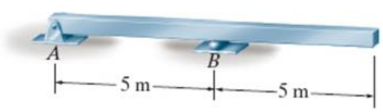
EXAMPLES 10.1
(Part 1A: IL for determinate beams)

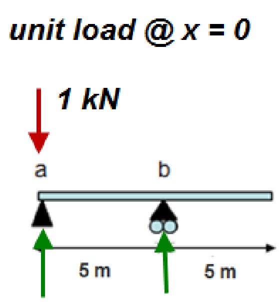
Lecture outline:
1. Examples: Determinate Beams (Tabular method)
2. Examples : Determinate Beams (Muller-Bresslau method)

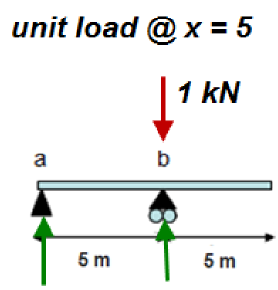
1. Examples - Determinate Beams (Tabular method)

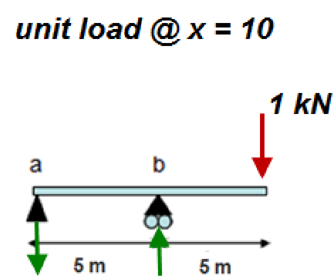
Example#1 - REACTION

Construct the influence line for the vertical reaction at B of the beam in Fig. 6–2a.

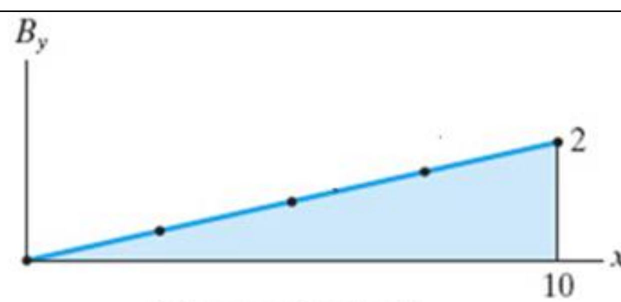








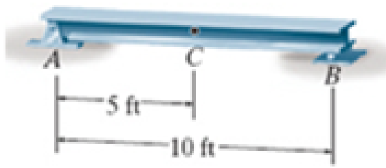
x (m)	By

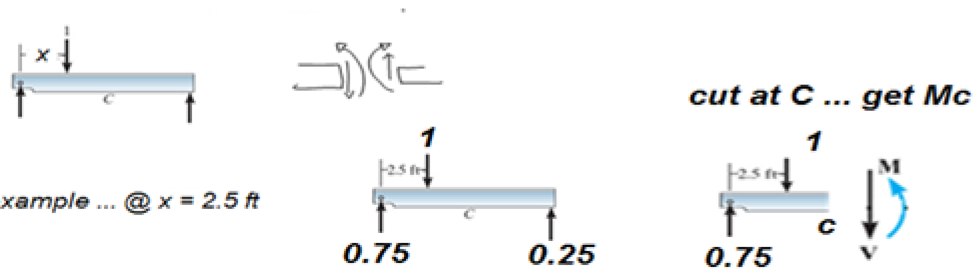


influence line for B_y

Example #2 – MOMENT

Construct the influence line for the moment @ C for the beam below:





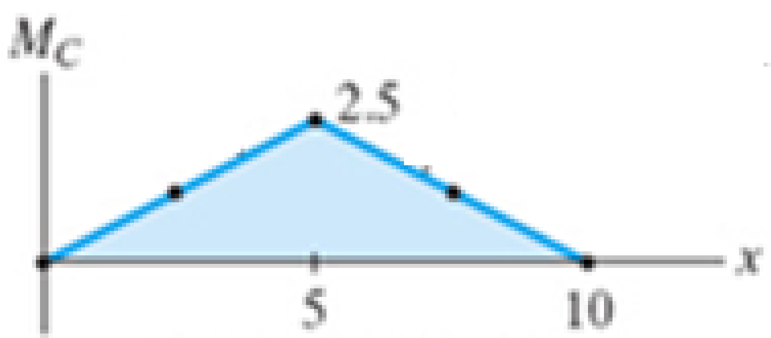
$$\circlearrowleft + \Sigma M_C = 0;$$

$$M_c - (0.75)(5) + (1)(2.5) = 0$$

$$M_c = 1.25 \text{ kN m}$$

Repeat for other positions and setup table then draw IL diagram ...

x	M_C
0	0
2.5	1.25
5	2.5
7.5	1.25
10	0



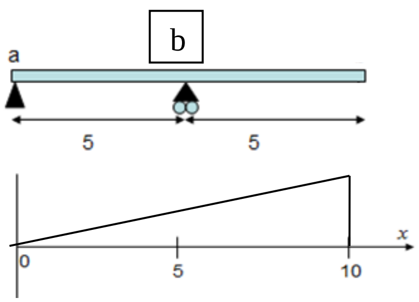
influence line for M_C

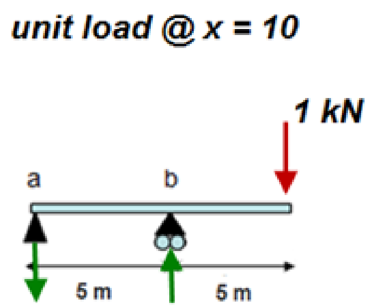
2. Examples - Determinate Beams (Muller-Bresslau method)

