Universitas Pembangunan Jaya

Integrity, Professionalism, & Entrepreneurship

Mata Kuliah : Statika & Mekanika Bahan
Kode : CIV – 102
SKS : 4 SKS

Garis Pengaruh

Pertemuan – 10&11

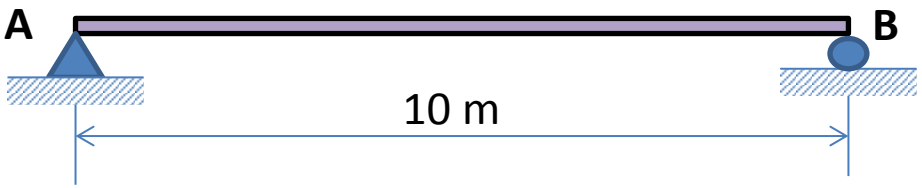
- Kemampuan akhir yang diharapkan
  - Mahasiswa dapat menjelaskan konsep garis pengaruh
- Bahan Kajian (Materi Ajar)
  - Garis pengaruh Balok
  - Garis pengaruh Rangka batang

Definisi

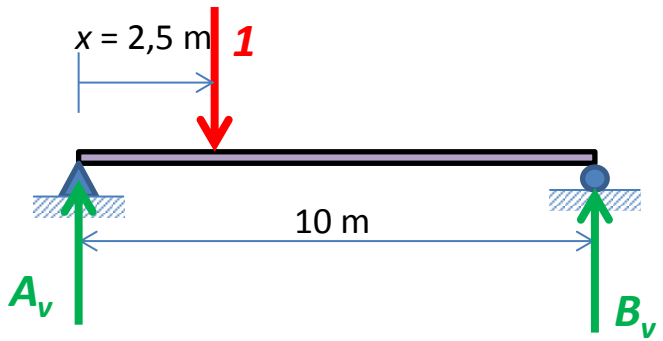
- Garis pengaruh merupakan variasi dari reaksi, momen ataupun lintang akibat gaya terpusat yang bekerja pada titik tertentu dalam sebuah struktur.
- Garis pengaruh merepresentasikan efek dari beban bergerak pada titik tertentu dalam struktur sedangkan diagram gaya dalam (Momen, Lintang dan Normal) merupakan representasi efek dari beban tersebut terhadap keseluruhan bagian struktur.
- Pada Balok, perhitungan persamaan Garis Pengaruh dapat dilakukan terhadap reaksi Perletakan (R), momen (M), ataupun gaya Lintang (D), dengan menempatkan gaya satuan pada balok tersebut.

Garis Pengaruh Reaksi Tumpuan

- Sebuah struktur balok sederhana



- Tempatkan gaya 1 satuan (unit load) dengan jarak **x = 2,5 m**. Hitung Reaksi di A



