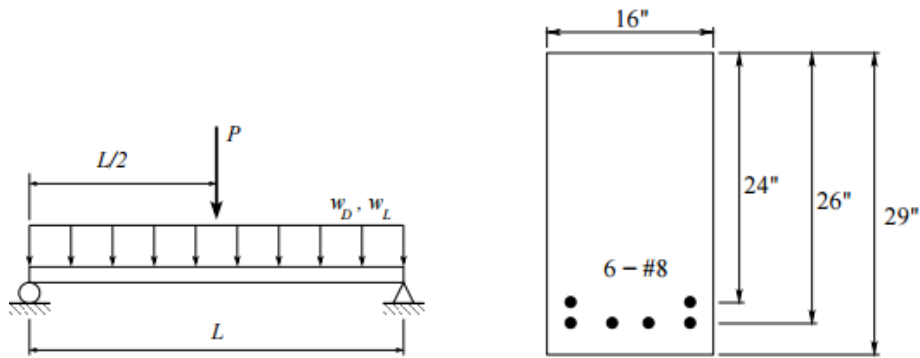


The purpose of this group project is to become comfortable using Excel VBA Functions and VBA code and Mathcad for calculations.

Please follow these instructions to complete your deliverable.

Problem Statement

Your office is designing a simply supported beam subject to the loading shown below. The point load is a live load with $P = 20 \text{ kip}$, the distributed loads are $w_D = 0.8 \text{ kip/ft}$ and $w_L = 1.2 \text{ kip/ft}$. The span length is $L = 35 \text{ ft}$. Your co-worker has given you the beam design shown below to check. Material strengths are: $f'_c = 3.5 \text{ ksi}$, $f_y = 60 \text{ ksi}$. Is the beam adequate?



Analysis Approach

Analyze the given reinforced concrete beam using special functions in Excel, as well as in Mathcad (addition directions to follow in page 3). Use Mathcad to keep track of units, and make sure to format and organize your calculations so that they are easy to follow. Use the procedure below to develop your calculations.

Steps:

1. Compute M_u – maximum factored load

$$w_u = 1.2 w_D + 1.6 w_L$$

$$M_{u,dist} = \frac{w_u L^2}{8} \quad M_{u,point} = \frac{P_u L}{4} \quad P_u = 1.2 P_D + 1.6 P_L$$

$$M_u = M_{u,dist} + M_{u,point}$$

Where,

w_D – Distributed dead load

w_L – Distributed live load

P_D – point load – dead

P_L – point load – live

2. Check minimum steel

$$d = \frac{4(26 \text{ in}) + 2(24 \text{ in})}{6} = 25.3 \text{ in}$$

d = Distance from top of beam to centroid of reinforcement.

Area of one #8 Steel bar = 0.79 in² Number of steel reinforcements = 6

$$A_s = \# \text{ of rebar} \times 0.79 \text{ in}^2$$

A_s total area of steel at a section in the beam

In an actual analysis you will check if the A_s you computed is greater than the minimum required by the code. But for now – do not worry about this.

3. Compute T , C, a

$$T = f_y A_s \qquad C = 0.85 f'_c a b \qquad \text{where } b \text{ is the width of your beam (=16")}$$

$$T = C$$

Where

C is the compressive force from the concrete.

T is the tension force from the reinforcement.

$$a = \frac{C}{0.85 f'_c b}$$

4. Compute M_n , check $\phi M_n \geq M_u$

$$M_n = T \left(d - \frac{a}{2} \right)$$

$$\phi = 0.90$$

If $\phi M_n \geq M_u$, the beam is adequate. If it is not, then the beam is not adequate.

In Excel, you must solve this problem 2 ways: (1) define user-defined functions to compute M_u , T , C , and a . Then complete the rest of your calculations in the spreadsheet, and (2) write an Excel subroutine, where all calculations are done in a subprogram and only results are written to a sheet (similar to the example we covered in class).

In Mathcad let the program keep track of units, and make sure to format and organize your calculations so that they are easy to follow.