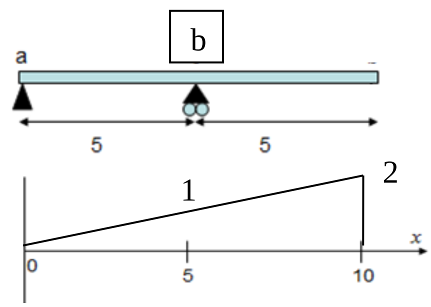
For the beams shown below

- Draw the "qualitative' influence line (i.e. just the shape)
- Then draw the "quantitative' influence line for the reaction that is indicated

Example 1a: Reaction @ B

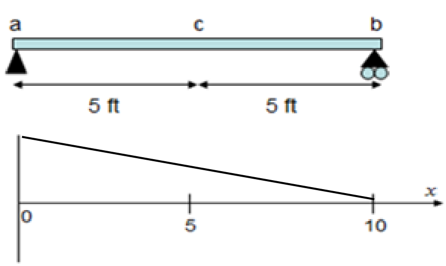


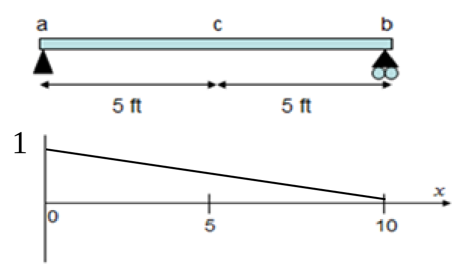




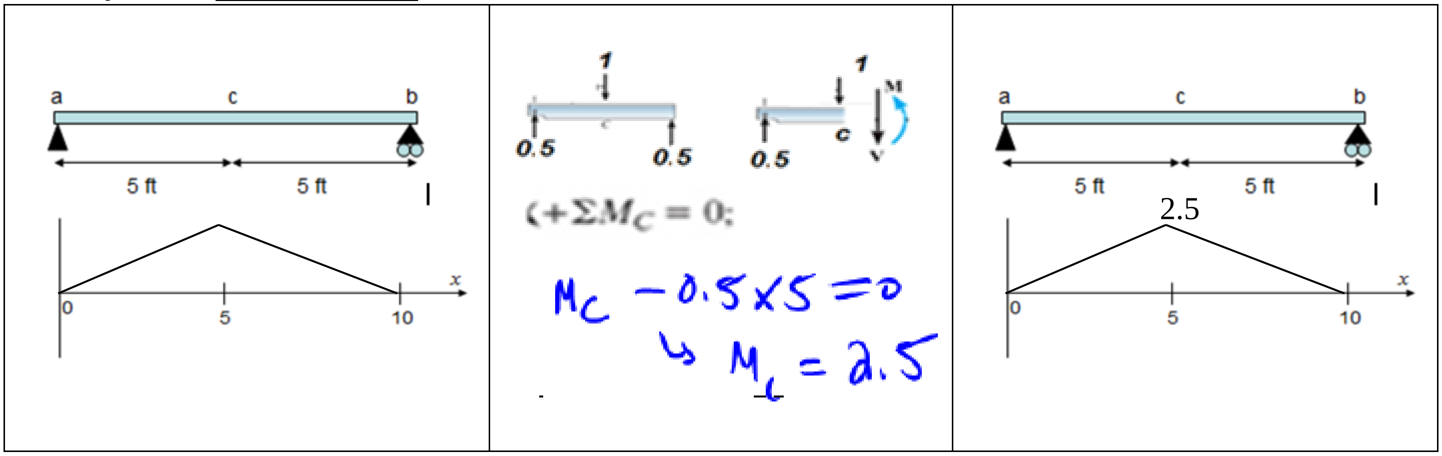