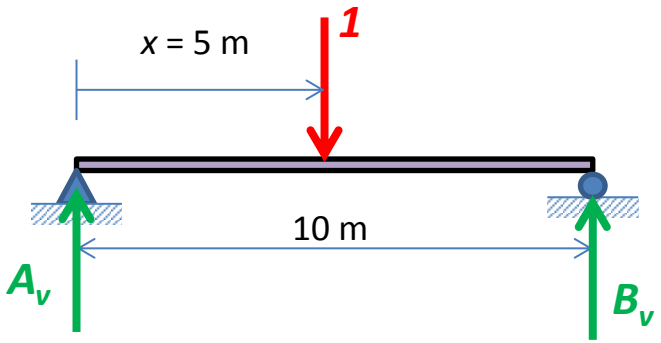
$\Sigma M_B = 0$

$A_v(10) - 1(7,5) = 0$

$\mathbf{A_v = 0,75}$

Garis Pengaruh Reaksi Tumpuan

- Tempatkan gaya satuan dengan jarak **x = 5 m**

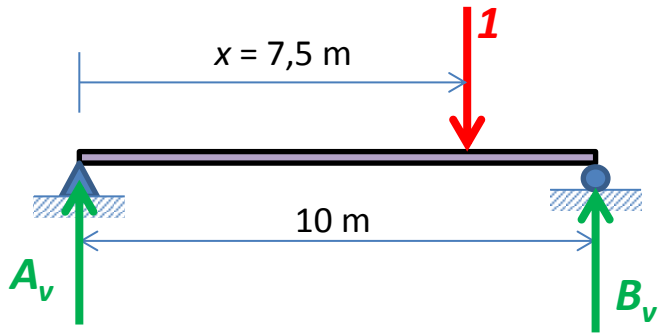


$\Sigma M_B = 0$

$A_v(10) - 1(5) = 0$

$\boldsymbol{A_v = 0{,}5}$

- Tempatkan gaya satuan dengan jarak **x = 7,5 m**



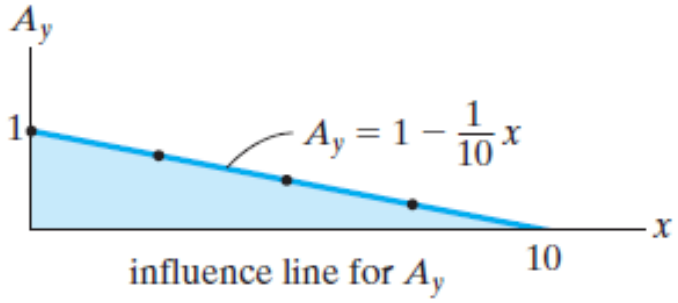
$\Sigma M_B = 0$

$A_v(10) - 1(5) = 0$

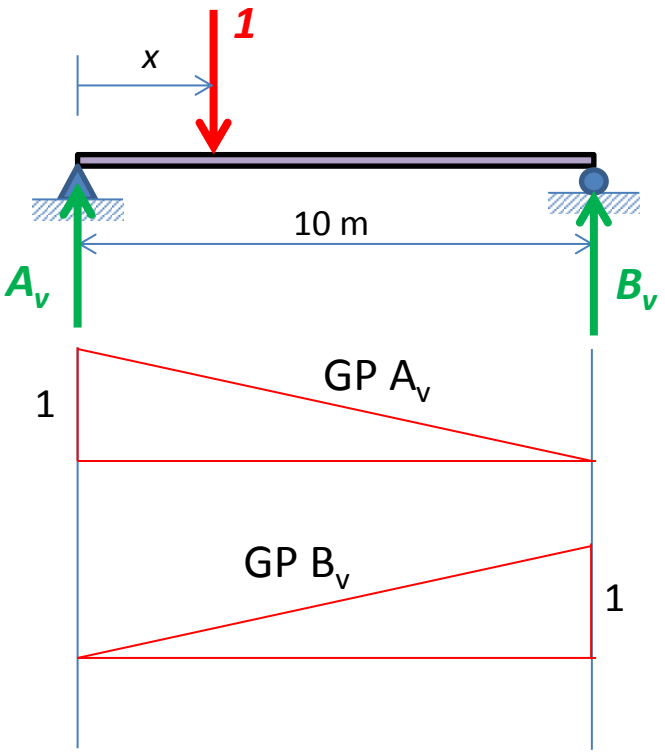
$\boldsymbol{A_v = 0{,}5}$

- Dengan cara yang sama, untuk $x = 0$ ($P = 1$ berada di A), maka $\boldsymbol{A_v = 1}$,
- Dan untuk $x = 10$ m ($P = 1$ berada di B), diperoleh $\boldsymbol{A_v = 0}$
- Tabelkan hasil perhitungan dengan variasi jarak

x	A_y
0	1
2.5	0.75
5	0.5
7.5	0.25
10	0



- Secara lebih umum, Garis pengaruh reaksi tumpuan dapat dituliskan dalam suatu persamaan, yaitu dengan menempatkan beban 1 satuan pada jarak x dari tumpuan A.



