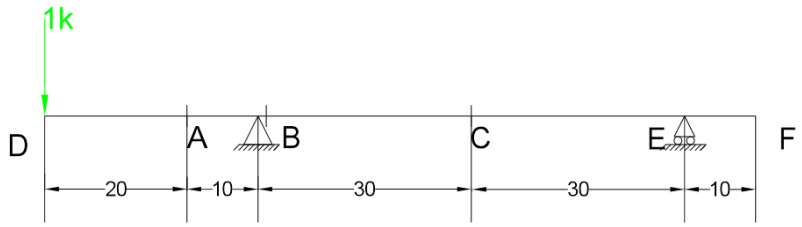
Problem 1:

When 1k at point D:



$R_B = 1.5\ k$
$R_E = -0.5k$

$V_A = -1\ k$
$V_B = 0.5k$
$V_C = 0.5\ k$

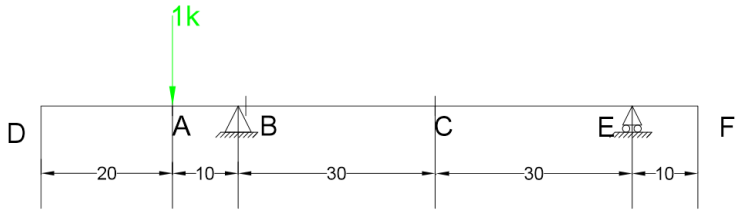
$M_A = -20\ k - ft$
$M_B = -30\ k - ft$
$M_C = -15\ k - ft$

When 1k at point A:

$R_B = 1.167\ k$
$R_E = -0.167\ k$

$V_A = -1\ k\ (when\ 1k\ at\ slight\ left\ of\ A)$
$V_A = 0\ k\ (when\ 1k\ at\ slight\ right\ of\ A)$
$V_B = 0.167\ k$
$V_C = 0.167\ k$

$M_A = 0\ k - ft$
$M_B = -10\ k - ft$
$M_C = -5\ k - ft$

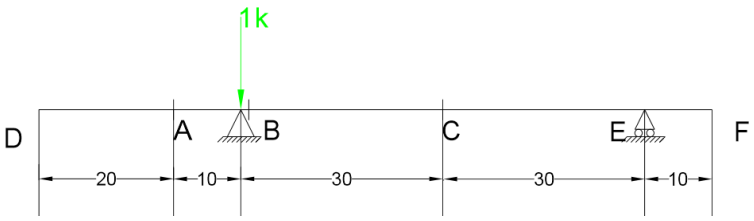


When 1k at point B:

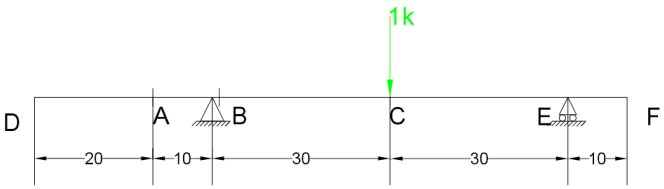
$R_B = 1\ k$
$R_E = 0\ k$

$V_A = 0\ k$
$V_B = 0\ k\ (when\ 1k\ at\ slight\ left\ of\ B)$
$V_B = 1\ k\ (when\ 1k\ at\ slight\ right\ of\ B)$
$V_c = 0\ k$

$M_A = 0\ k - ft$
$M_B = 0\ k - ft$
$M_C = 0k - ft$



When 1k at point C:

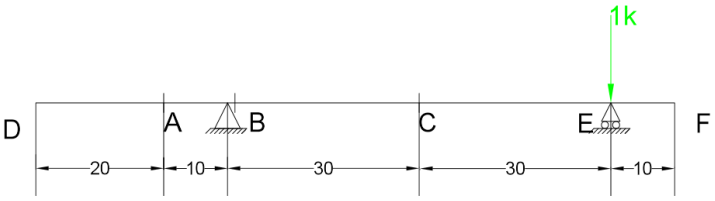


$R_B = 0.5\ k$
$R_E = 0.5k$

$V_A = 0\ k$
$V_B = 0.5\ k$
$V_C = -0.5\ k\ (when\ 1k\ at\ slight\ left\ of\ C)$
$V_C = 0.5\ k\ (when\ 1k\ at\ slight\ right\ of\ C)$

$M_A = 0\ k - ft$
$M_B = 0\ k - ft$
$M_C = 15\ k - ft$

When 1k at point E:

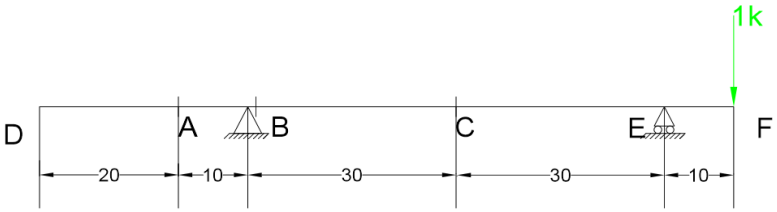


$R_B = 0\ k$
$R_E = 1k$

$V_A = 0\ k$
$V_B = 0\ k$
$V_C = 0\ \ k$

$M_A = 0\ k - ft$
$M_B = 0\ k - ft$
$M_C = 0\ k - ft$

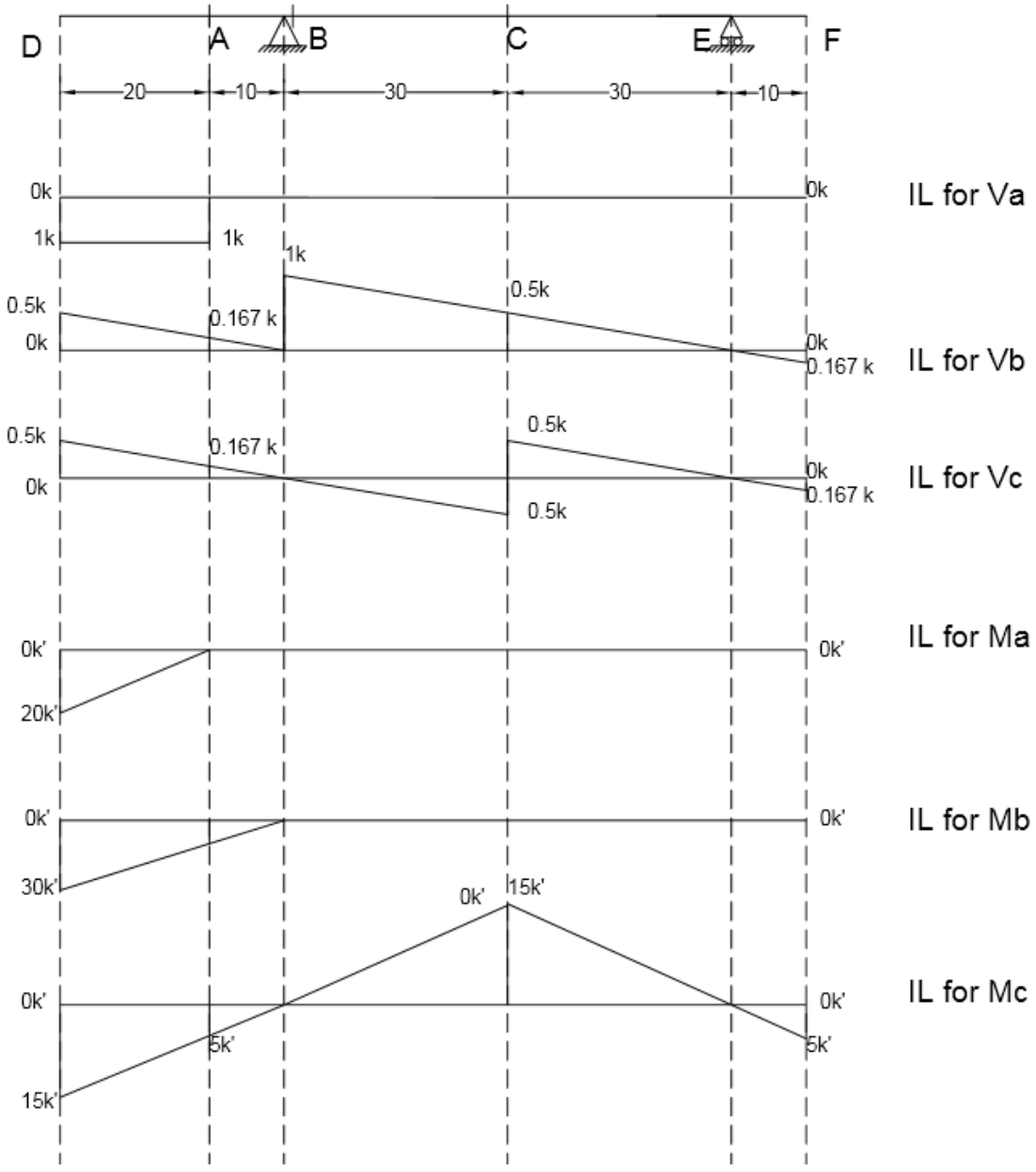
When 1k at point F:



$R_B = -0.167\ k$
$R_E = 1.167k$

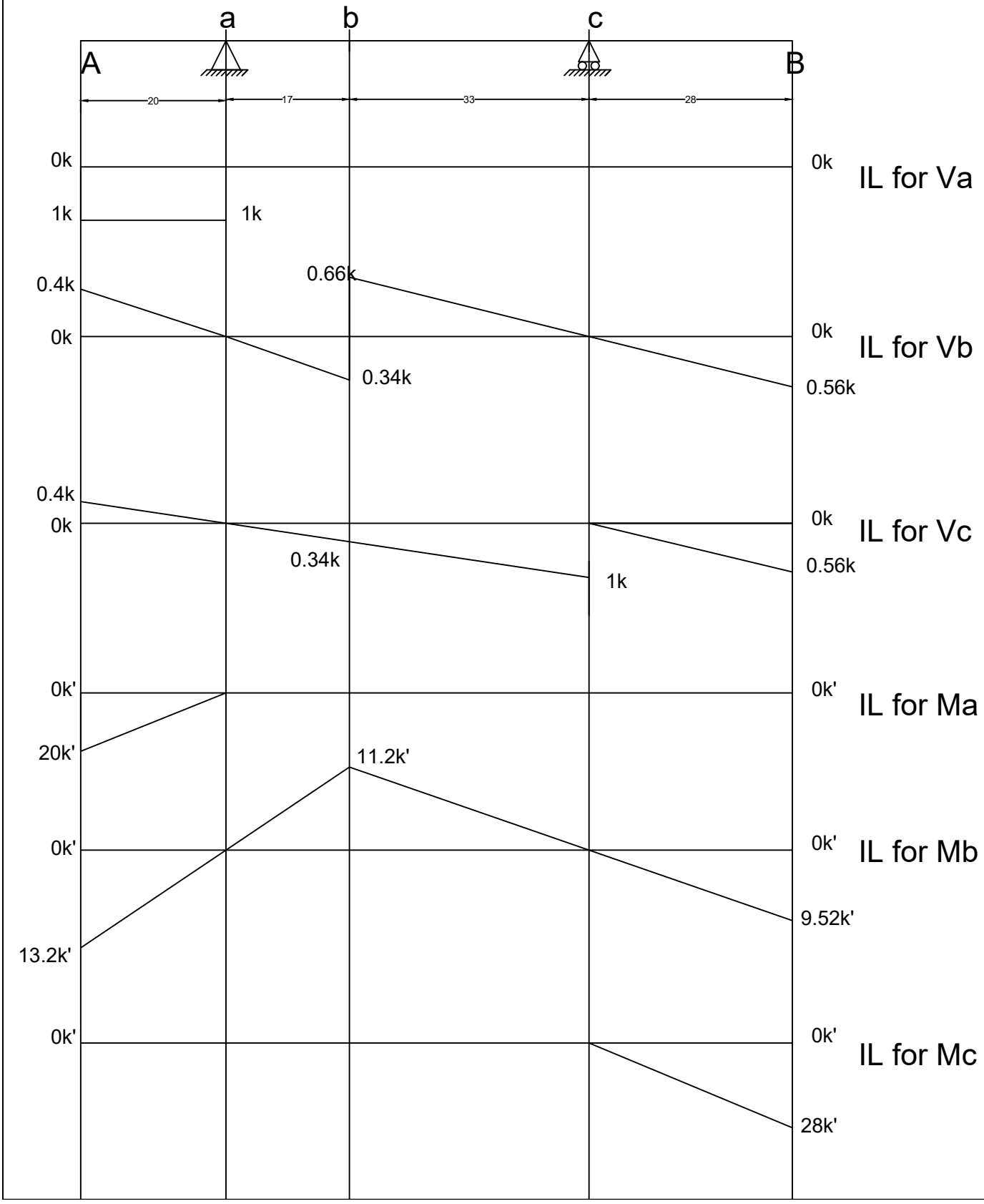
$V_A = 0\ k$
$V_B = -0.167\ k$
$V_C = -0.167\ \ k$

$M_A = 0\ k - ft$
$M_B = 0\ k - ft$
$M_C = -5\ k - ft$

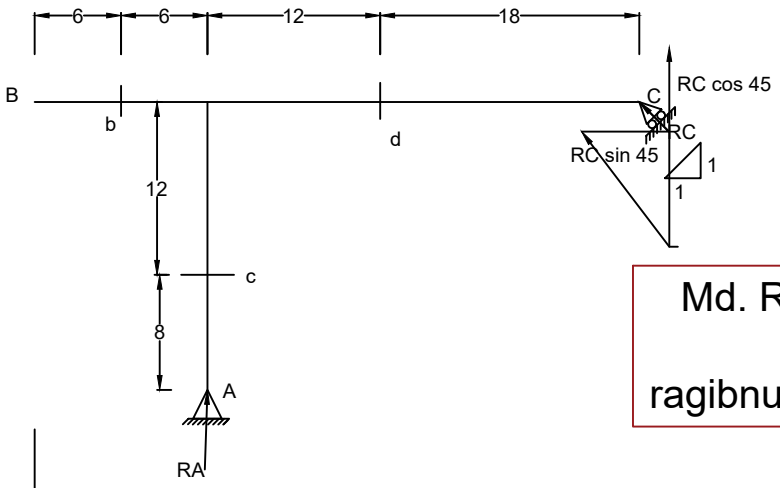


Problem 2

Draw ILD for shear and moment at a,b & c



Problem 4
Draw ILD for shear and moment at b,c & d



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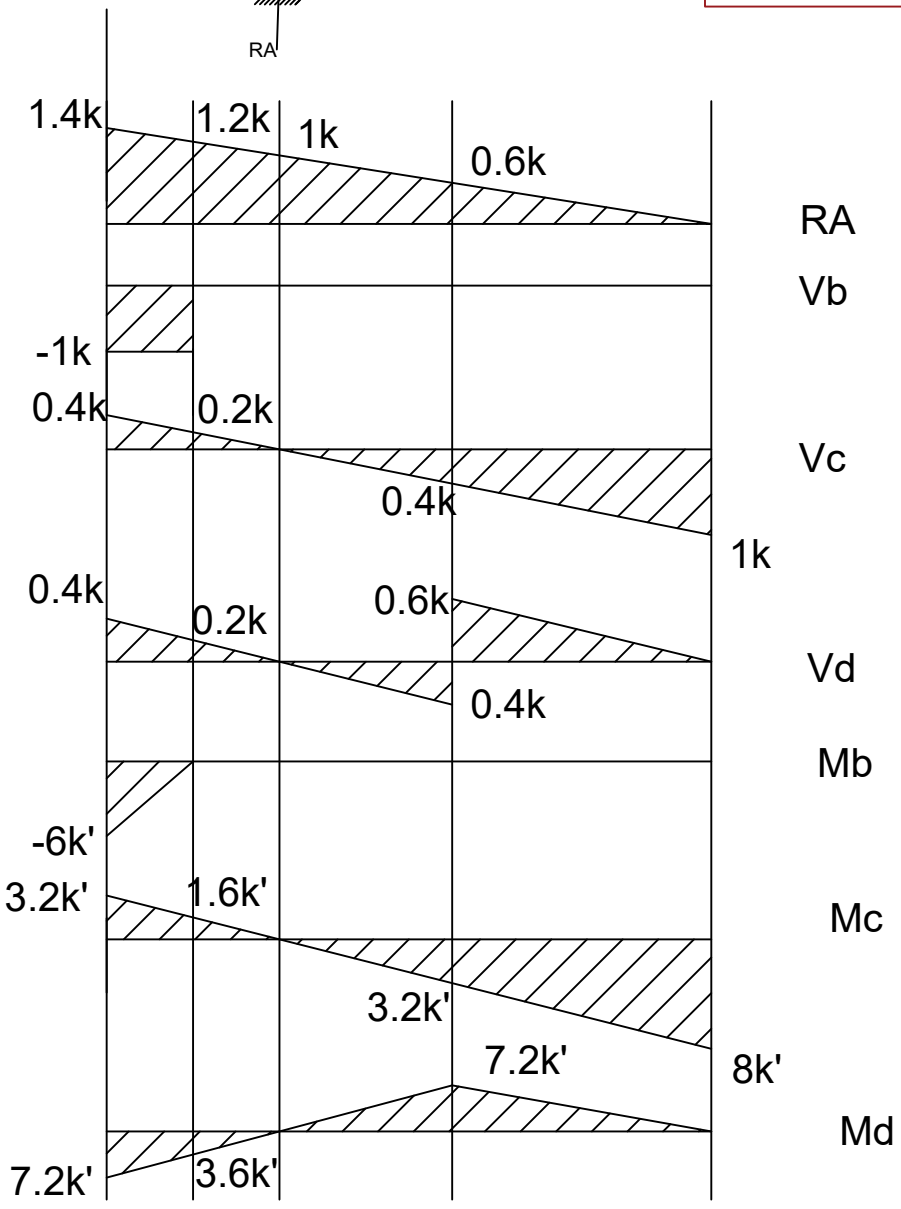
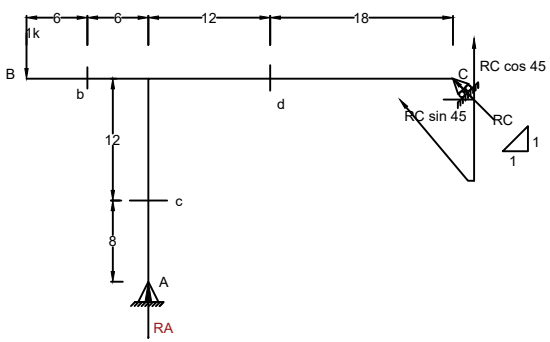




when 1k at B

$RA=\frac{42}{30}=1.4k$

RC cos 45 =-0.4k

$RC=-\frac{0.4}{\cos 45}=-0.566k$

RC sin 45=-0.566sin 45=-0.4k

Vb=-1k

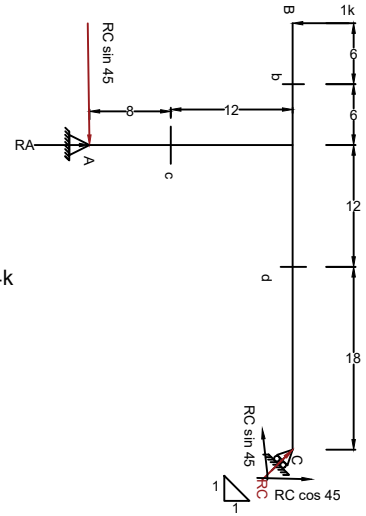
Vc=-RC sin 45=0.4

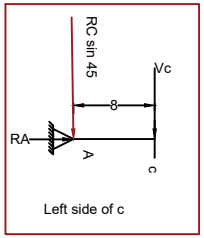
Vd=-RC cos 45 =0.4

Mb=-6k'

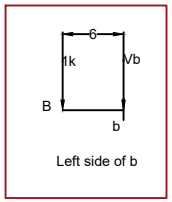
Mc=3.2k'

Md=-7.2k'

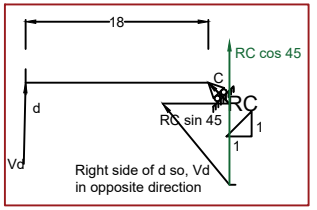




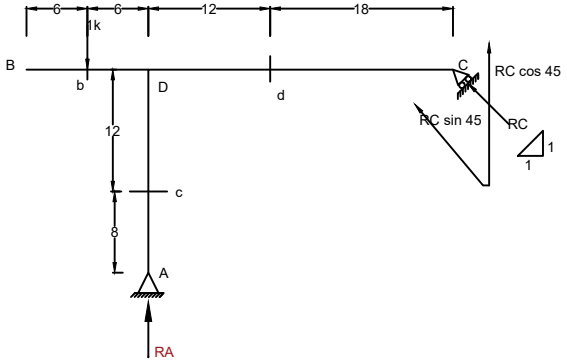
Left side of c



Left side of b



Right side of d so, Vd in opposite direction



When 1k at b

$RA=\frac{36}{30}=1.2k$

RC cos 45 =-0.2k

$RC=-\frac{0.2}{\cos 45}=-0.283k$

RC sin 45=-0.283sin 45=-0.2k

Vb=-1k(left)

