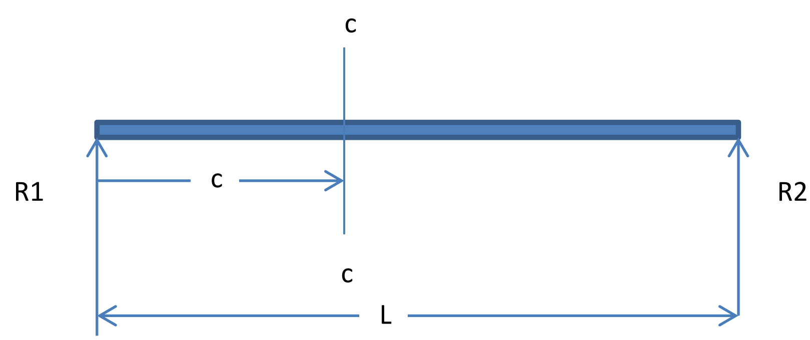
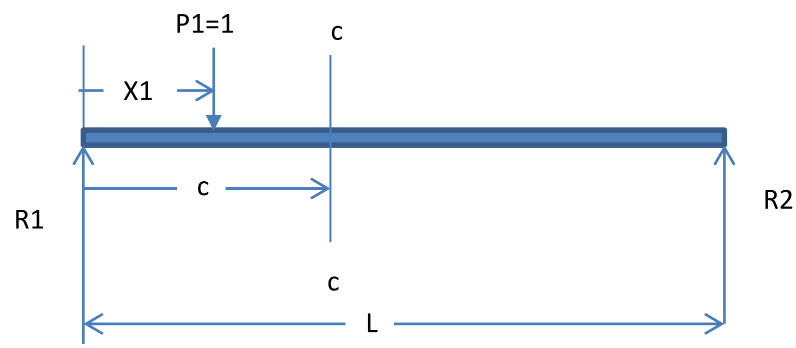
Alfurat Al-Awsat Technical University
Technical College / Al-Najaf
Department : Building & Construction Technology Engineering
Subject: Theory of Structures
Class: Third year
Lecturer : Professor Dr. Hakim Alkurayshi

Lecture (10) Influence lines for shearing forces at specified sections in beams

(1) Influence lines for shear forces at a section in a simply supported beam :

Let a unit load P1 =1 be at distance x1 from R1 where 0 ≤ x 1 ≤c.





Here S.F. at c-c is equal to (-R2) or (R1-P1),

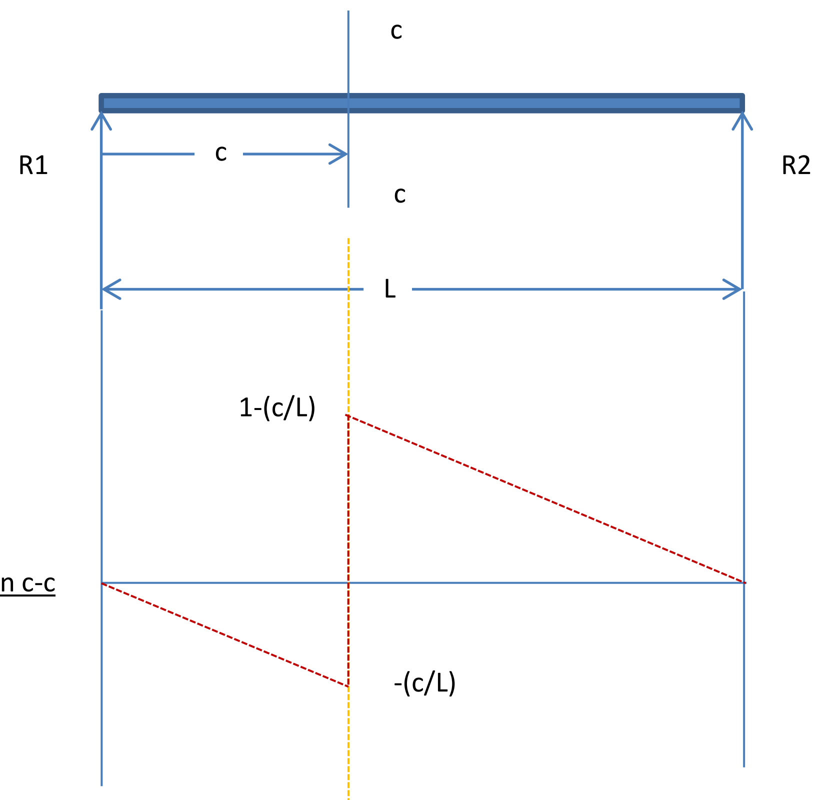
$$But \quad R_2 = \frac{P_1.x_1}{L} = \frac{x_1}{L} \qquad Then \ \ V = \frac{-x_1}{L}$$

Next let a unit load P2=1 be at distance x2 from R2 where 0 ≤ x 1 ≤ (L-c).