Example 1b: Reaction @ A

Reaction @ A



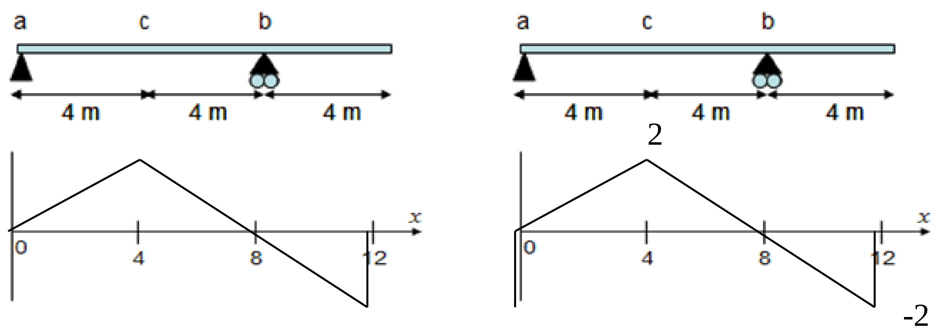


Example 2a: Moment @ C



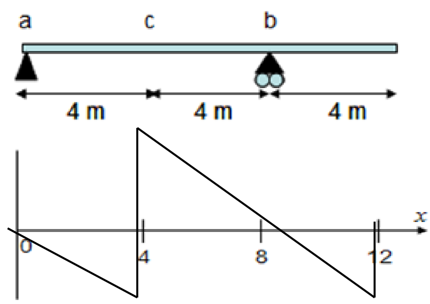
Example 2b: Moment @ C

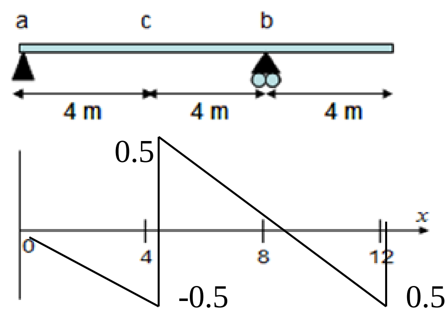
Moment @ C



Example 3: Shear @ C

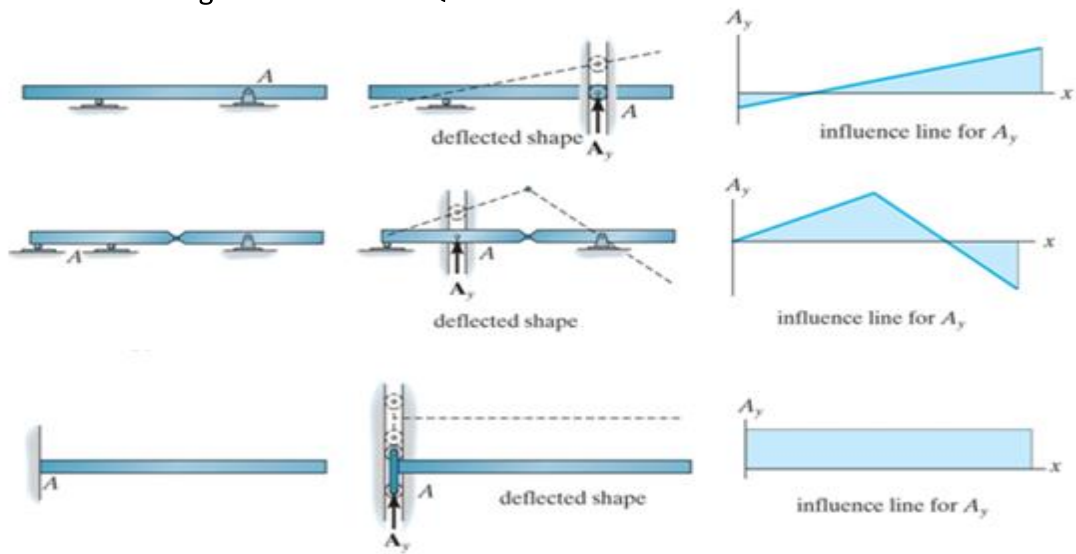
Shear @ C





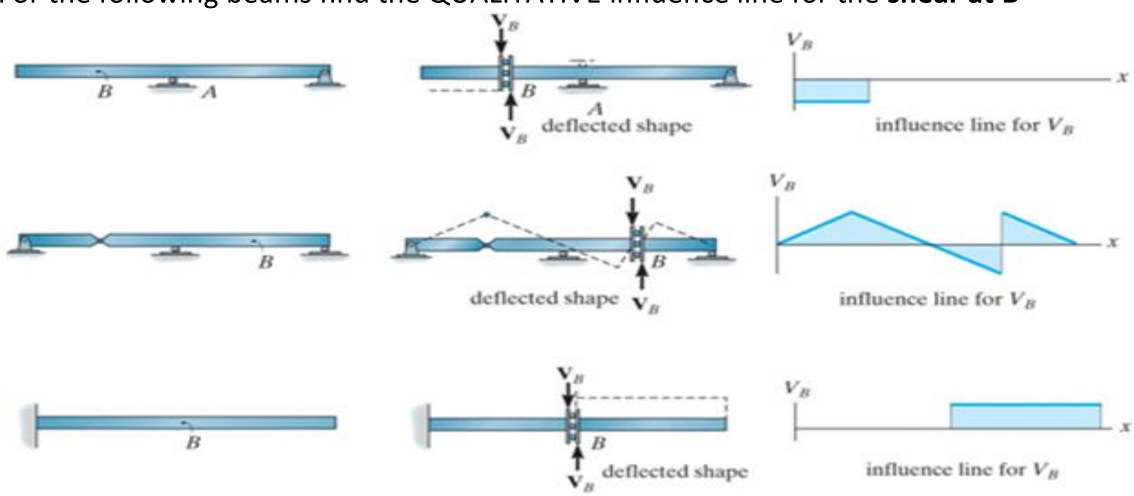
Extra Examples : - More challenging...

