate the head loss due to friction if the frictional coefficient is 0.004

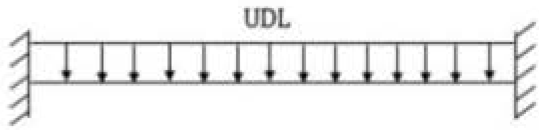
Solution:

Head loss due to friction, $h_f = \frac{4\, f\, L\, V^2}{2\, g\, d}$

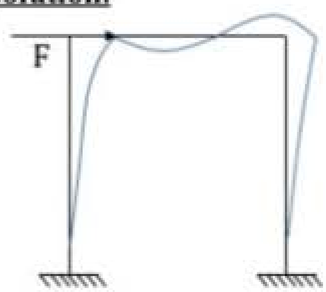
$h_f = \frac{4 \text{ x } 0.004 \text{ x } 1500 \text{ x } 5^2}{2 \text{ x } 9.81 \text{ x } 0.15} = 203.87 \text{ m}$

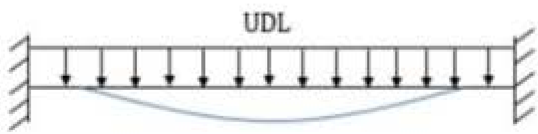
Question: Show the deflection diagram for the following section





Solution:





Question: What advantages are taken by using Pre-Stress Girder instead of RCC Girder?

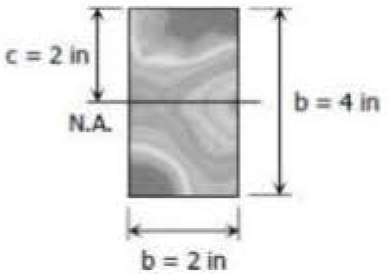
Solution:

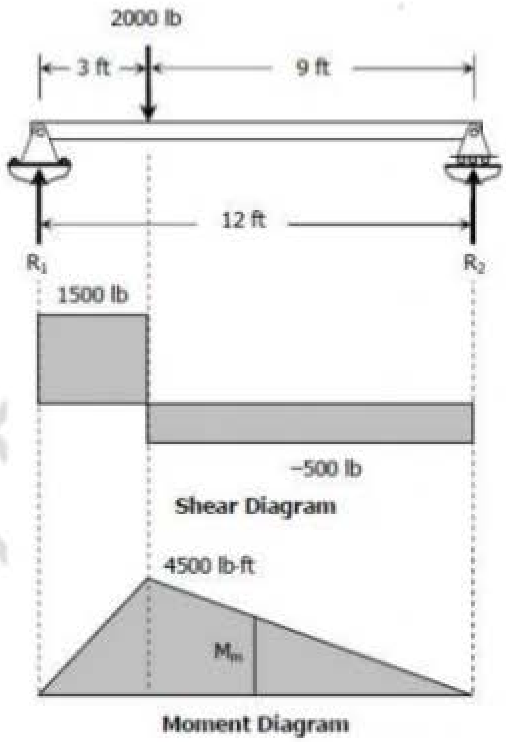
- In RCC girder the concrete in the compression side of the neutral side of the axis alone is effective. The concrete in the tension side of the neutral axis is ineffective. But in the pre-stressed concrete girder, the entire section is effective.
- Reinforced concrete girder are generally heavy. They always need shear reinforcements besides the longitudinal reinforcement for flexure. Pre-stressed concrete girders are lighter. By providing the curved tendons and the pre-compression, a considerable part of the shear is resisted.
- In reinforced concrete girder, high strength concrete is not needed. But in pre-stressed concrete girder, high strength concrete and high strength steel are necessary. High strength concrete is needed to resist high stresses at the anchorages. High strength steel is needed to transfer large pre-stressing force.
- Reinforced concrete girder being massive and heavy are more suitable in situations where the weight is more desired than strength. Pre-stressed concrete girder are very suitable for heavy loads and longer spans. They are slender and artistic treatments can be easily provided. Cracks do not occur under working loads. Even if a minute crack occurs when overloaded, such crack gets closed when the overload is removed. The deflections of the pre-stressed concrete girder are small.

Question: A simply supported beam, 2 in wide by 4 in high and 12 ft long is subjected to a concentrated load of 2000 lb at a point 3 ft from one of the supports. Determine the maximum fiber stress and the stress in a fiber located 0.5 in from the top of the beam at midspan.

Solution:

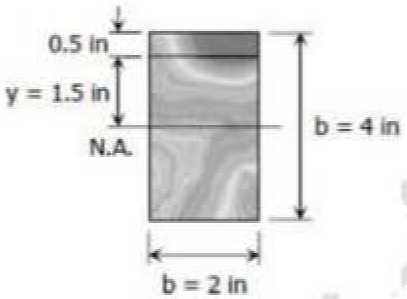
Maximum fiber stress:





$$f_{b,max} = \frac{M\,c}{I} = \frac{4500 \times 12 \times 2}{\frac{2 \times 4^3}{12}} = 10125 \text{ psi}$$

Stress in a fiber located 0.5 in from the top of the beam at midspan:



$$\frac{M_m}{6} = \frac{4500}{9}$$

$$M_m = 3000 \text{ lb} - \text{ft}$$

$$f_b = \frac{M\,y}{I} = \frac{3000 \times 12 \times 1.5}{\frac{2 \times 4^3}{12}} = 5062.5 \text{ psi}$$

Question: Define Segregation, Laitance and Workability of Concrete. What factors control the workability of concrete?

Solution:

Segregation can be defined as the separation of the constituent materials of concrete. In case of segregation, the heavy aggregate particles settle down leaving a sand cement mix on top affecting the quality adversely. Fine aggregate could be used to overcome the problem. However, design mix must be such that required strength could be achieved.

Laitance is caused by bleeding of concrete. In case of bleeding, only water accumulates at the top of the surface, but in case of laitance, along with water certain quantity of cement also comes to the surface, forming a thin layer of cement paste at the surface. This formation of cement paste at the surface is known as laitance.

Concrete is said to be workable if it is easily transported, placed, compacted and finished without any segregation or bleeding. The property of fresh concrete which is indicated by the amount of useful internal work required to fully compact the concrete without bleeding or segregation in the finished product. Workability is directly proportional to water cement ratio. An increase in water-cement ratio increases the workability of concrete. Workability can be measured by conducting slump test.

Factors control the workability of concrete

a) Cement content of concrete
b) Water content of concrete
c) Mix proportions of concrete
d) Size of aggregates
e) Shape of aggregates
f) Grading of aggregates
g) Surface texture of aggregates
h) Use of admixtures of concrete
i) Use of supplementary cementitious materials.