$\Sigma M_B = 0$

$A_v(10) - 1(10 - x) = 0$

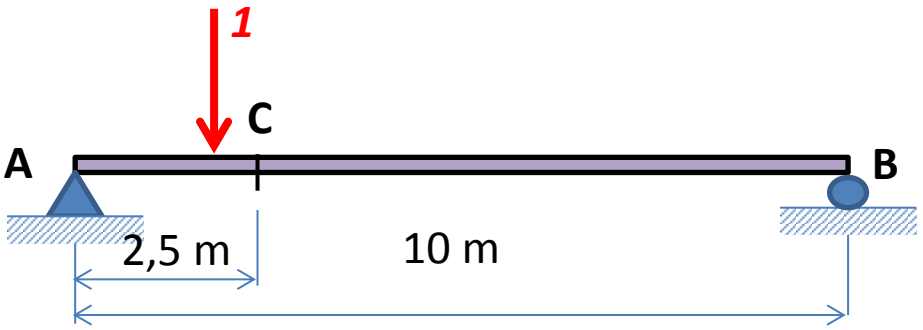
$A_v = 1 - (x/10)$

$\Sigma M_A = 0$

$-B_v(10) + 1(x) = 0$

$B_v = x/10$

- **Garis Pengaruh Gaya Lintang**



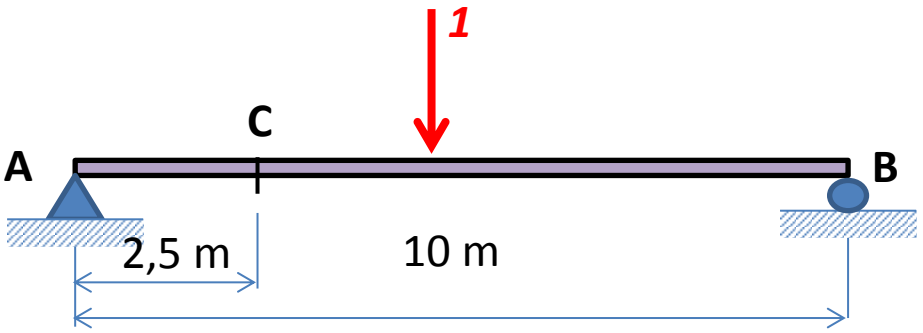
- Pada saat *P* berjalan di antara titik A ($x = 0$) dan titik C ($x = 2{,}5$), maka besarnya gaya geser di titik C adalah :

$$V_C = A_v - P = (1 - \frac{x}{10}) - 1 = -\frac{x}{10}$$

Atau $\boldsymbol{V_C = -B_V}$

- Gambarkan persamaan ini pada ruas antara titik A dan titik C.