For the following beams find the QUALITATIVE influence line for the **vertical reaction at A**



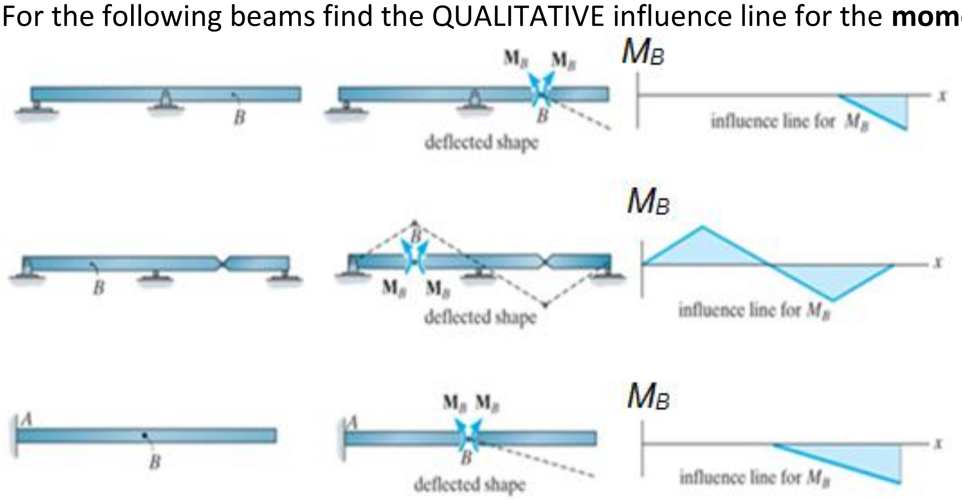
Extra Examples: - More challenging...

For the following beams find the QUALITATIVE influence line for the **shear at B**



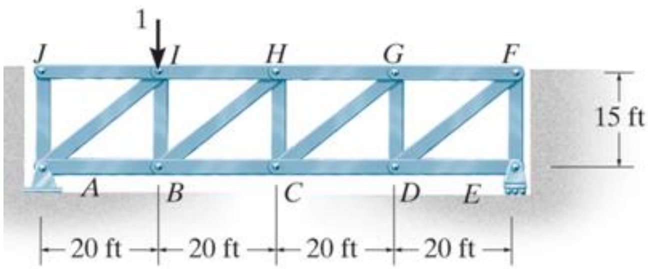
Extra Examples: - More challenging...

For the following beams find the QUALITATIVE influence line for the **moment at B**



3. Examples - Determinate Trusses

Example 1: Draw the influence line for member BC in the truss below. Assume the load moves along the top chord.



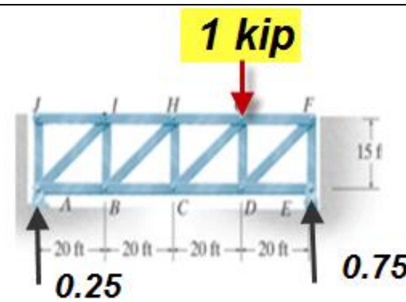
Load @ joint J (x =0ft): F_{BC} = **0**

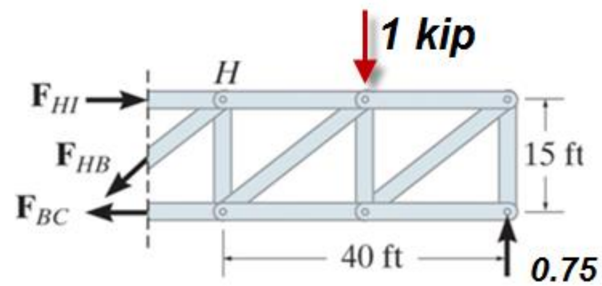
Load @ joint I (x =20ft): F_{BC} = **0,667**

Load @ joint H (x = 40 ft): F_{BC} = **1.33**

Load @ joint G (x =60 ft): F_{BC} = ________

Load @ joint F (x = 80 ft) : F_{BC} = **0**



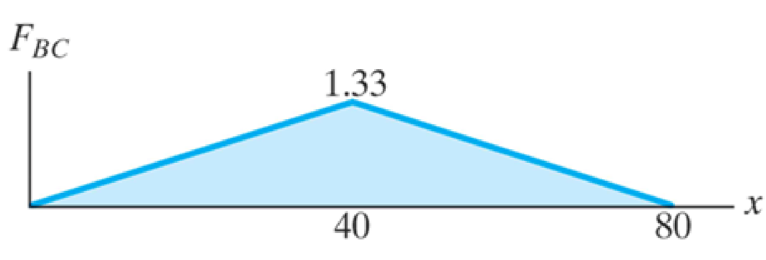


$\circlearrowleft + \Sigma M_H = 0$;

$-F_{BC}(15) + (\quad)(40) - (\quad)(\quad) = 0$

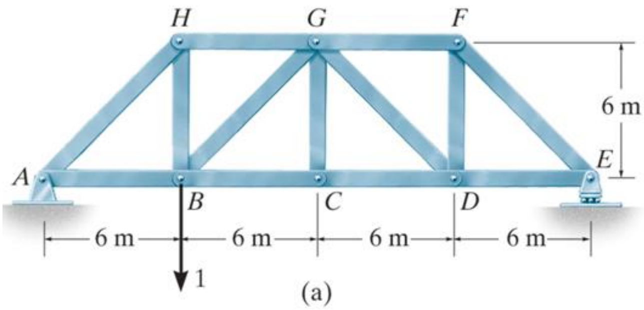
$F_{BC} = 0.667$ (T)

x	F_{BC}
0	0
20	0.667
40	1.33
60	0.667
80	0



influence line for F_{BC}

Example 2: Draw the influence line for member GB in the truss below. Assume the load moves along the Bottom chord.



