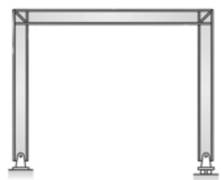
## Shear and Moment Diagrams for Frames

- A ***frame*** is a structure composed of several members that are either fixed- or pin-connected at their ends.
- It is often necessary to draw shear and moment diagrams to design frames.



## Shear and Moment Diagrams for Frames

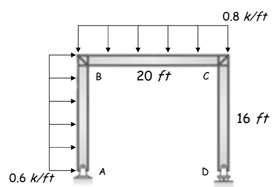
- **Procedure for analysis** - the following is a procedure for constructing the shear and moment diagrams for a frame

1. Determine the support reactions for the frame, if possible.
2. Determine the support reactions ***A***, ***V***, and ***M*** at the end of each member using the method of sections.
3. Construct both shear and moment diagrams just as before.

We will use the following sign convention: *always draw the moment diagram on the compression side of the member.*

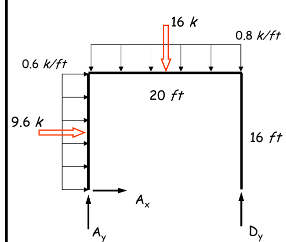
## Shear and Moment Diagrams for Frames

- ***Example***: Draw the shear and moment diagrams for the following frame (see notes page 38):




## Shear and Moment Diagrams for Frames

- First, find as many external reactions as possible.




$$\sum M_A = 0$$

$$= -9.6k(8ft) - 16k(10ft) + D_y(20ft)$$

$D_y$ = 11.84 $k$

$$\sum F_y = 0 = A_y + D_y - 16k$$

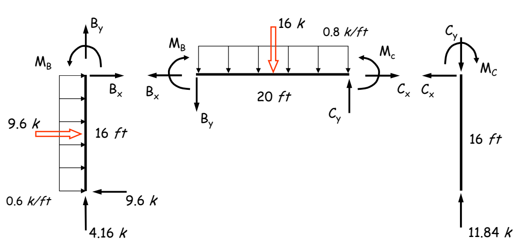
$A_y$ = 4.16 $k$

$$\sum F_x = 0 = A_x + 9.6k$$

$A_x$ = -9.6 $k$

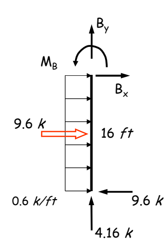
## Shear and Moment Diagrams for Frames

- Second, cut the frame into its component members and find the internal reactions




## Shear and Moment Diagrams for Frames

- Next, solve the equations of equilibrium for each member. Let's start with member AB.




$$\sum M_B = 0 = M_B + 9.6k(8ft) - 9.6k(16ft)$$

$M_B$ = 76.8 $k$ $ft$

$$\sum F_y = 0 = 4.16k + B_y$$

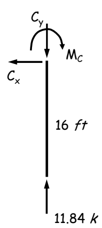
$B_y$ = -4.16 $k$

$$\sum F_x = 0 = B_x - 9.6k + 9.6k$$

$B_x$ = 0

## Shear and Moment Diagrams for Frames

- Next, solve the equations of equilibrium for member CD.



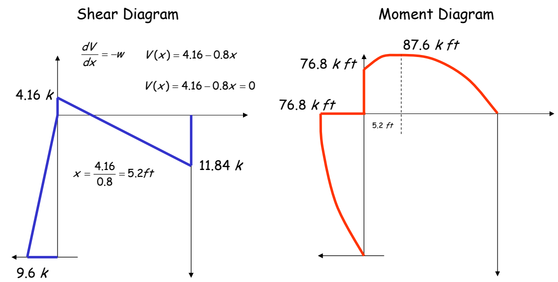

$\sum M_C = 0 = M_C$ **$M_C = 0$**

$\sum F_y = 0 = 11.84k - C_y$ **$C_y = 11.84\ k$**

$\sum F_x = 0 = C_x$ **$C_x = 0$**

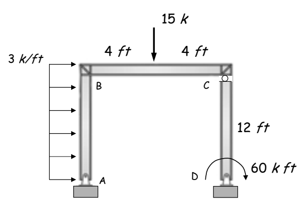
## Shear and Moment Diagrams for Frames

- Now, let's draw the shear and moment diagram (remember to draw the diagram on the compression side of the member).



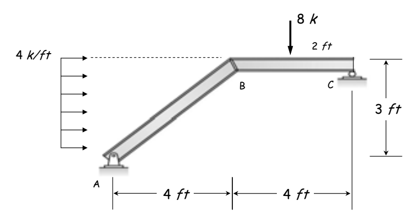

## Shear and Moment Diagrams for Frames

- ***Example***: Draw the shear and moment diagrams for the following frame (see notes page 40):




## Shear and Moment Diagrams for Frames

- ***Example***: Draw the shear and moment diagrams for the following frame (see notes page 41):

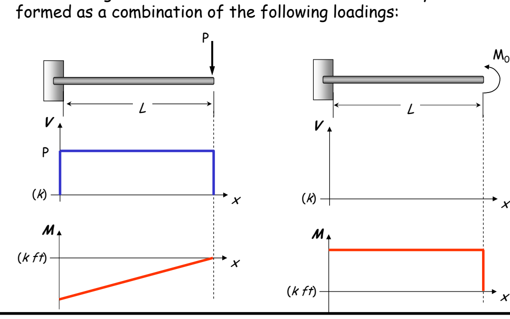



## Shear and Moment Diagrams by Superposition

- We have learned how to construct a moment diagram from either writing the moment as a function of *x* or from the slope relationship with the shear diagram.
- If the beam or frame is linearly elastic, we can use the principles of superposition to construct moment diagrams from a series of parts rather than from a single complex shape.