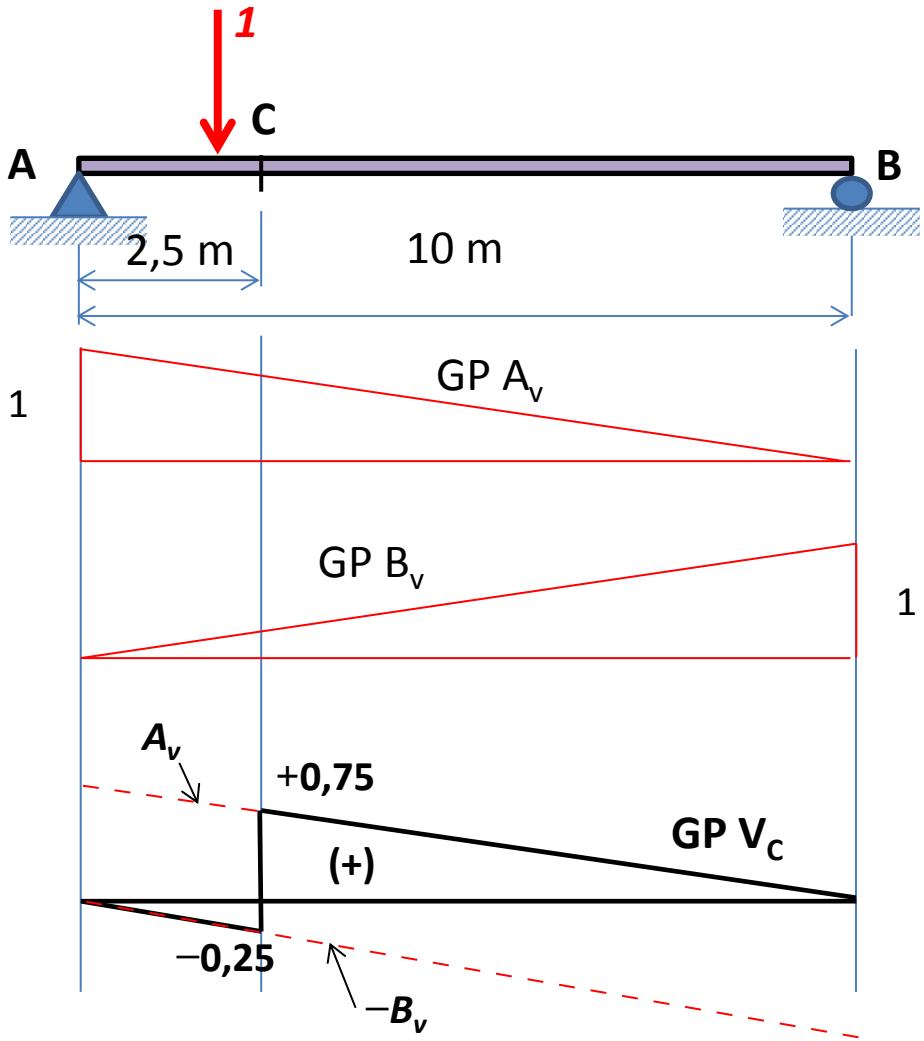
- **Garis Pengaruh Gaya Lintang**



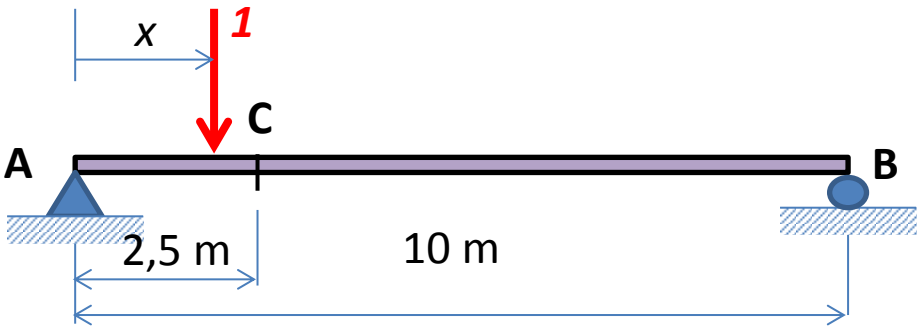
- Pada saat *P* berjalan antara titik C (x = 2,5) hingga titik B (x = 10), maka besarnya gaya geser di titik C adalah :

$$V_C = A_v = 1 - \frac{x}{10}$$

- Gambarkan persamaan ini pada ruas antara titik C dan titik B.


1
C
A
B
2,5 m
10 m
1
GP A_v
GP B_v
1
A_v
+0,75
GP V_C
(+)
–0,25
$-B_v$

- **Garis Pengaruh Momen Lentur**



- Pada saat *P* berjalan di antara titik A ($x = 0$) dan titik C ($x = 2,5$), maka besarnya momen lentur di titik C adalah :

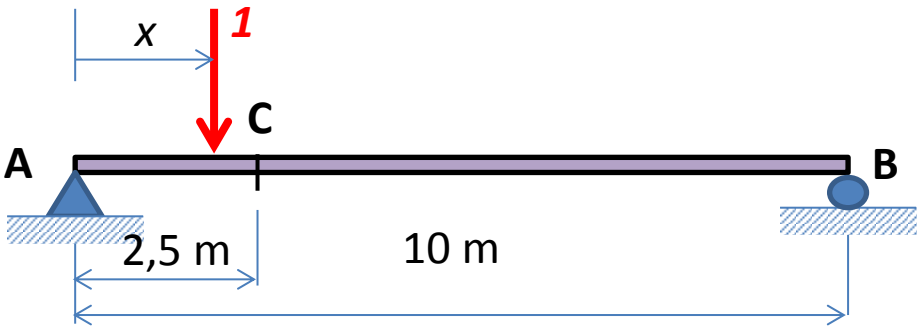
$$M_C = A_v(2) - 1(2,5 - x) = A_v(2,5) - 2,5 + x$$

$$= (1 - \frac{x}{10})(2,5) - 2,5 + x = \frac{7,5}{10}x$$

Atau $\mathbf{M_C = 7,5 \cdot B_v}$

Gambarkan persamaan ini pada ruas antara titik A dan titik C.