Then S.F. at c-c is,

$$V = R_1 \quad or \quad V = P_2 - R_2$$

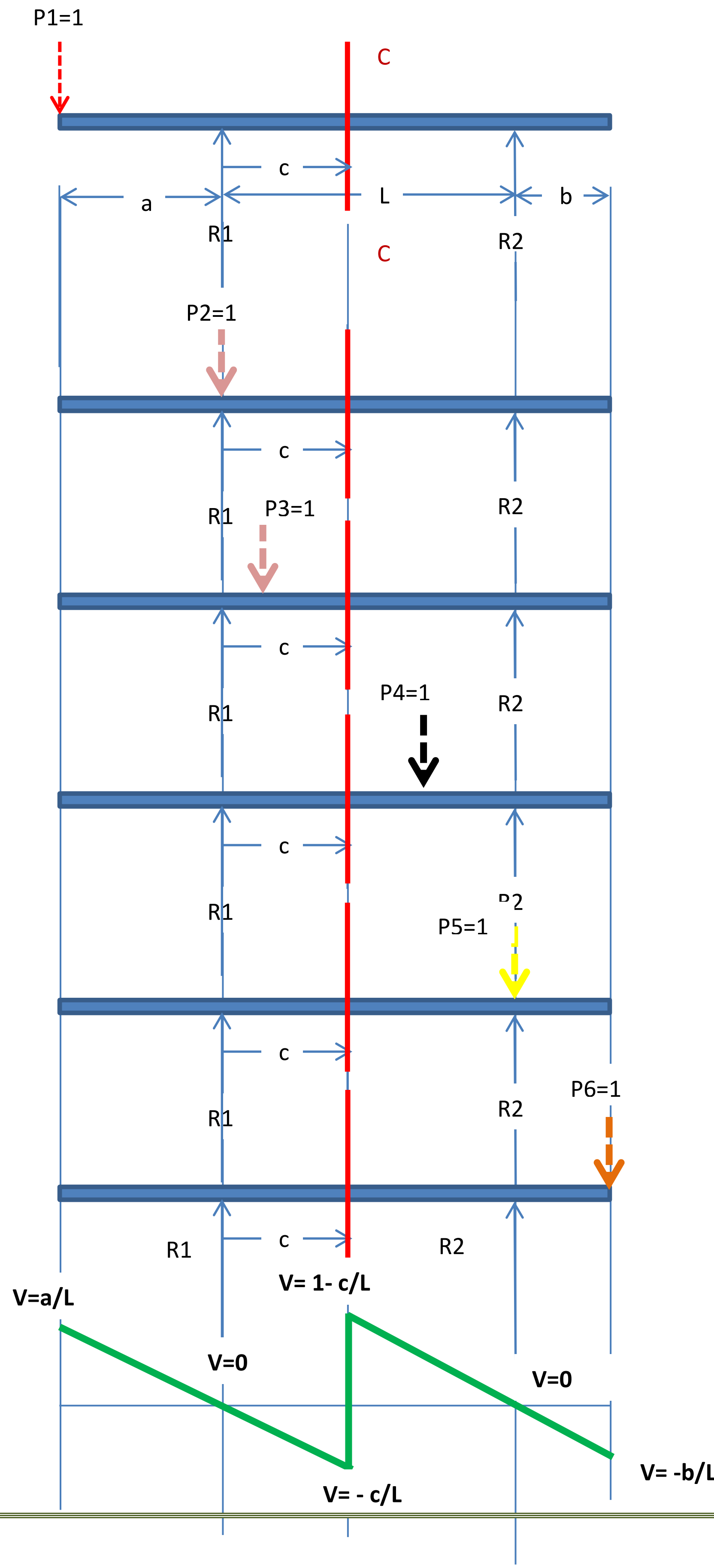
$$But \quad R_1 = \frac{P_2 . x_2}{L} = \frac{x_2}{L} \qquad Then\ V = \frac{x_2}{L}$$



<u>Influence line for shear force at section c-c</u>

(2) I.L. for shear in a simply supported beam with overhangs:

Draw the I.L. for S.F. at section c-c



Solution : The influence line for force at any section in a statically determinate beam is made up of straight lines . Therefore, the values of shear forces are calculated when a unit load takes specified positions. **First put a unit load P1=1 at extreme left end**.

The S.F. at c-c is :

V=R1-P1 Or V=-R2

$$But\ R_1 = \frac{P_1(a+L)}{L} = (\frac{a}{L}+1)$$

$$Substitute\ \ V = \left(\frac{a}{L}+1\right) - 1 = \frac{a}{L}$$

When a unit load P2=1 is over R1.Then R1=1 and R2=0.Therefore the S.F.at c-c is V=0.