Vb=0(right)

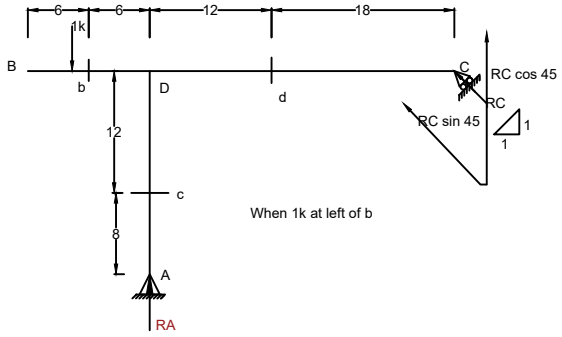
Vc=-RC sin 45=0.2

Vd=-RC cos 45 =0.2

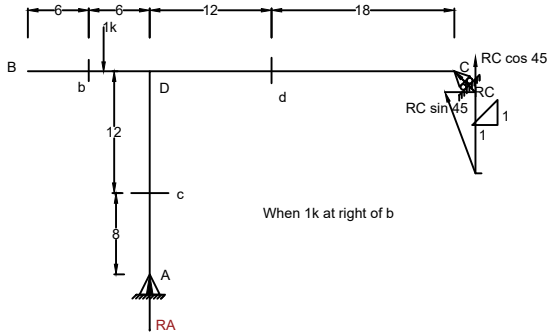
Mb=0k'

Mc=1.6k'

Md=-3.6k'



When 1k at left of b



When 1k at right of b

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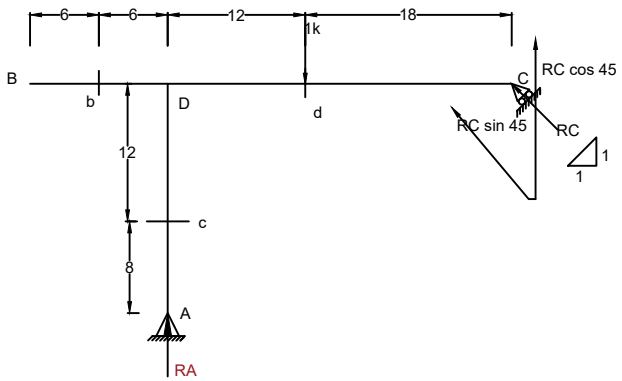


When 1k at d

RA=$\frac{18}{30}$ =0.6k

RC cos 45 =0.4k

RC= $\frac{0.4}{\cos 45}$ =0.566k

RC sin 45=0.566sin 45=0.4k

Vb=0k

Vc=-RC sin 45=-0.4k

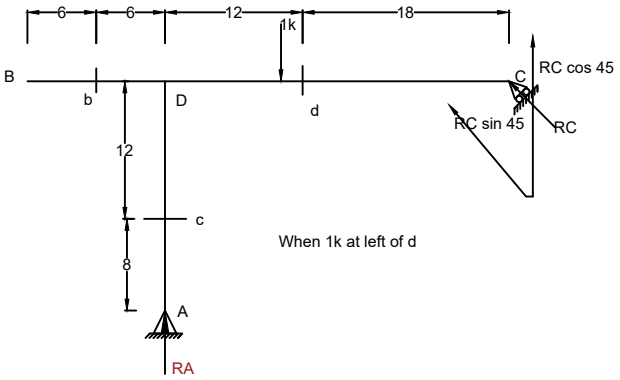
Vd=-RC cos 45 =-0.4k (left)

Vd=-RC cos 45 =0.6k (right)

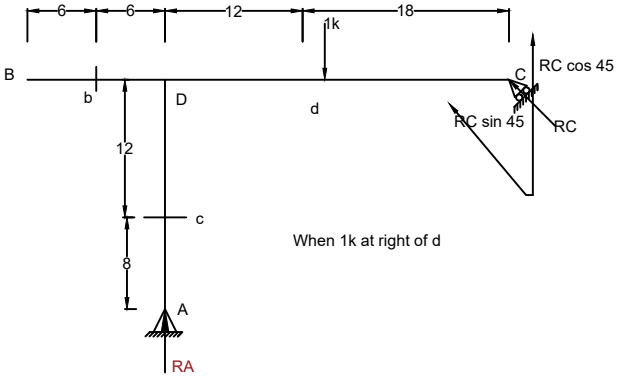
Mb=0k'

Mc=-3.2k'

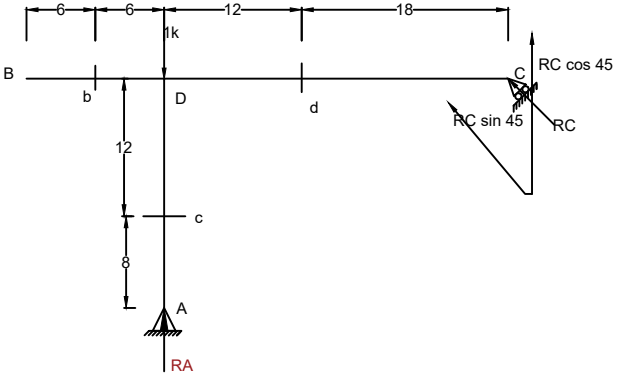
Md=7.2k'



When 1k at left of d



When 1k at right of d



When 1k at D

RA=1k

RC cos 45 =0k

RC=- $\frac{0.2}{\cos 45}$ =0k

RC sin 45=-0.283sin 45=0k

Vb=0k

Vc=-RC sin 45=0

Vd=-RC cos 45 =0

Mb=0k'

Mc=0k'

Md=0k'

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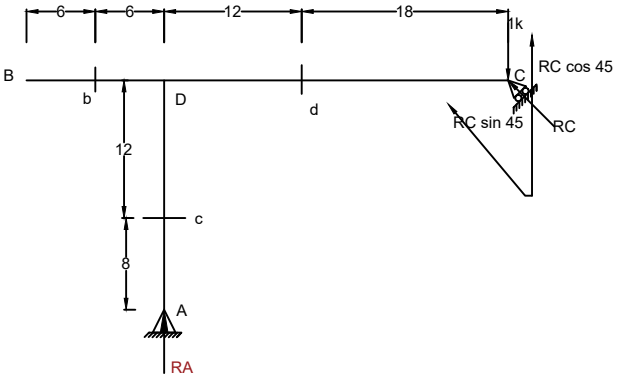


When 1k at C

RA=0k

RC cos 45 =1k

RC= $\frac{1}{\cos 45}$ =1.414k

RC sin 45=1.414sin 45=1k

Vb=0k

Vc=-RC sin 45=-1k

Vd=0k

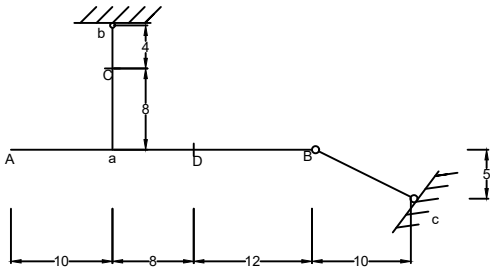
Mb=0k'

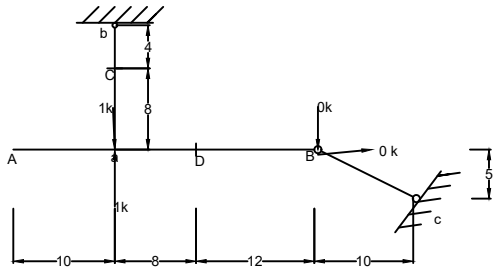
Mc=-8k'

Md=0k'

Problem 5

Draw ILD for shear and moment at C & D. If the load moves from A to B.





When 1k at a

Rb= 1 k

RBC sin 26 .565=0k

RBC =$\frac{0}{\sin 26.565}$=0k

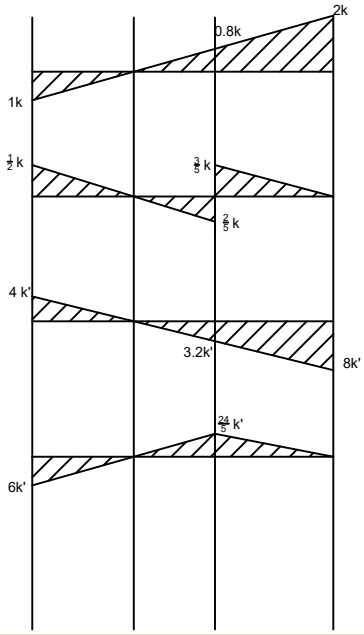
RBC cos 26.565=0k

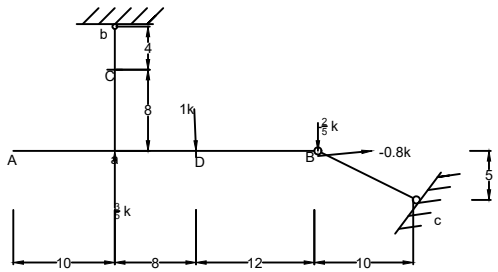
VC=0k

VD=0

MC= 0

MD= 0





When 1k at a

Rb= $\frac{3}{5}$ k

RBC sin 26 .565=-$\frac{2}{5}$ k

RBC =-$\frac{2/5}{\sin 26.565}$=-0.894

RBC cos 26.565=-0.8k

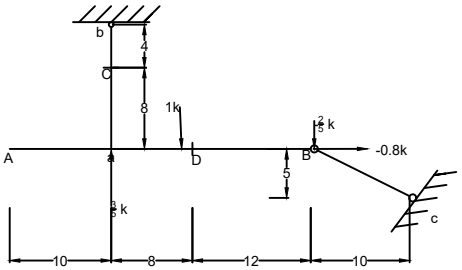
VC=0.8k

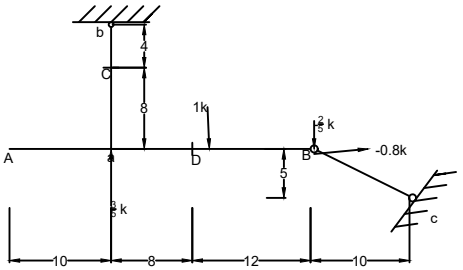
VD=-$\frac{2}{5}$ k(left)