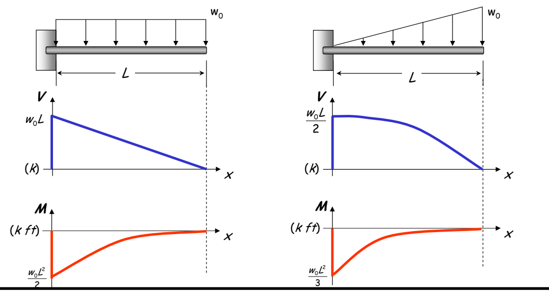
## Shear and Moment Diagrams by Superposition

- Most loadings on beams and frames in structural analysis can be formed as a combination of the following loadings:



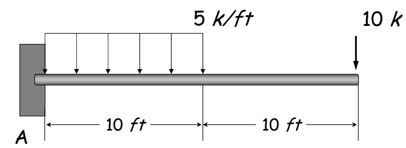
## Shear and Moment Diagrams by Superposition

- Most loadings on beams and frames in structural analysis can be formed as a combination of the following loadings:



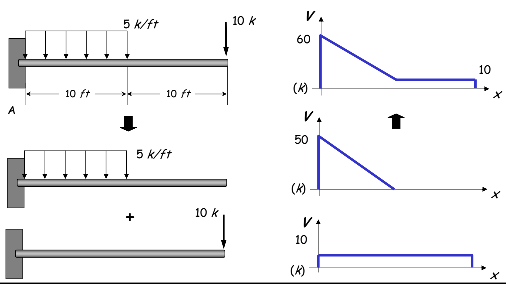

## Shear and Moment Diagrams by Superposition

- ***Example***: Draw the shear and moment diagrams for the following beam using superposition (see notes page 43):



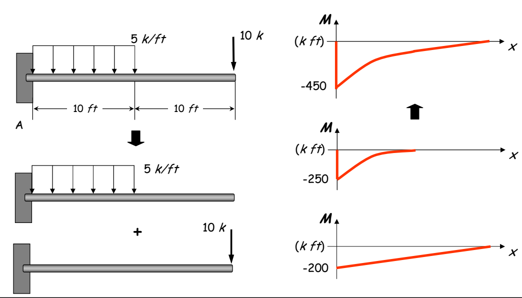

## Shear and Moment Diagrams by Superposition

- The shear diagrams using superposition



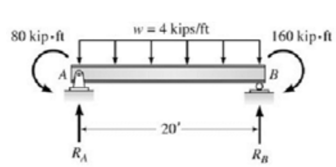

## Shear and Moment Diagrams by Superposition

- The moment diagrams using superposition



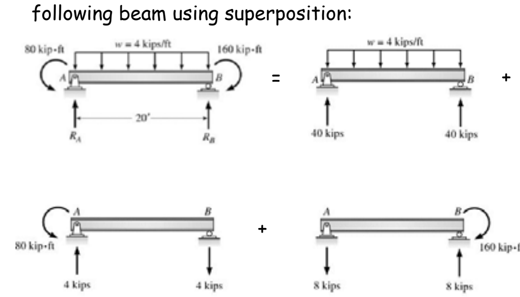

## Shear and Moment Diagrams by Superposition

- ***Example***: Draw the shear and moment diagrams for the following beam using superposition:



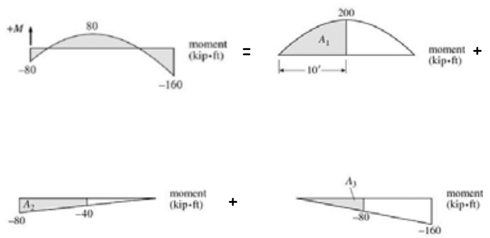

## Shear and Moment Diagrams by Superposition

- ***Example***: Draw the shear and moment diagrams for the following beam using superposition:



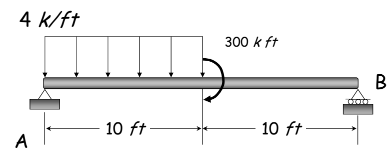
## Shear and Moment Diagrams by Superposition

- ***Example***: Draw the shear and moment diagrams for the following beam using superposition:




## Shear and Moment Diagrams by Superposition

- ***Example***: Draw the shear and moment diagrams for the following beam using superposition (see notes page 43):




## End of Internal Loads – Part 4

Any questions?