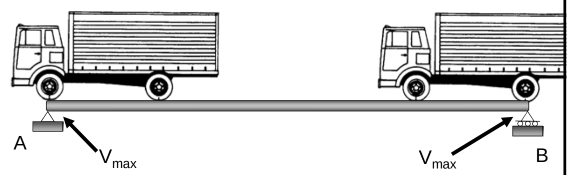
Absolute Maximum Shear And Moment

- We need to develop a method for computing the maximum shear and moment on a beam that determines both the location of the point and position of the loading.
- If the beam is cantilevered or simply supported the problem is not so hard.

Absolute Maximum Shear And Moment

- ***Shear*** - For both a cantilevered and simply supported beam the maximum shear will occur at the support.
- The resulting value of the shear can be easily calculated with the method of sections.



Absolute Maximum Shear And Moment

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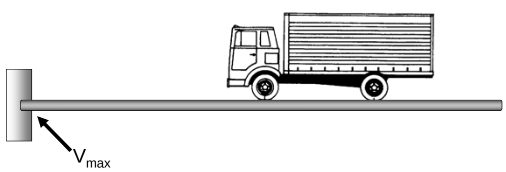
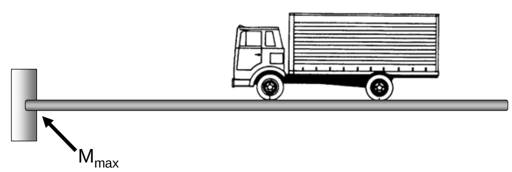


Absolute Maximum Shear And Moment

- ***Moment*** - For a cantilevered beam the maximum moment will occur at the support when the loading is at the end of the cantilevered member



Absolute Maximum Shear And Moment

- For a simply supported beam the maximum moment cannot be located by inspection.
- However, it can be proved that the absolute maximum moment in a simply-supported beam occurs under one of the concentrated loads.

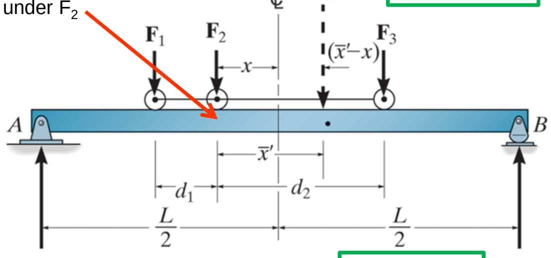
Absolute Maximum Shear And Moment

- The location is determined such that this force is positioned on the beam so that it and the resultant force of the system are equidistance from the beam's center line.
- By applying this technique to each of the concentrated forces, the absolute maximum moment can be calculated.

Absolute Maximum Shear And Moment

Let's look at the moment under F_2

$\sum F_R = F_1 + F_2 + F_3$

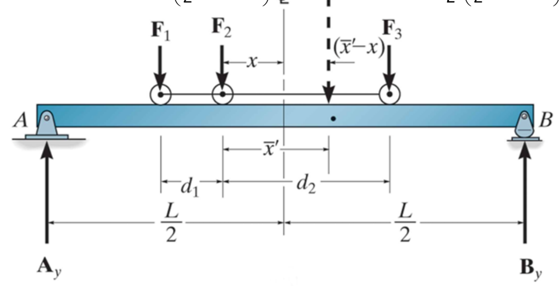


$\sum M_{F_2} = -F_R\bar{x}' = -F_3 d_2 + F_1 d_1 \Rightarrow \bar{x}' = \frac{-F_3 d_2 + F_1 d_1}{-F_R}$

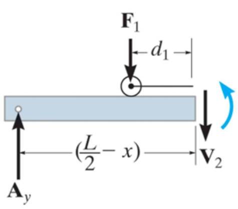
Absolute Maximum Shear And Moment

$\sum M_B = 0 = -A_y(L) + F_R\left(\frac{L}{2} - (\bar{x}' - x)\right)$

$A_y = \frac{F_R}{L}\left(\frac{L}{2} - (\bar{x}' - x)\right)$



Absolute Maximum Shear And Moment



$\sum M_{cut} = 0 = M_2 - A_y\left(\frac{L}{2} - x\right) + F_1 d_1$

$M_2 = F_R\left(\frac{L}{4} - \frac{\bar{x}'}{2} - \frac{x^2}{L} + \frac{x\bar{x}'}{L}\right) - F_1 d_1$

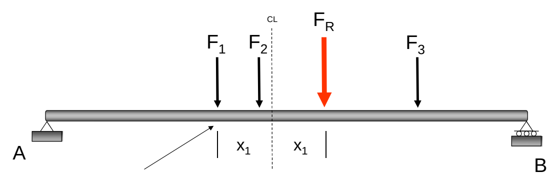
$\frac{dM_2}{dx} = 0 = F_R\left(-\frac{2x}{L} + \frac{\bar{x}'}{L}\right)$

$\Rightarrow \quad x = \frac{\bar{x}'}{2}$

Absolute Maximum Shear And Moment

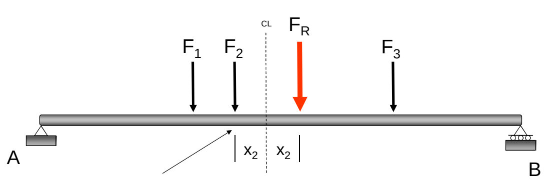
- ***Case 1 –*** Check at the position of the first force balanced about the centerline with the resultant force.

$$F_R = F_1 + F_2 + F_3$$



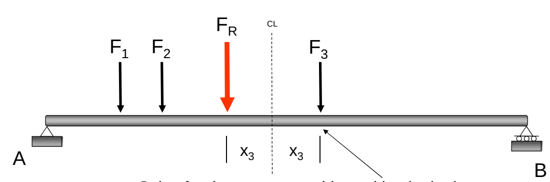
Absolute Maximum Shear And Moment

- ***Case 2 –*** Check at the position of the second force balanced about the centerline with the resultant force.



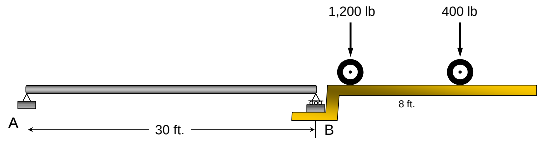
Absolute Maximum Shear And Moment

- ***Case 3 –*** Check at the position of the third force balanced about the centerline with the resultant force.



Live Loads for Bridges

- ***Example***: Determine the absolute maximum moment in beam below due to the wheel loads of a moving truck. The truck travels from right to left.



Live Loads for Bridges

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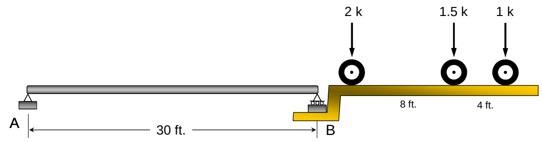

End of Influence Lines – Part 4

Any questions?