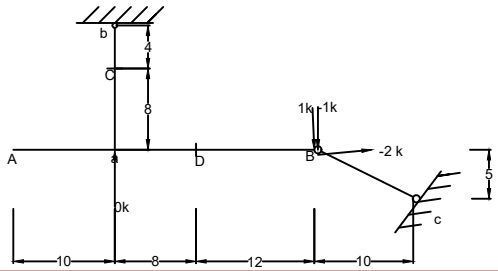
VD=$\frac{3}{5}$ k(right)

MC= -3.2k'

MD= $\frac{24}{5}$ k







When 1k atB

Rb= 0 k

RBC sin 26 .565=-1k

RBC =-$\frac{1}{\sin 26.565}$=-2.236

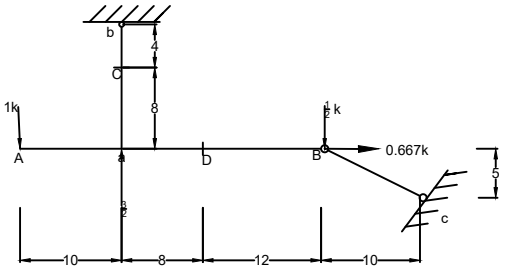
RBC cos 26.565=-2k

VC=2k

VD=0k

MC= -8k'

MD= 0k'



When 1k at A

Rb= $\frac{30}{20}$= $\frac{3}{2}$ k

RBC sin 26 .565=$\frac{1}{2}$ k

RBC =$\frac{1/2}{\sin 26.565}$=1.118k

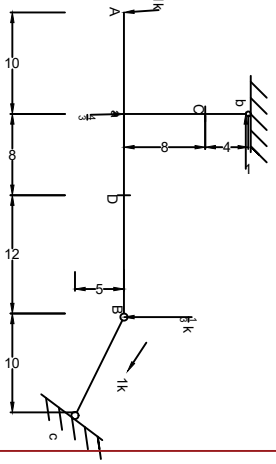
RBC cos 26.565=1k

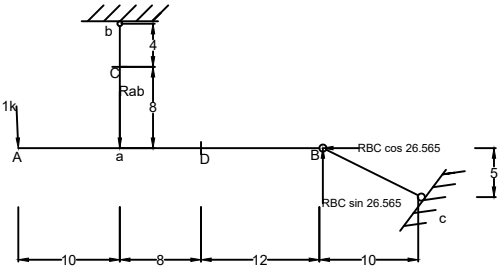
VC=-1

VD=RBC sin 26 .565=$\frac{1}{2}$ k

MC= 4k'

MD= -6k'





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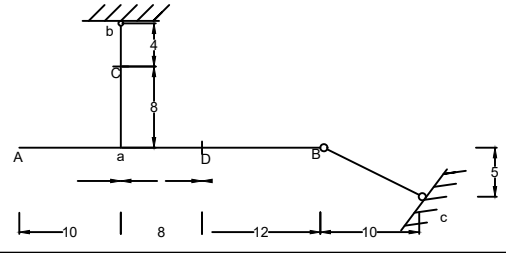

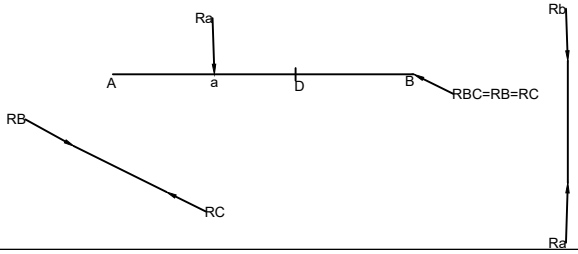

Problem 06

Find shear and moment at 1,2 &3 and reaction at C if load moves from B to D

Shear force is sum of all the transverse forces (perpendicular to the member or beam)

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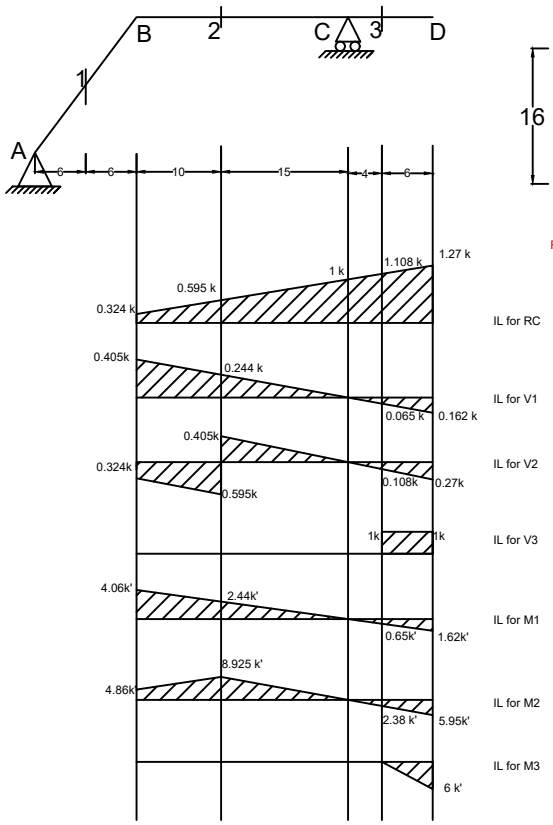
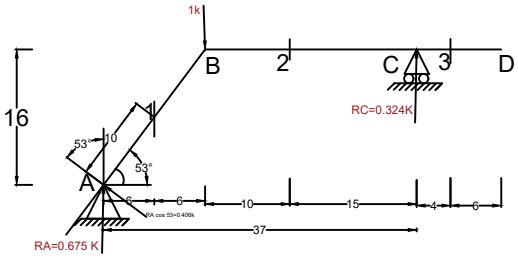
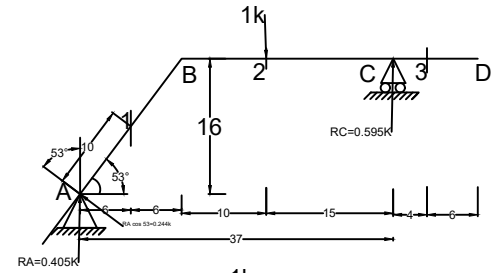




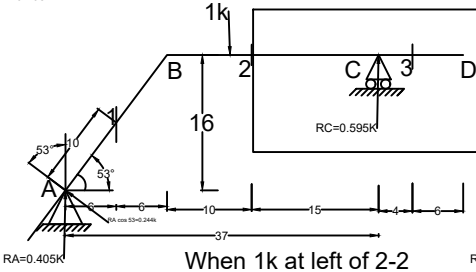
When 1k at B

RC= $\frac{16}{37}$= 0.324 k
RA=1-RC=0.675 k
V1=RA cos 53= 0.405 k
V2= -0.324 k
V3= 0k
M1= 10 * 0.406 = 4.06 k'
M2= 15 * 0.324 = 4.86 k'
M3= 0 k'

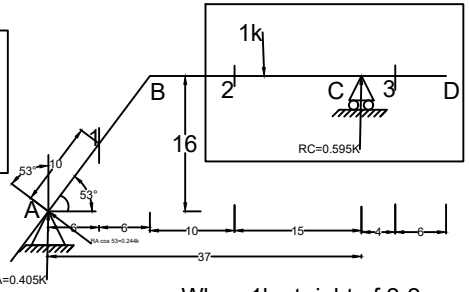


When 1k at 2-2

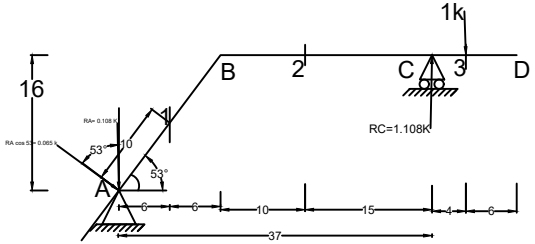
RC= $\frac{22}{37}$= 0.595 k
RA=1-RC=0.405 k
V1=RA cos 53= 0.244 k
V2= -0.595 k (When 1k at left of 2-2)
V2= 0.405 k (When 1k at right of 2-2)
V3= 0k
M1= 10 * 0.244 = 2.44 k'
M2= 15 * 0.595 = 8.925 k'
M3= 0 k'



When 1k at left of 2-2

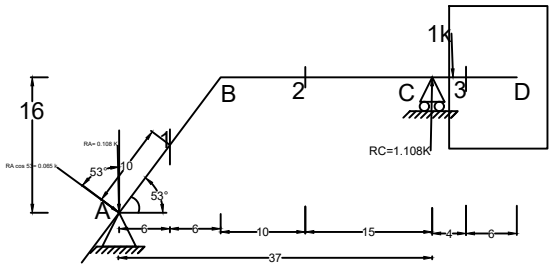


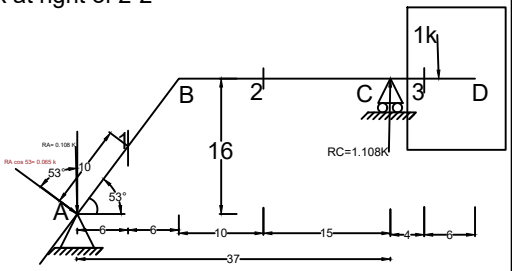
When 1k at right of 2-2

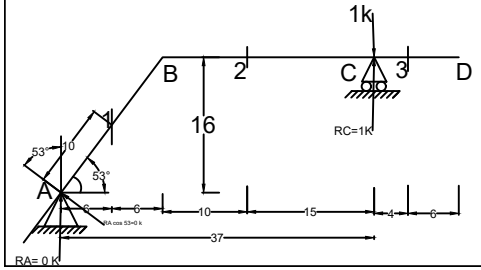


When 1k at 3-3

RC= $\frac{41}{37}$= 1.108 k
RA=1-RC= 0.108 k
V1=RA cos 53= -0.065 k
V2= -0.108k
V3= 0 k (When 1k at left of 3-3)
V3= 1 k (When 1k at right of 3-3)
M1= -10 * 0.065 =- 0.65k'
M2= 15 * 1.108 -19*1 = -2.38 k'
M3= 0 k'