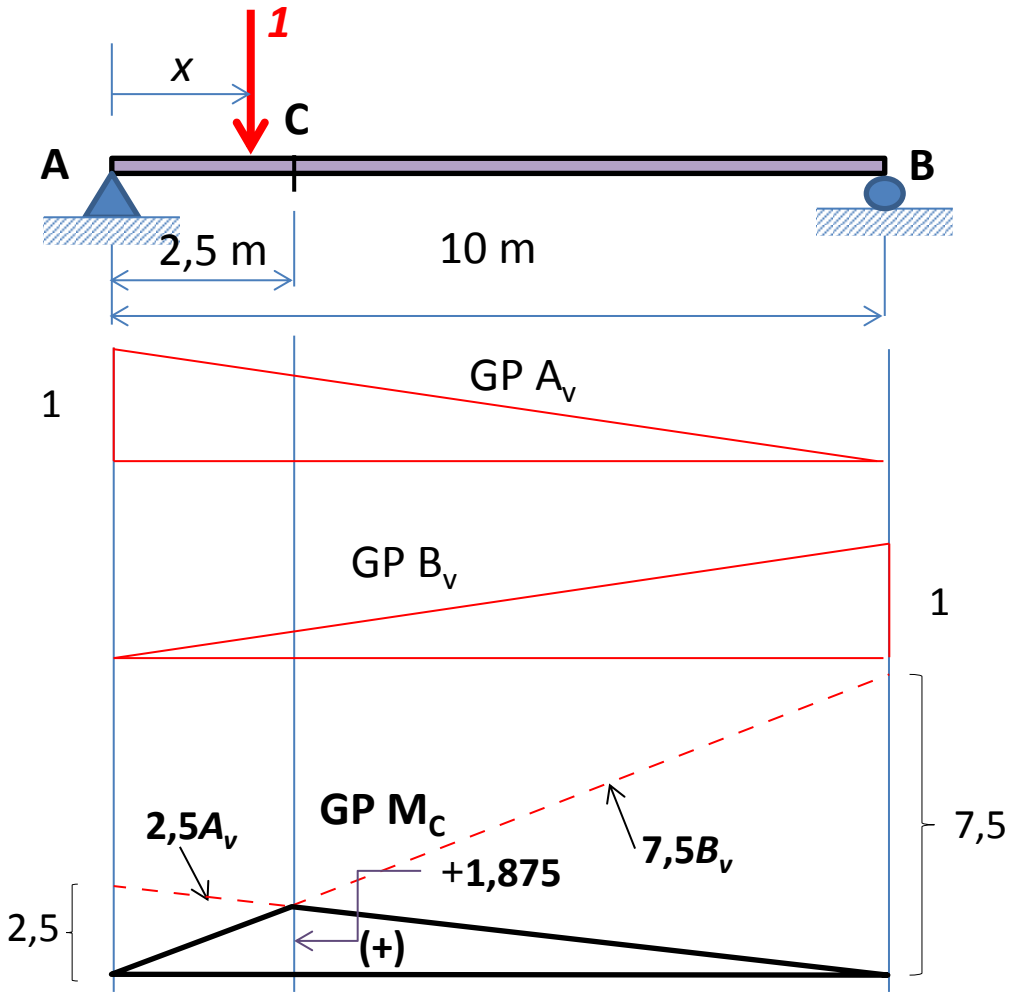
- **Garis Pengaruh Momen Lentur**



- Pada saat *P* berjalan di antara titik C (x = 2,5) dan titik B (x = 10), maka besarnya momen lentur di titik C adalah :