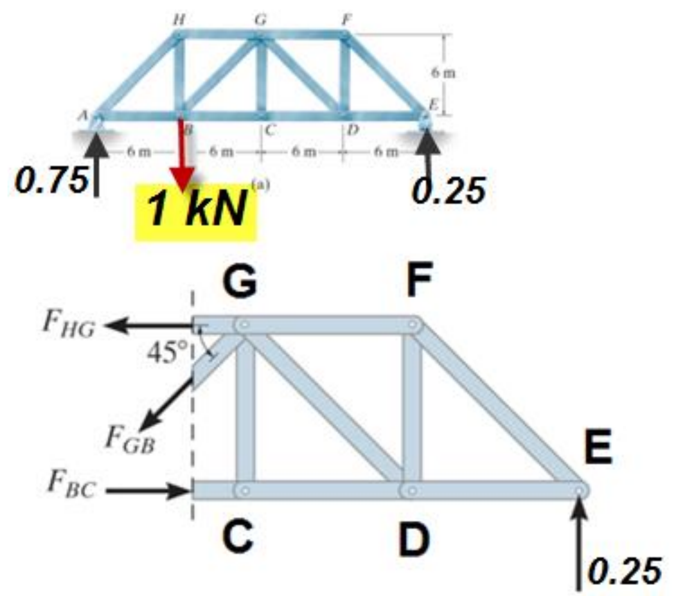
Load @ joint A (x =0m): F_{GH} = __0__.

Load @ joint B (x =6m): F_{GH} = ________

Load @ joint C (x =12m): F_{GH} = __-0.707__.

Load @ joint D (x =18m): F_{GH} = __-0.354__.

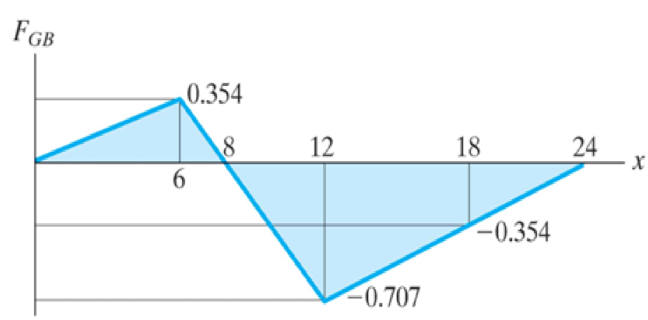
Load @ joint E (x = 24m): F_{GH} = __0__.



$\Sigma F_y = 0;$ (   ) - $F_{GB} \sin 45° = 0$

F_{GB} = ________

x	F_{GB}
0	0
6	0.354
12	−0.707
18	−0.354
24	0



influence line for F_{GB}

EXAMPLES
10.2: Influence Lines
(Part 2: Application examples)

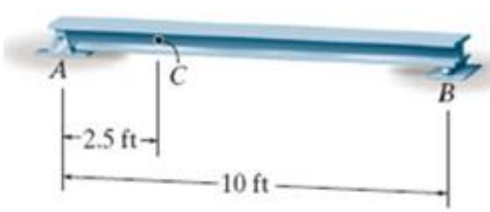
Examples outline:

1. Examples: Determinate Beams - Maximum load effects

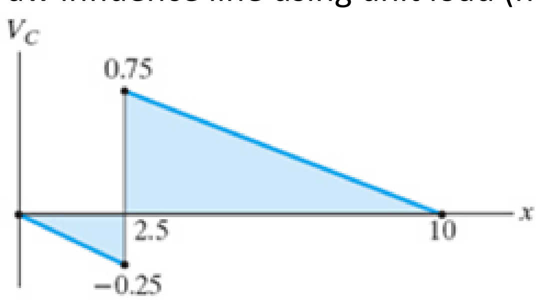
Example #1

Determine the max **+ve** shear that can be developed **@ C** due to:

- Concentrated live load of 4000 lb and;
- Distributed live load of 2000 lb/ ft

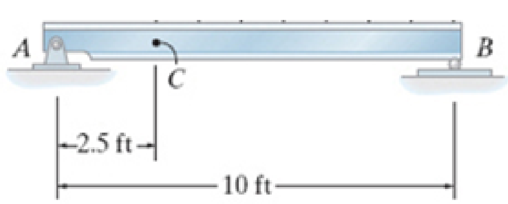


Draw influence line using unit load (Muller-Bresslau + similar triangles)

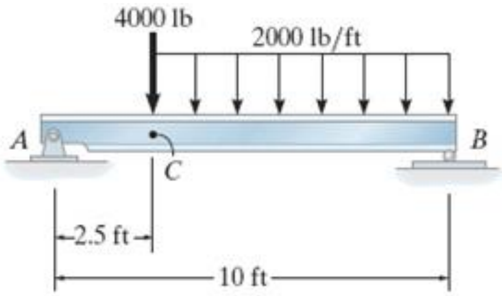


influence line for V_C

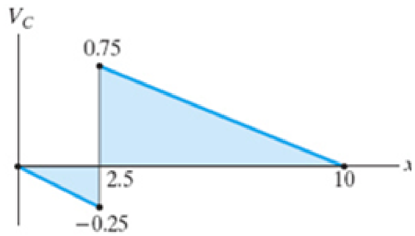
Loading for maximum positive shear @ C .... V_c^+ ?