When a unit load P3=1 is just left of c-c the S.F.at c-c is V=R-P3 or V=-R2.

$$But\ R_1 = \frac{P_3(L-c)}{L} = (1-\frac{c}{L})$$

$$Then\ V = \left(1-\frac{c}{L}\right) - 1 = -\frac{c}{L}$$

When a unit load P4=1 is just right of c-c the S.F.at c-c is ,

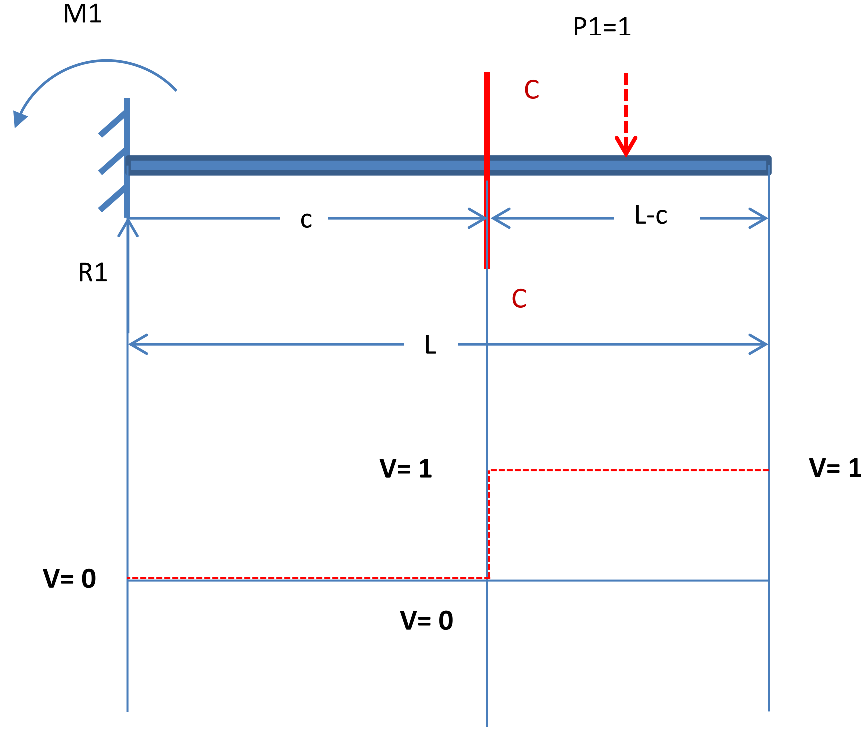
$$Then\ V = R_1 = 1 - \frac{c}{L}$$

When a unit load P5=1 is over R2.Then V=R1=0

When a unit load P6=1 is at extreme right end then,

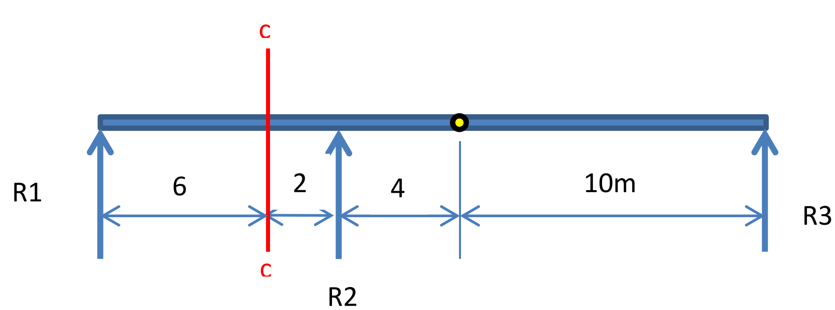
$$V = R_1 = -\frac{P_6.b}{L} = -\frac{b}{L}$$

(3) I.L. for shear in cantilever



(4) Influence line for shear in hinged beams;

Draw I.L. for S.F. at section c-c. A uniform load 2t/m (of any length) and a single load 40 t move on this beam .The self-weight is 3t/m .Calculate the max. values of S.F. at section c-c.



Solution : The influence line for force at any section in a statically determinate beam is made up of straight lines . Therefore, the values of shear forces are calculated when a unit load takes specified positions. **First put a unit load P1=1 at extreme left end** OR over R1.