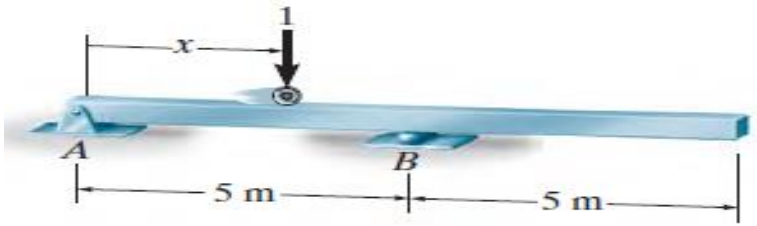
$$M_C = A_v\,(2{,}5)$$

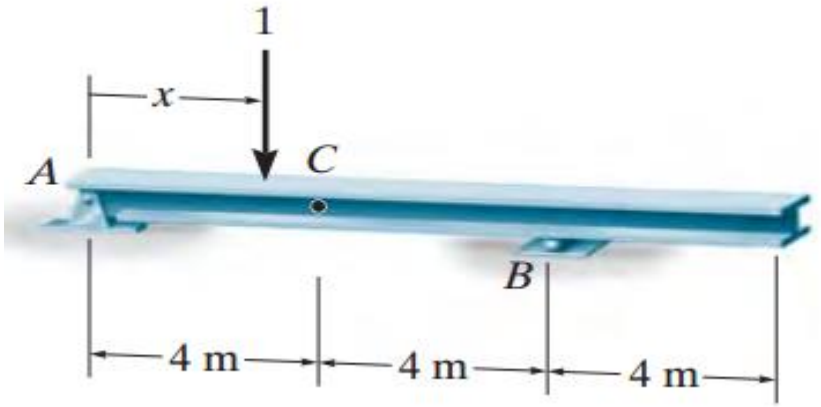
Gambarkan persamaan ini pada ruas antara titik C dan titik B.


1
x
C
A
B
2,5 m
10 m
1
GP A_v
GP B_v
1
GP M_C
$2{,}5A_v$
$7{,}5B_v$
+1,875
(+)
2,5
7,5

Example 1

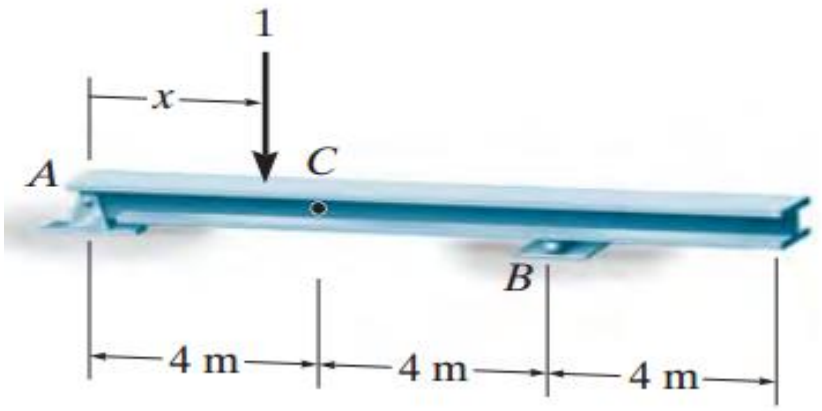
- Construct the influence line for the vertical reaction at *B* of the beam





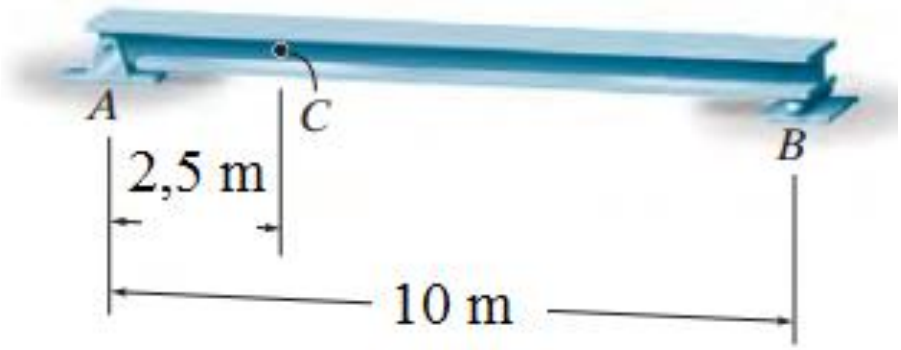
Example 2

- Construct the influence line for the shear and moment at point *C* of the beam in Figure