Loading for maximum positive shear @ C .... V_c^+ :



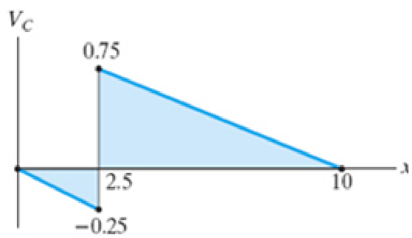
Effect of concentrated live load of 4000 lbs:



influence line for V_C

$$V_C = 0.75(4000 \text{ lb}) = 3000 \text{ lb}$$

Effect of distributed live load of 2000 lb/ft:



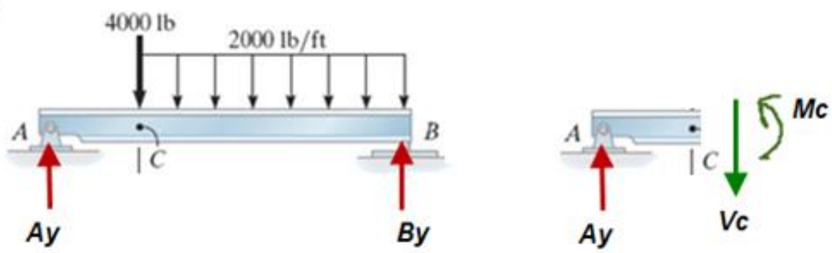
influence line for V_C

$$V_C = \left[\tfrac{1}{2}(10 \text{ ft} - 2.5 \text{ ft})(0.75)\right]2000 \text{ lb/ft} = 5625 \text{ lb}$$

Total Maximum Shear at C

$$(V_C)_{max} = 3000 \text{ lb} + 5625 \text{ lb} = 8625 \text{ lb} \qquad \textit{Ans.}$$

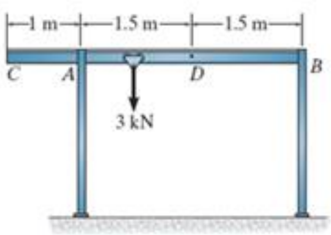
Note, we could have also determined this value using statics (try yourself)...



Example #2

The beam shown below is used to support a moving crane.
The loads on the beam are:

- Concentrated live load of 3kN;
- Distributed live load of 2 kN/m
- Distributed dead load due to self-weight (24 kg/m)
- Assume the beam is pinned @ A and has a roller @ B.



(a) Determine the max **vertical reaction** that can be developed **@ A**.

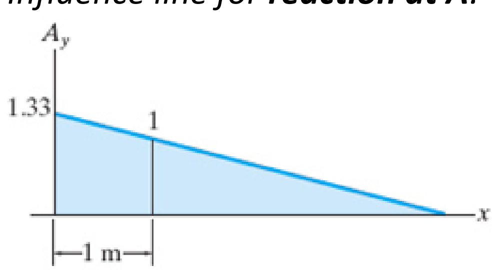
Loads:

- *Concentrated live load =*

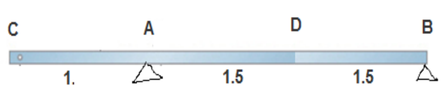
- *Distributed live load =*

- *Distributed dead load =*

*Influence line for **reaction at A**:*



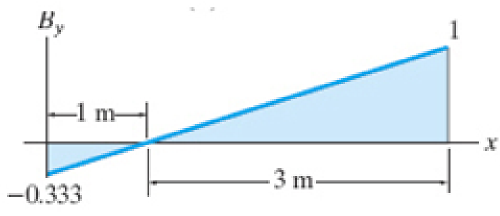
*Loading for **maximum reaction at A**:*



***Ay→**:* $A_{y\max} = (3)(1.33) + 2\left[\frac{1}{2}\times 4 \times 1.33\right] + 0.235\left[\frac{1}{2}\times 4\times 1.33\right] =$

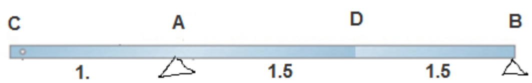
(b) Determine the max **+ve vertical reaction** that can be developed **@ B**.

*Influence line for **reaction at B**:*



influence line for B_y

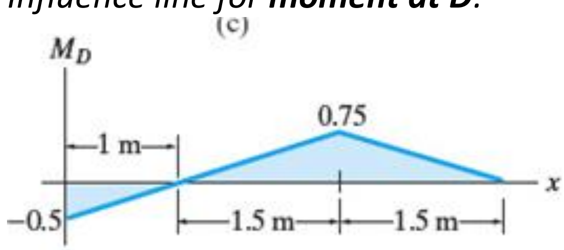
*Loading for **maximum positive reaction at B**:*



***By→**:* $B_{y\max} = (3)(1) + 2\left[\frac{1}{2}\times 3\times 1\right] + 0.235\left[\left(\frac{1}{2}\times 3\times 1\right) + \left(\frac{1}{2}\times 1\times -0.333\right)\right] =$

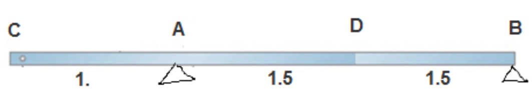
(c) Determine the max **+ve moment** that can be developed **@ D**.