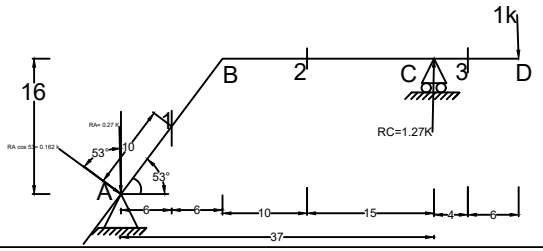






When 1k at C

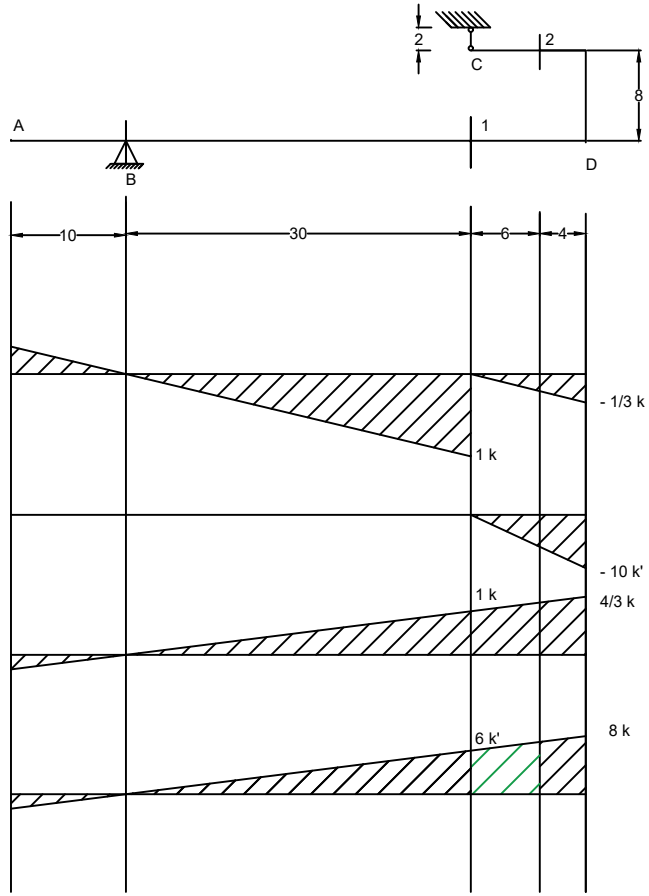
RC= 1 k
RA=1-RC=0 k
V1=RA cos 53= 0 k
V2= 0 k
V3= 0k
M1= 0 k'
M2= 0 k'
M3= 0 k'

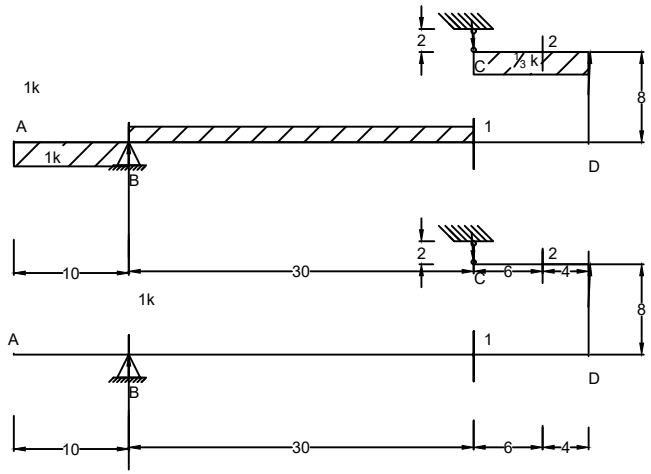


When 1k at D

RC= $\frac{47}{37}$= 1.27 k
RA=1-RC= 0.27 k
V1=RA cos 53= -0.162 k
V2= -0.27k
V3= 1 k
M1= -10 * 0.162 = -1.62 k'
M2= 15 * 1.27 - 25*1 = -5.95 k'
M3= -6 k'

Problem 7





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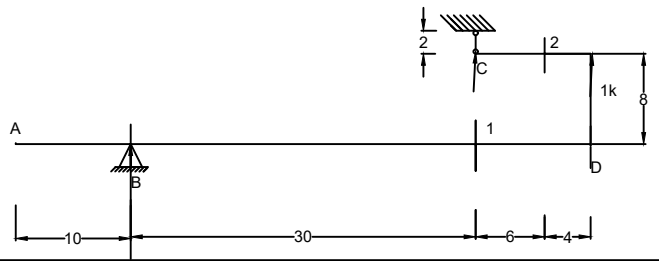
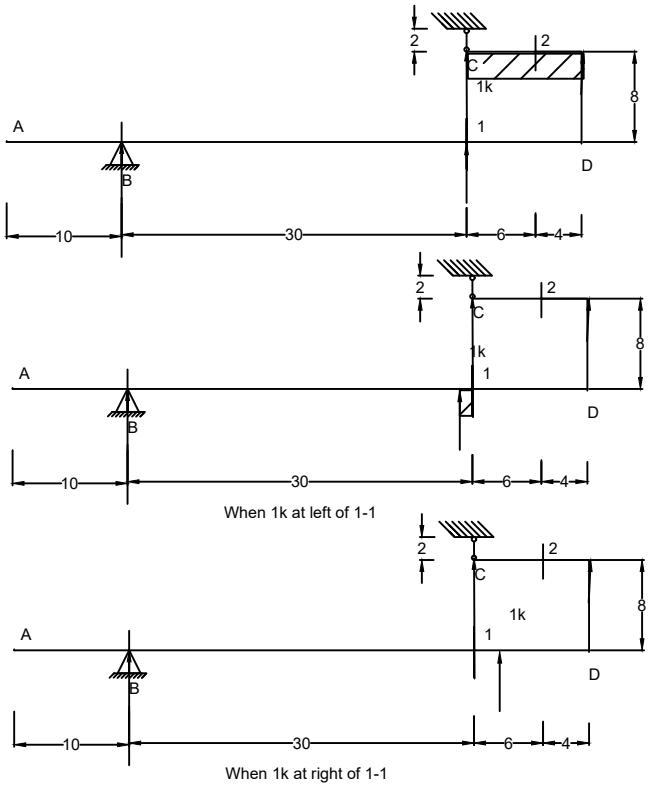


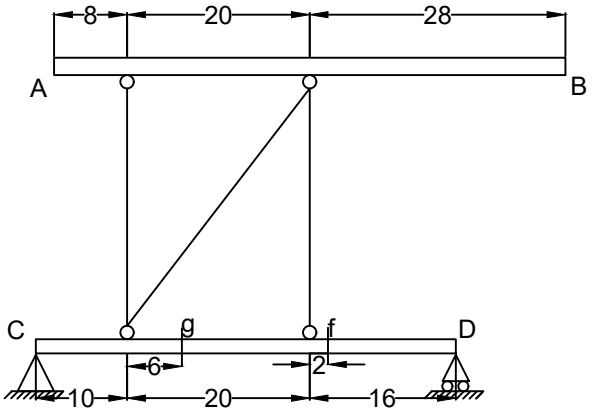
When 1k at D
Rc=$\frac{4}{3}$ k Rb=- $\frac{1}{3}$ k
V1= - $\frac{1}{3}$ k
M1=-10k
V2= $\frac{4}{3}$ k
M2= 8 k'

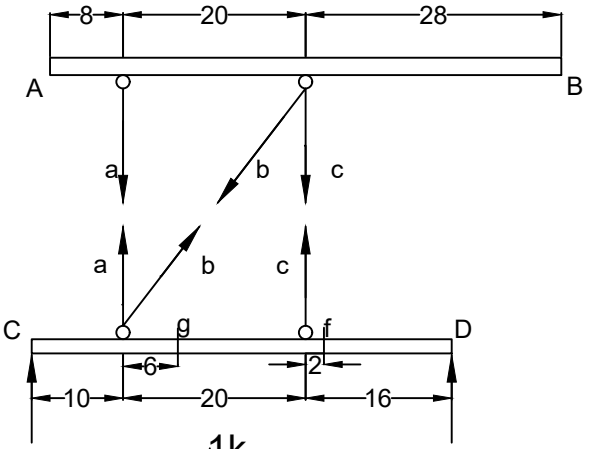
When 1k at 1-1
Rc=1 k Rb=0 k
V1= 1 k(left)
V1=0 k (right)
M1= 0k
V2= 1 k
M2= 6 k

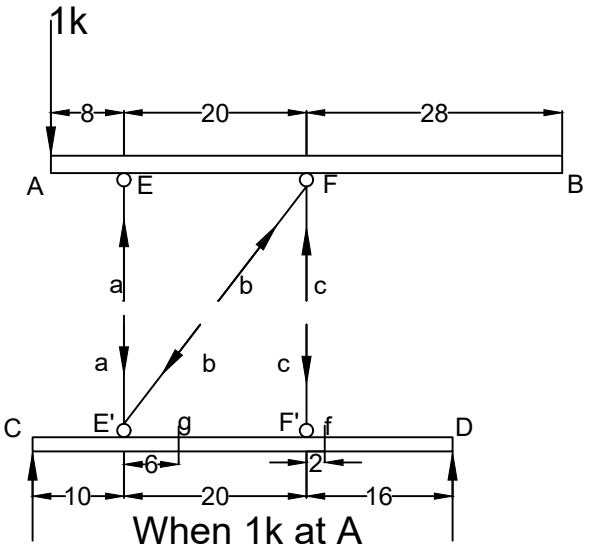


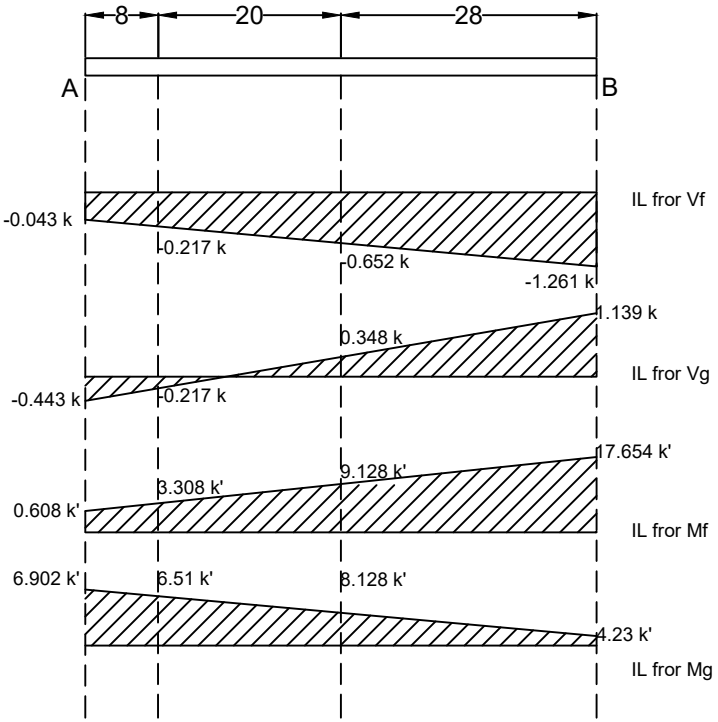
Problem 08

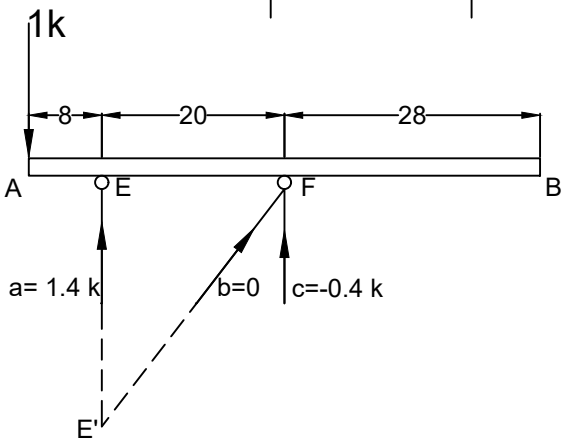
Draw ILD for shear and moment for f & g for the unit load moving from A to B.