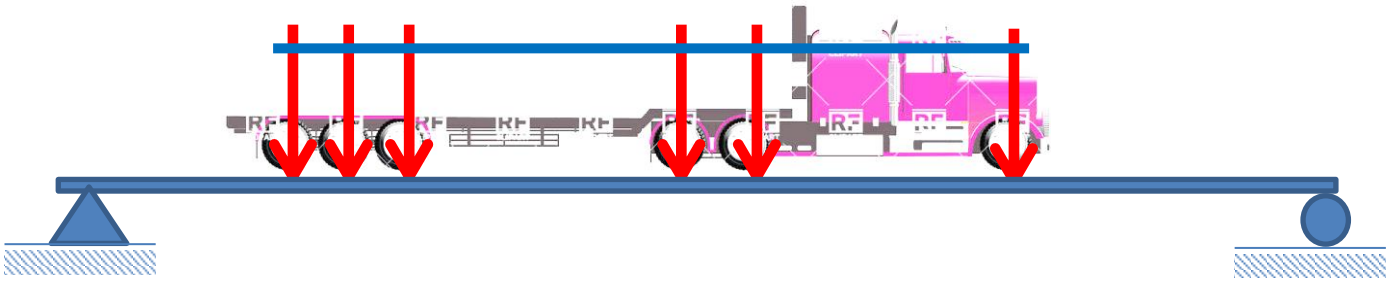
Example 3

- Determine the maximum *positive* shear that can be developed at point *C* in the beam shown in Figure due to a concentrated moving load of 4 kN and a uniform moving load of 2 kN/m.



Series of Concentrated Moving Loads

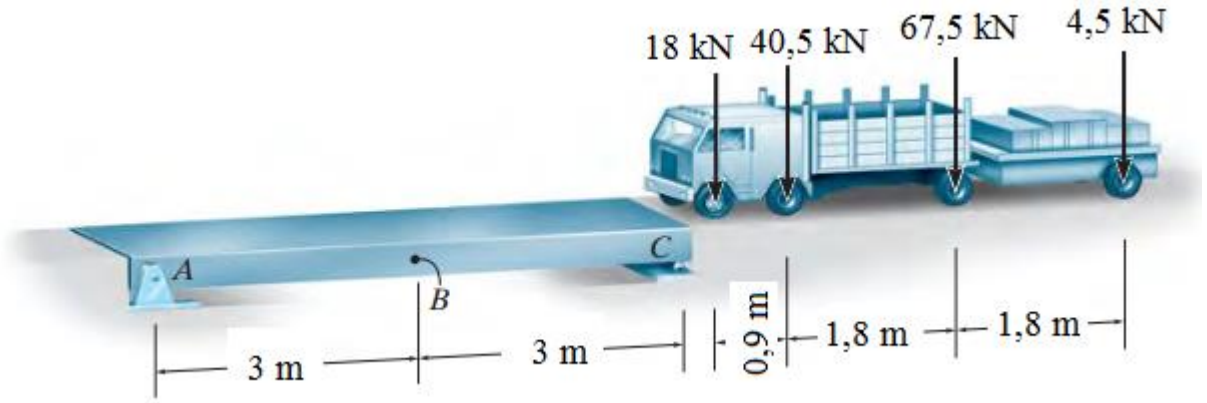
- In some cases, *several* concentrated forces must be placed on the structure.
- An example would be the wheel loadings of a truck or train.



- The maximum effect caused by a series of concentrated force is determined by multiplying the peak ordinate of the influence line by the corresponding magnitude of force

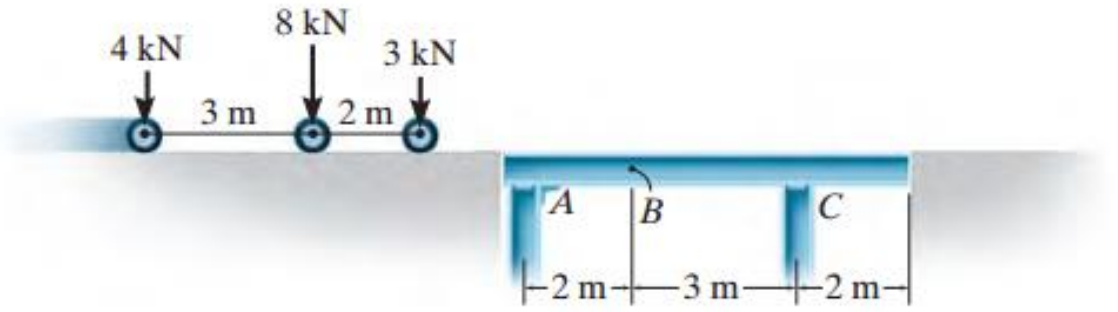
Example 4

- Determine the maximum positive shear created at point *B* in the beam shown in Figure due to the wheel loads of the moving truck.