*Influence line for **moment at D**:*



influence line for M_D

*Loading for **maximum positive moment at D**:*



***MD+→**:* $M^{+}_{b\max} = (3)(0.75) + 2\left[\frac{1}{2}\times 3\times 0.75\right] + 0.235\left[\left(\frac{1}{2}\times 3\times 0.75\right) + \left(\frac{1}{2}\times 1\times -0.5\right)\right] =$

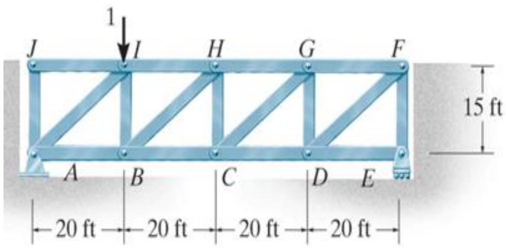
2. Examples: Trusses - Maximum axial force

Example #1

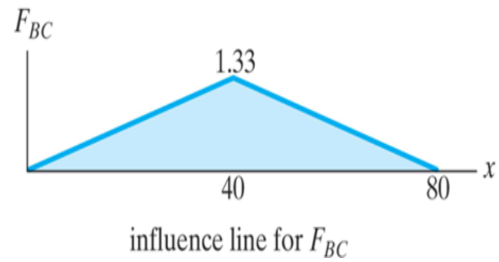
Determine the **maximum tensile axial force** that can be developed in **member BC** of the truss due to:

- a concentrated live load of 20 kips
- The loading is applied at the top chord.

Recall we had found the influence line for member BC (see below) ...



x	F_{BC}
0	0
20	0.667
40	1.33
60	0.667
80	0



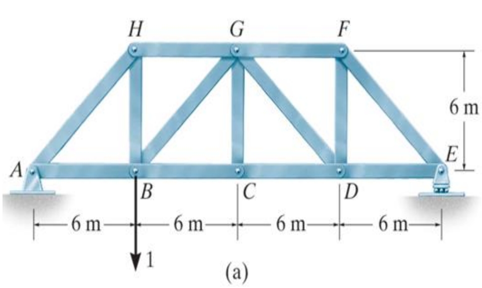
Answer: Maximum Tensile axial force = 20 * 1.33 = 26.6 kips

Example #2

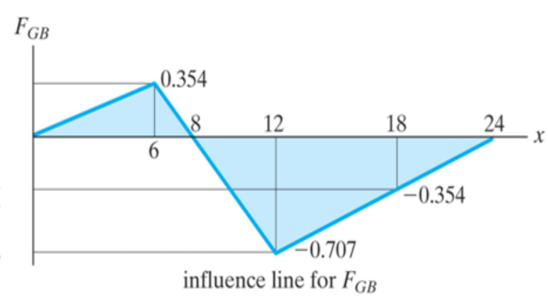
Determine the **maximum compressive axial force** that can be developed in **member GB** of the truss due to:

- a concentrated live load of 50 kN and
- a distributed live load of 5 kN/m.
- The loading is applied at the bottom chord.

Recall we had found the influence line for member GB (see below)



x	F_{GB}
0	0
6	0.354
12	−0.707
18	−0.354
24	0



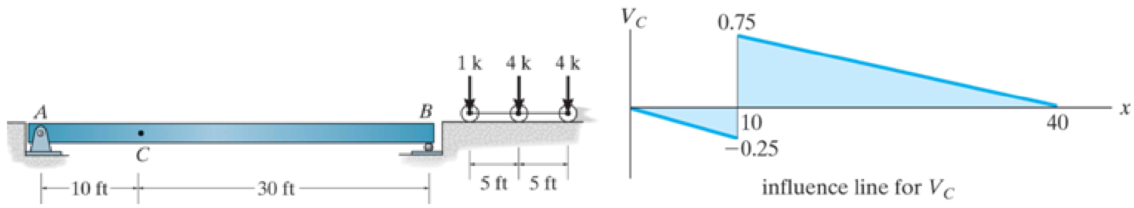
Answer: Maximum Compressive axial force =

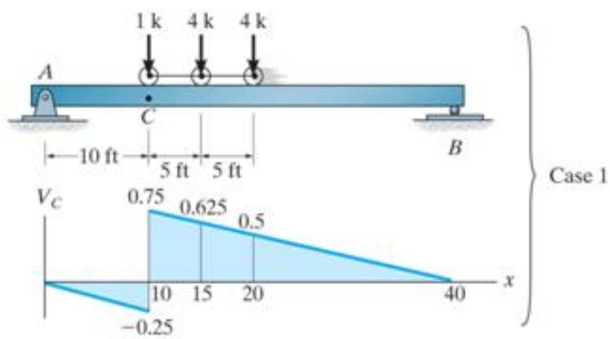
50*(0.707) +5 [(1/2 *4*0.707) + (1/2 *12*0.707)] = **63.6 kips (C)**