The S.F. at c-c is :

V=R1-P1 ButR1=P1=1

Then V=0

When a unit load P2=1 is just left of c-c the S.F.at c-c is V=R1-P2 .Find R1 first:

R3x10=0 (B.M.=0at H) Or R3=0

Use ΣM=0 about R2

R1x8-P2x2-R3x13=0 Then R1=0.25

V=0.25-1 =-0.75

When a unit load P3=1 is just right of c-c the S.F.at c-c is ,

$$V = R_1 \; Or \; V = P_3 - R_2 - R_3$$

To find R1,use B.M.=0 at hinge H. Then R3=0

Use ΣM=0 about R2.Then R1=0.25 and V=0.25

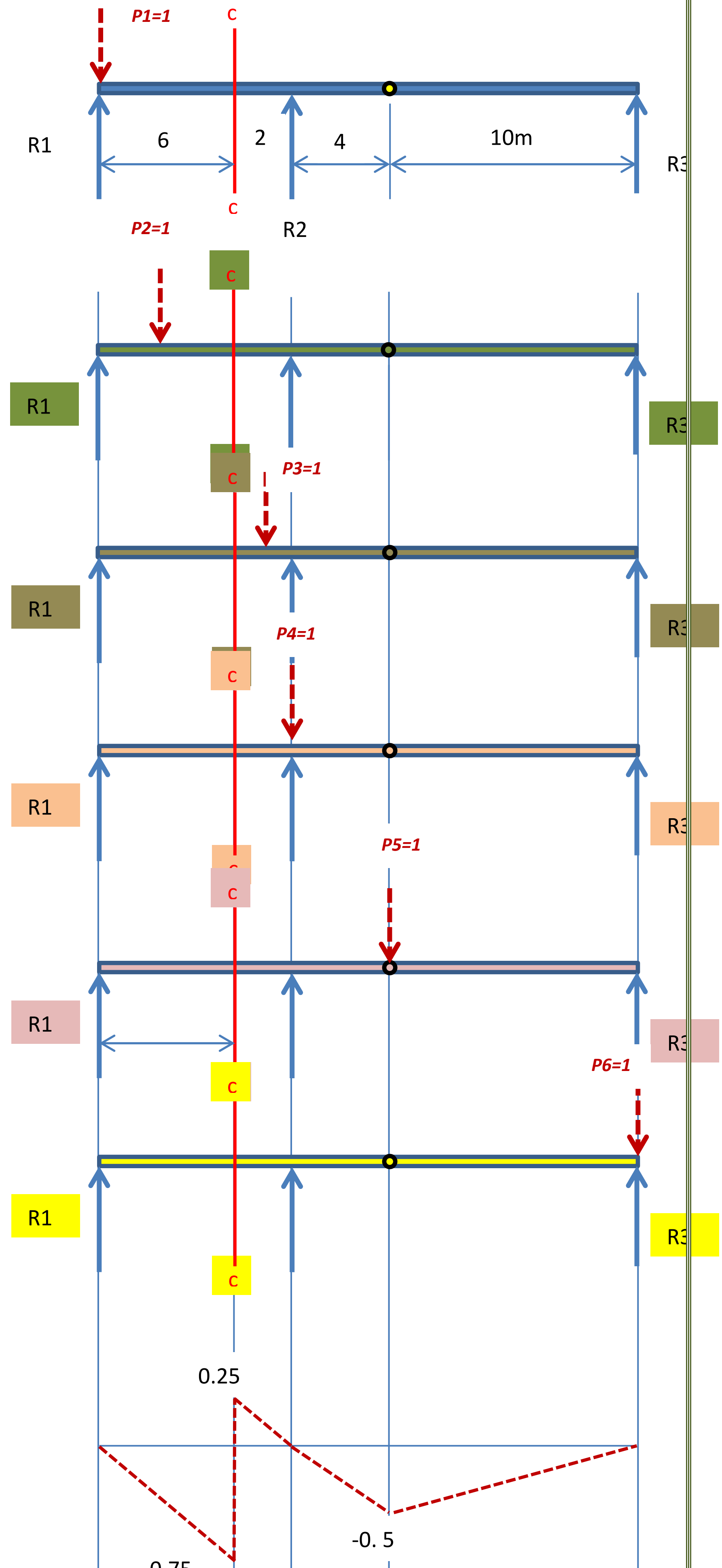
When a unit load P4=1 is over R2.Then V=R1=0

When a unit load P5=1 is at hinge H. Then V=R1. To find R1,use B.M.=0 at hinge H. Then R3=0

Use ΣM=0 about R2.

R1x8+P5x4-R3x14=0…….R1=-0.5 and V=-0.5

When a unit load P6=1 is over R3.Then V=R1=0



Maximum S.F.at c-c is:

$(+ve)_{Max.}$=3x{-0.5x0.75x6+0.5x0.25x2-0.5x0.5x14}

+2x{0+0.5x0.25x2-0}

+40x0.25=-6t

No maximum positive shear.

$(-ve)_{Max.}$=3x{-0.5x0.75x6+0.5x0.25x2-0.5x0.5x14}

+2x{-0.5x0.75x6+0-0.5x0.5x14}

-40x0.75=-58t

الفرق بين الحالتين هو أن الحمل المتحرك

يضرب مرة بربع ((0.25)) لتمثيل الجزء الموجب حين مرور الحمل الفردي عليه ويضرب ب ثلاثة أرباع ((0.75)) الذي يمثل الجزء السالب