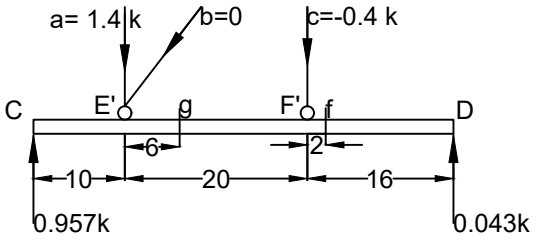












When 1k at A

Take moment about F so, unknown reduced to 1 sum of moments at

$\sum ME' = 0$

$\Rightarrow -1*8-c*20=0$

$\Rightarrow c= -0.4$ k

$\sum MF = 0$

$\Rightarrow -1*28+a*20=0$

$\Rightarrow a=\frac{28}{20}=1.4$ k

$\sum Fy = 0$

$\Rightarrow a+c+by-1=0$

$\Rightarrow 1.4 - 0.4+by-1=0$

$\Rightarrow by= 0$

Then take moment about E'
a and b passes through E'

$\sum Fx = 0$

$\Rightarrow bx= 0$

Take moment about C

$\sum MC = 0$

$\Rightarrow 1.4*10-0.4*30-RD*46=0$

$\Rightarrow RD=\frac{2}{46}=0.0434$ k

$\sum Fy = 0$

$\Rightarrow 1.4-0.4-0.043-RC=0$

$\Rightarrow RC=0.957$k

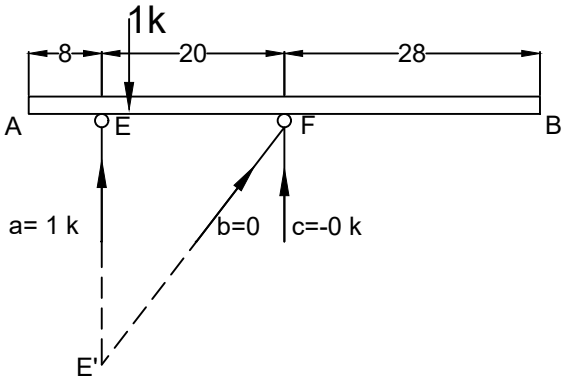
$Vf= -0.0434$k

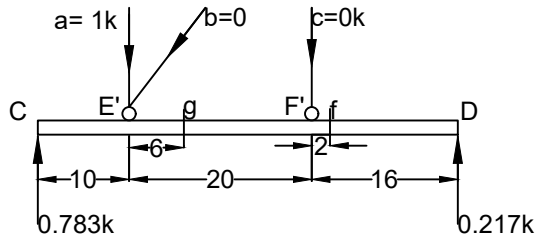
$Vg= -0.0434-0.4= -0.4434$k

$Mf= 0.0434*14= 0.6076$k'

$Mg= 0.0434*30+ 0.4*14= 6.902$k'

When 1k at E





Take moment about F. so, unknown reduced to 1. sum of moments at

$\sum MF = 0$
$\Rightarrow -1*20+a*20=0$
$\Rightarrow a=1k$

Then take moment about E' . since, a and b passes through E'

$\sum ME' \ 0$
$\Rightarrow c = 0$

$\sum Fy = 0$
$\Rightarrow by= 0$

$\sum Fx = 0$
$\Rightarrow bx= 0$

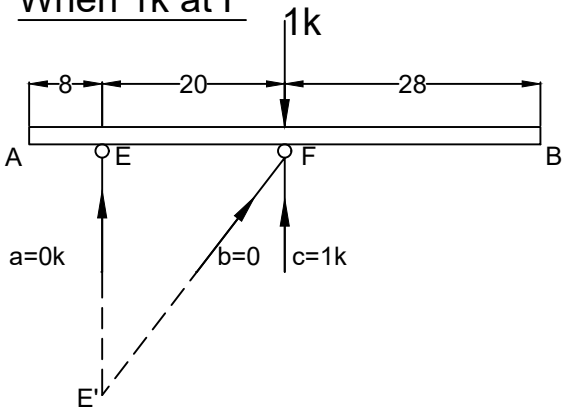
Take moment about C
$\sum MC = 0$
$\Rightarrow 1*10-RD*46=0$
$\Rightarrow RD=\frac{10}{46}=0.217$ k

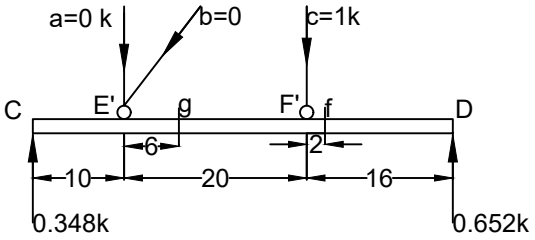
$\sum Fy = 0$
$\Rightarrow 1-0.217-RC=0$
$\Rightarrow RC=0.783k$

$Vf= -0.217k$
$Vg= -0.217k$

$Mf= 0.217*14= 3.038k'$
$Mg= 0.217*30= 6.51k'$

When 1k at F





Take moment about F. so, unknown reduced to 1. sum of moments at F

$\sum MF = 0$
$\Rightarrow a=0k$

Then take moment about E' a and b passes through E'

$\sum ME' \ 0$
$\Rightarrow -1*20+c*20=0$
$\Rightarrow c = 1k$

$\sum Fy = 0$
$\Rightarrow by= 0$

$\sum Fx = 0$
$\Rightarrow bx= 0$

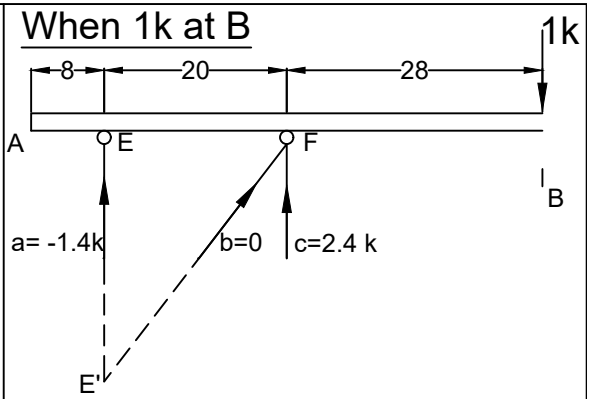
Take moment about C
$\sum MC = 0$
$\Rightarrow$
$1.4*10-0.4*30-RD*46=0$
$\Rightarrow RD=\frac{30}{46}=0.652$ k

$\sum Fy = 0$
$\Rightarrow 1-0.652-RC=0$
$\Rightarrow RC=0.348$ k

$Vf= -0.652k$
$Vg= 1-0.652= 0.348k$

$Mf= 0.348*14= 9.128k'$
$Mg= 0.652*30-1*14= 5.56k'$

When 1k at B



Take moment about F so, unknown reduced to 1.sum of moments at F

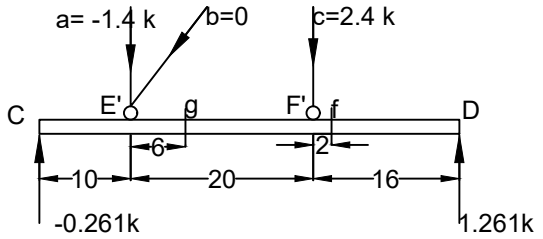
$\sum MF = 0$
$\Rightarrow a*20+1*28=0$
$\Rightarrow a=-1.4k$

$\sum ME' \ 0$
$\Rightarrow 1*48-c*20=0$
$\Rightarrow c = 2.4k$

$\sum Fy = 0$
$\Rightarrow 1.4+1-2.4-by=0$
$\Rightarrow by= 0$

Then take moment about E' . a and b passes through E'

$\sum Fx = 0$
$\Rightarrow bx= 0$



Take moment about C
$\sum MC = 0$
$\Rightarrow -1.4*10+2.4*30-RD*46=0$
$\Rightarrow RD=\frac{58}{46}=1.261$ k