4. Examples: Truck loads

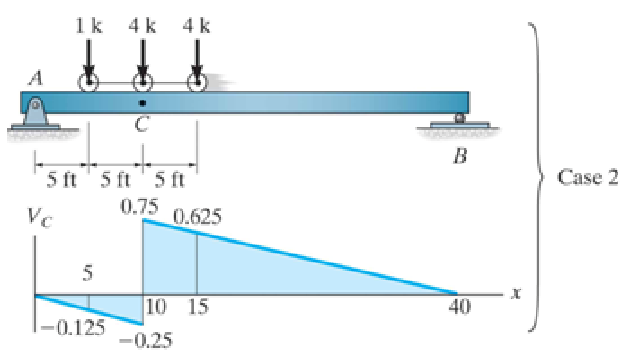
Example: bridge beam

Find the placement of the truck loads that causes **maximum positive shear at C**

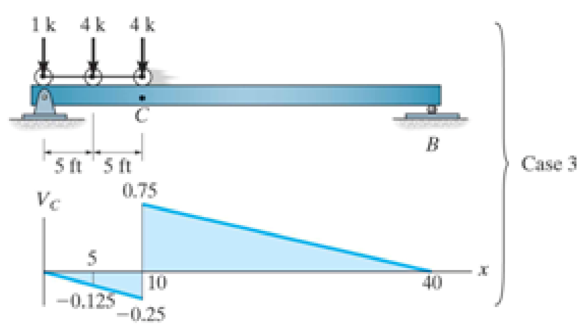




$$V_C = 1 \times (0.75) + 4 \times (0.625) + 4 \times (0.5) = 5.25k$$



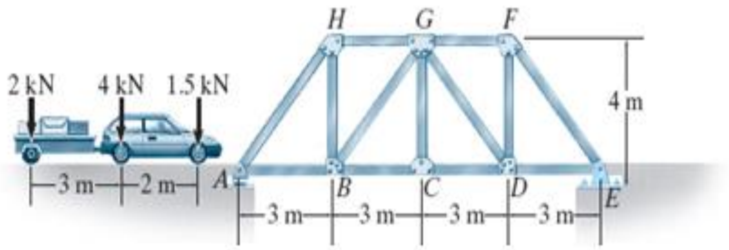
$$V_C = 1 \times (-0.125) + 4 \times (0.75) + 4 \times (0.625) = 5.375k$$

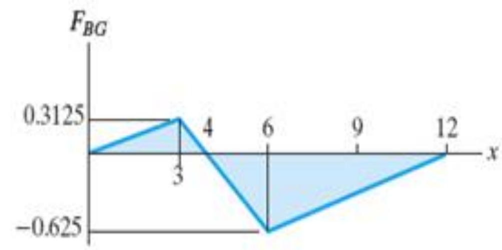


$$V_C = 1 \times (0) + 4 \times (-0.125) + 4 \times (0.75) = 2.5k$$

Example: bridge truss

Determine the maximum compressive force developed in member *BG* of the side truss in Fig. 6–32*a* due to the right side wheel loads of the car and trailer. Assume the loads are applied directly to the truss and move only to the right.



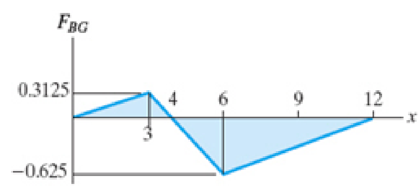


influence line for F_{BG}

3 cases to consider:

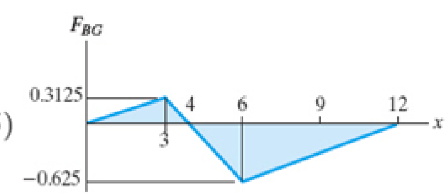
1. with 1.5 kN load @ point C

$$F_{BG} = 1.5\text{ kN}(-0.625) + 4(0) + 2\text{ kN}\left(\frac{0.3125}{3\text{ m}}\right)(1\text{ m})$$
$$= -0.729\text{ kN}$$



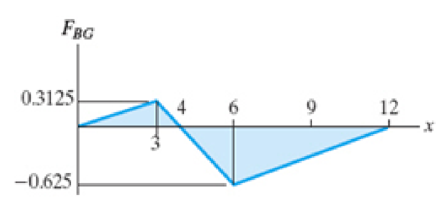
2. with 4 kN load @ point C

$$F_{BG} = 4\text{ kN}(-0.625) + 1.5\text{ kN}\left(\frac{-0.625}{6\text{ m}}\right)(4\text{ m}) + 2\text{ kN}(0.3125)$$
$$= -2.50\text{ kN}$$



3. with 2 kN load @ point C

$$F_{BG} = 2\text{ kN}(-0.625) + 4\text{ kN}\left(\frac{-0.625}{6\text{ m}}\right)(3\text{ m}) + 1.5\text{ kN}\left(\frac{-0.625}{6\text{ m}}\right)(1\text{ m})$$
$$= -2.66\text{ kN} \qquad \textit{Ans.}$$



Since this final case results in the largest answer, the critical loading occurs when the 2-kN load is at *C*.