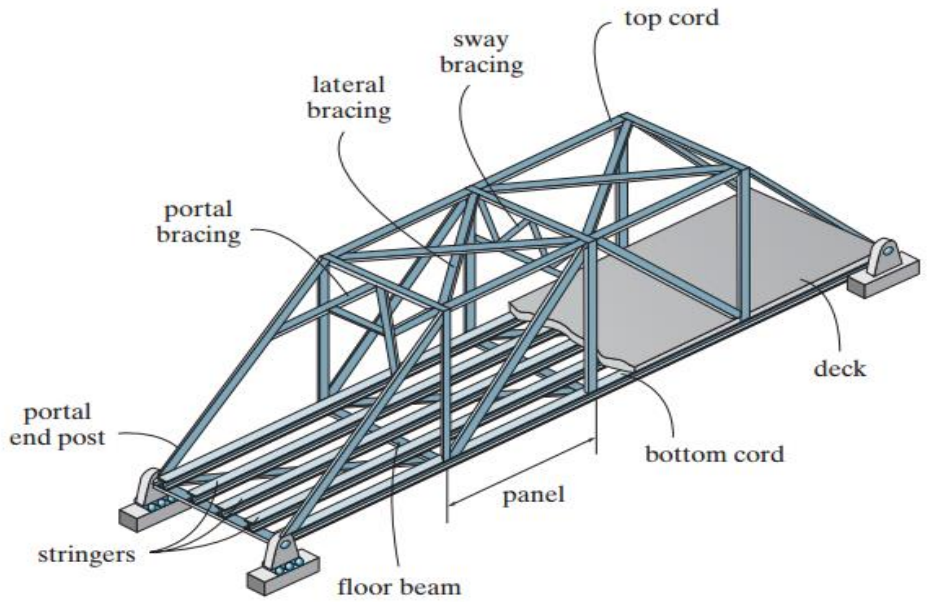
Example 5

- Determine the maximum positive moment created at point *B* in the beam shown in Figure due to the wheel loads of the crane.



Garis Pengaruh Rangka Batang

- the loading on the bridge deck is transmitted to stringers, which in turn transmit the loading to floor beams and then to the *joints* along the bottom cord of the truss.

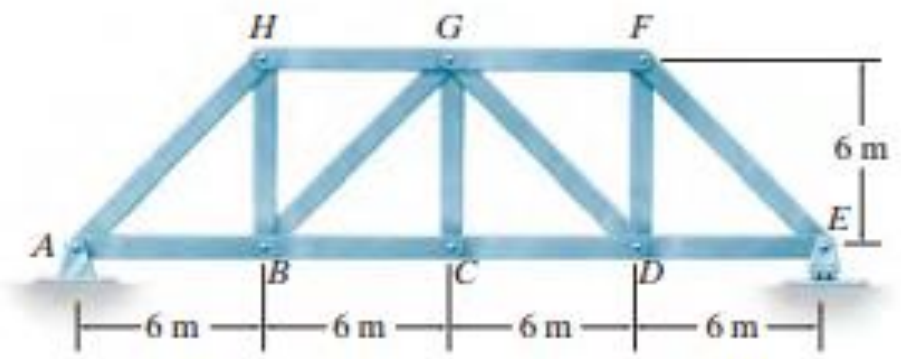


- Since the truss members are affected only by the joint loading, we can therefore obtain the ordinate values of the influence line for a member by loading each joint along the deck with a unit load and then use the method of joints or the method of sections to calculate the force in the member.
- The data can be arranged in tabular form, listing “unit load at joint” versus “force in member.”

- As a convention, if the member force is *tensile* it is considered a *positive* value; if it is *compressive* it is *negative*.
- The influence line for the member is constructed by plotting the data and drawing straight lines between the points

Example 1

- Draw the influence line for the force in member *GB and CG* of the bridge truss shown in Figure



Example 2

- Determine the maximum compressive force developed in member *BG* of the side truss in Figure 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.