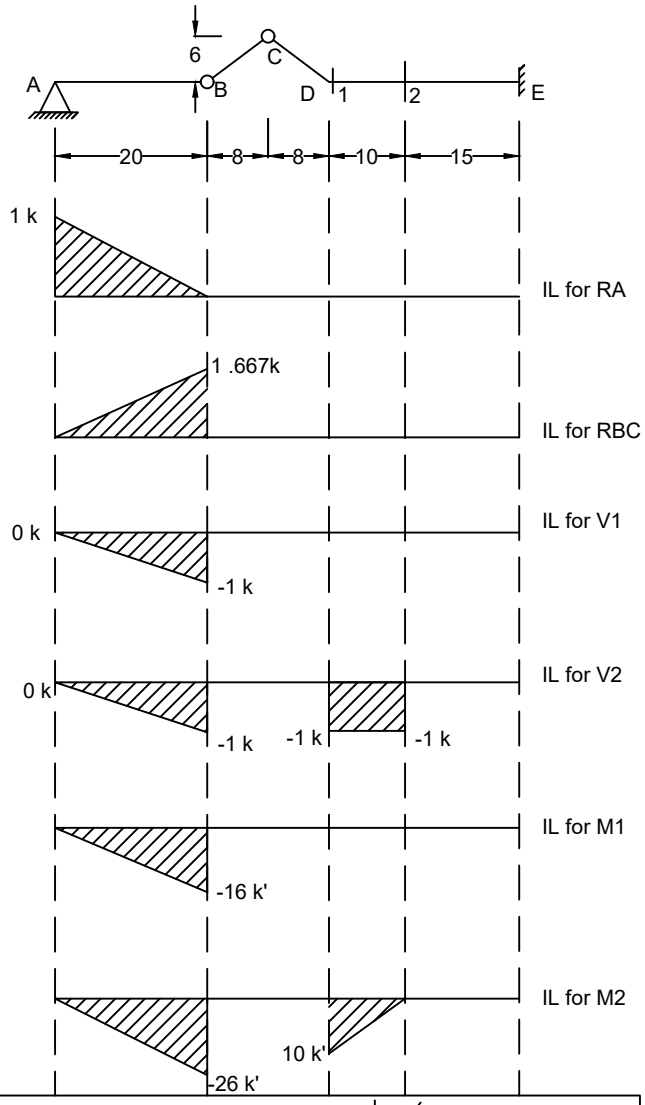
$\sum Fy = 0$
$\Rightarrow -1.4+2.4-1.261-RC=0$
$\Rightarrow RC=-0.261k$

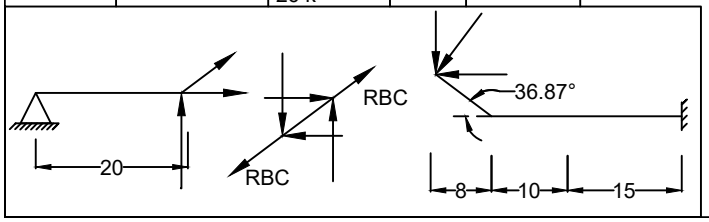
$Vf= -1.261k$
$Vg= -1.261+ 2.4= 1.139k$

$Mf= 1.261*14= 17.654k'$
$Mg= 1.261*30-2.4*14= 4.23k'$

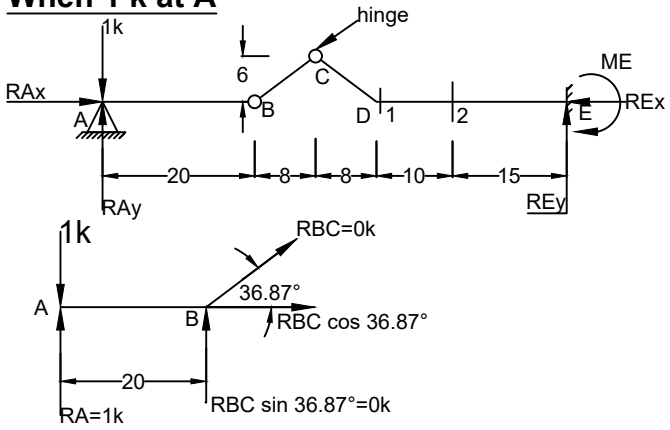
Problem 09

Draw ILD for RA, RBC, shear & moment at 1-1 & 2-2





When 1 k at A



$\sum MB = 0$

$\Rightarrow RA = 1k$

$\sum Fy = 0$

$\Rightarrow RBC \sin 36.87° \quad 0k$

$\Rightarrow RBC = \frac{0}{\sin 36.87°} = 0k$

$\Rightarrow RBC \cos 36.87° \quad 0k$

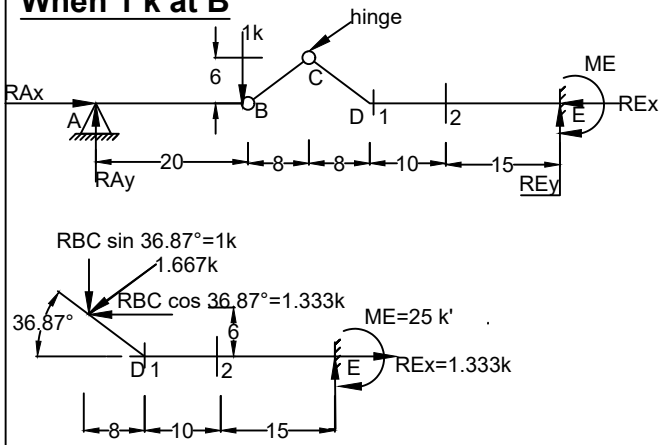
$V1 = 0k$

$V2 = 0k$

$M1 = 0k'$

$M2 = 0k'$

When 1 k at B



$\sum MB = 0$

$\Rightarrow RA = 0k$

$\sum Fy = 0$

$\Rightarrow RBC \sin 36.87° \quad 1k$

$\Rightarrow RBC = \frac{1}{\sin 36.87°} = 1.667k$

$\Rightarrow RBC \cos 36.87° \quad 1.333k$

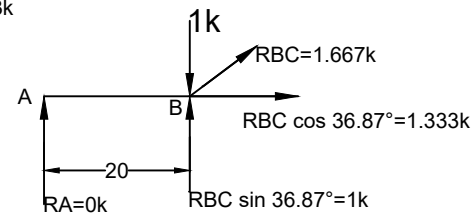
$ME = 33*1 + 1.333*6 = 41k'$

$V1 = -1\ k$

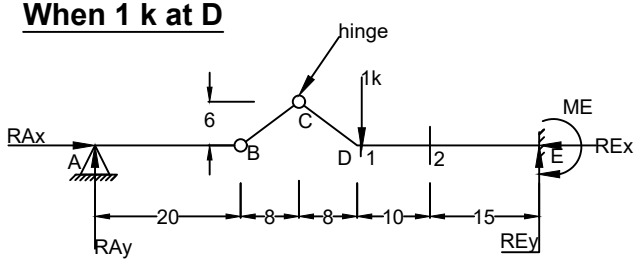
$V2 = -1\ k$

$M1 = -41 + 25 = -16k'$

$M2 = -25 + 15 = -26k'$

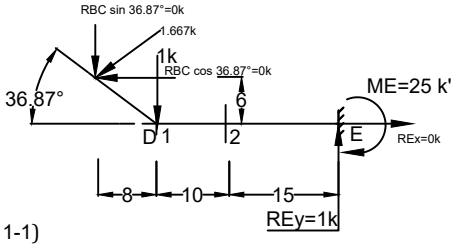


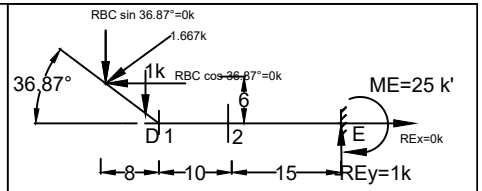
When 1 k at D



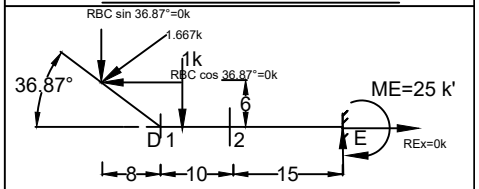
$\sum MB = 0$
$\Rightarrow RA = 0k$
$\sum Fy = 0$
$\Rightarrow RBC \sin 36.87° \quad 0k$
$\Rightarrow RBC = \frac{0}{\sin 36.87°} = 0k$
$\Rightarrow RBC \cos 36.87° \quad 0k$
$ME = -25*1 = -25k'$

V1= -1 k(Just left of section 1-1)
V1= 0k (Just right of section 1-1)
V2= -1 k
M1= -25+ 25= 0k'
M2= -25+ 15= -10k'



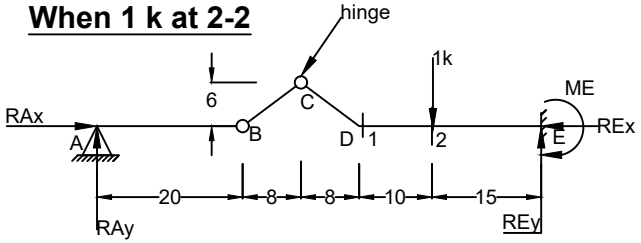


Just left of section 1-1



Just right of section 1-1

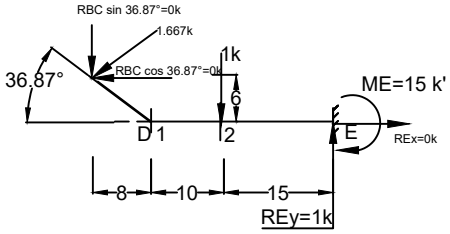
When 1 k at 2-2

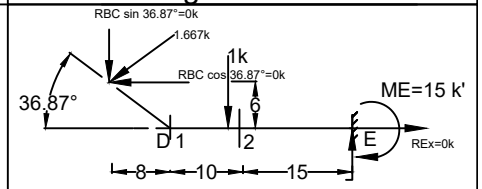


$\sum MB = 0$
$\Rightarrow RA = 0k$
$\sum Fy = 0$
$\Rightarrow RBC \sin 36.87° \quad 0k$
$\Rightarrow RBC = \frac{0}{\sin 36.87°} = 0k$
$\Rightarrow RBC \cos 36.87° \quad 0k$
$ME = -15*1 = -15k'$

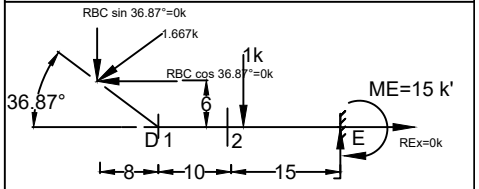
V1= 0 k
V2= -1 k(Just left of section 2-2)
V2= 0k (Just right of section 2-2)

M1= -15-10+ 25= 0k'
M2= -15+ 15= 0k'



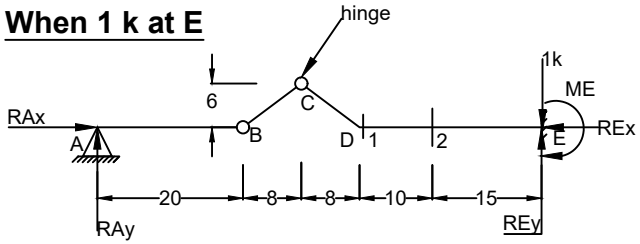


Just left of section 2-2



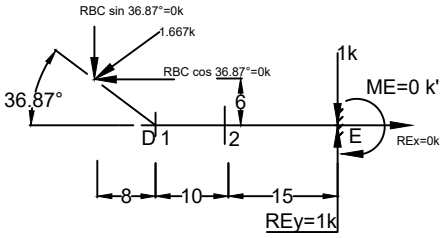
Just right of section 2-2

When 1 k at E



$\sum MB = 0$
$\Rightarrow RA = 0k$
$\sum Fy = 0$
$\Rightarrow RBC \sin 36.87° \quad 0k$
$\Rightarrow RBC = \frac{0}{\sin 36.87°} = 0k$
$\Rightarrow RBC \cos 36.87° \quad 0k$
$ME = 0k'$

V1= 0 k
V2= 0 k
M1= -25+ 25= 0k'
M2= -15+ 15= 0k'



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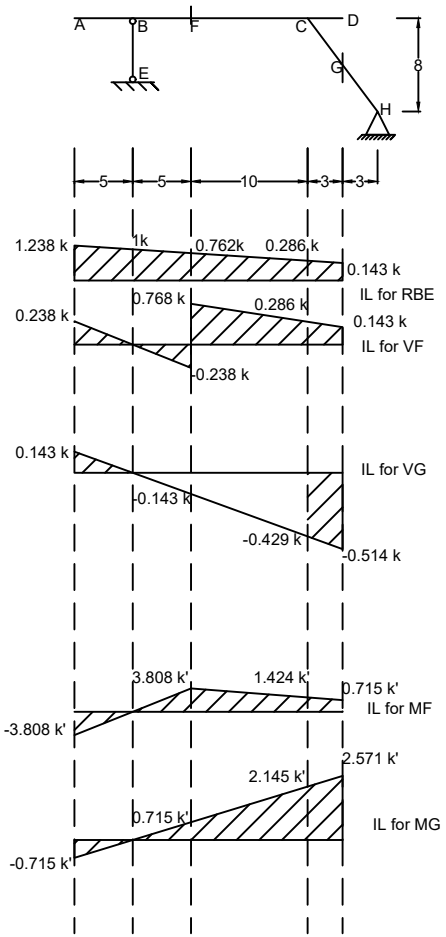
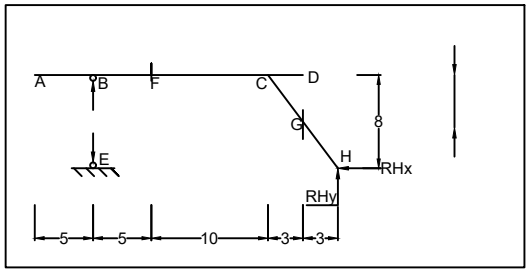
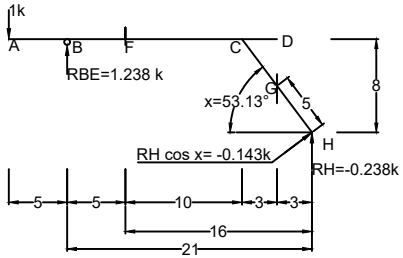
Problem 10
Draw ILD for RBE, shear & moment at F & G





When 1 k at A

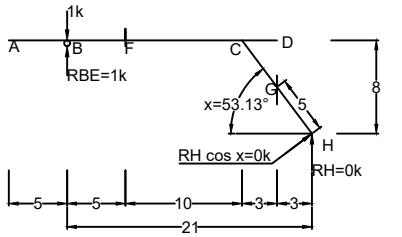


∑MH = 0
⇒RBE*21-26*1= o
⇒RBE= 1.238 k
∑Fy=0
⇒RH= -0.238k
⇒RH cos 53.13° -0.143k

VF= 1.238-1= 0.238k
VG= 0.143k

MF= -0.238*16= -3.808k'
MG= -0.143*5= -0.715k'

When 1 k at B

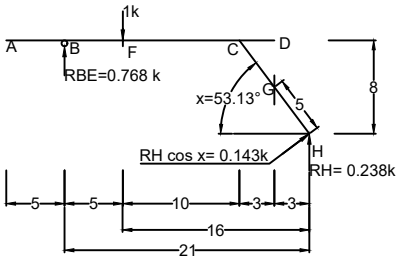


∑MH = 0
⇒RBE*21-21*1= o
⇒RBE= 0 k
∑Fy=0
⇒RH = 0k
⇒RH cos 53.13° 0k

VF= 0k
VG= 0k

MF= 0k'
MG= 0k'

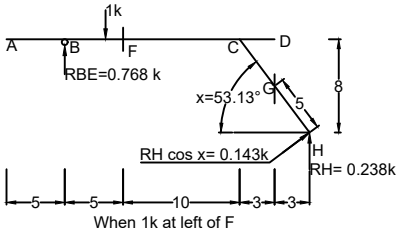
When 1 k at F



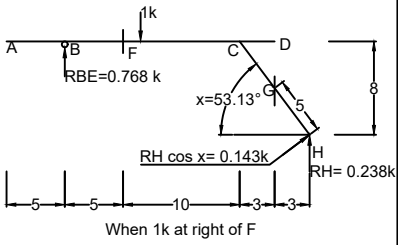
∑MH = 0
⇒RBE*21-16*1= o
⇒RBE= 0.762 k
∑Fy=0
⇒RH= 0.238 k
⇒RH cos 53.13° 0.143k

VF= -0.238k(1k at left of F)
VF= 0.768k(1k at right of F)
VG= -0.143k

MF= 3.808k'
MG= 0.715k'

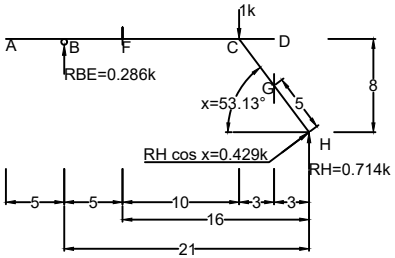


When 1k at left of F



When 1k at right of F

When 1 k at C

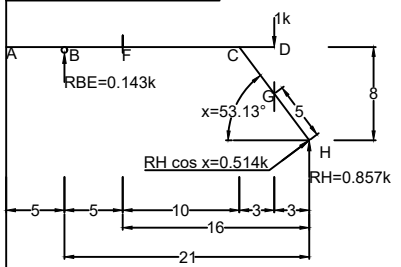


∑MH = 0
⇒RBE*21-6*1= o
⇒RBE= 0.286 k
∑Fy=0
⇒RH = 0.714k
⇒RH cos 53.13° 0.429k

VF= 0.286k
VG= -0.429k

MF= 0.714*16-10= 1.424k'
MG= 0.429*5= 2.145k'

When 1 k at D



∑MH = 0
⇒RBE*21-3*1= o
⇒RBE= 0.143 k
∑Fy=0
⇒RH = 0.857k
⇒RH cos 53.13° 0.514k

VF= 0.143k
VG= -0.514k

MF= 0.143*5= 0.715k'
MG= 0.514*5= 2.571k'

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Problem :11

When 1k at point A:

$A_y = 1\ k$
$R_{BD} = 0\ k$

$V_a = 0k$
$V_b = 0k$

$M_A = 0\ k - ft$
$M_a = 0\ k - ft$
$M_b = 0\ k - ft$

When 1k at point a:

$A_y = 1\ k$
$R_{BD} = 0\ k$

$V_a = 0k\ (when\ 1k\ at\ left)$
$V_a = 1k\ (when\ 1k\ at\ right)$
$V_b = 0k$

$\sum M_A = 0$
$\Rightarrow M_A + 6 = 0$

$\Rightarrow M_A = -6\ k - ft$

$\sum M_a = 0$
$\Rightarrow M_A + M_a + 6 = 0$
$\Rightarrow M_a - 6 + 6 = 0$
$\Rightarrow M_a = 0\ k - ft$
$M_b = 0\ k - ft$

When 1k at point B:

$A_y = 1\ k$
$R_{BD} = 0\ k$

$V_a = 1k$
$V_b = 0k$

$\sum M_A = 0$
$\Rightarrow M_A + 12 = 0$

$\Rightarrow M_A = -12\ k - ft$

$\sum M_a = 0$
$\Rightarrow M_a + M_A + 9 = 0$
$\Rightarrow M_a - 12 + 6 = 0$
$\Rightarrow M_a = -6\ k - ft$
$M_b = 0\ k - ft$

When 1k at point C:

$R_{BD} \sin 36.87 = 1.4\ k$
$R_{BD} = \dfrac{1.4}{\sin 36.87} = 2.33$
$R_E = -0.4$
$A_y = 1.4\ k$

$V_a = 1.4\ k$
$V_b = 0.4\ k$
$\sum M_A = 0$
$\Rightarrow M_A + 1.4 * 12 = 0$

$\Rightarrow M_A = -16.8\ k - ft$

$\sum M_a = 0$
$\Rightarrow M_a + M_A + 6 * 1.4 = 0$
$\Rightarrow M_a - 16.8 + 8.4 = 0$
$\Rightarrow M_a = -8.4\ \ k - ft$
$\sum M_b = 0$
$\Rightarrow M_b + 0.4 * 6 = 0$

$\Rightarrow M_b = -2.4\ k - ft$

When 1k at point D:

$R_{BD} \sin 36.87 = 1k$
$R_{BD} = \dfrac{1}{\sin 36.87} = 1.667\ k$
$R_E = 0k$
$A_y = 1\ k$

$V_a = 1\ k$
$V_b = 0\ k$
$\sum M_A = 0$
$\Rightarrow M_A + 12 * 1 = 0$

$\Rightarrow M_A = -12\ k - ft$

$\sum M_a = 0$
$\Rightarrow M_a + M_A + 6 * 1 = 0$
$\Rightarrow M_a - 12 + 6 = 0$
$\Rightarrow M_a = -6k - ft$

$M_b = 0\ k - ft$

When 1k at point b:

$R_{BD} \sin 36.87 = 0.6\ k$
$R_{BD} = \dfrac{0.6}{\sin 36.87} = 1k$
$R_E = 0.4k$
$A_y = 0.6\ k$

$V_a = 0.6\ k$
$V_b = -0.4\ k(just\ at\ left\ of\ b)$

$V_b = 0.6\ k(just\ at\ right\ of\ b)$

$\sum M_A = 0$

$\Longrightarrow M_A + 0.6 * 12 = 0$

$\Longrightarrow M_A = -7.2\ k - ft$

$\sum M_a = 0$

$\Longrightarrow M_a + M_A + 6 * 0.6 = 0$

$\Longrightarrow M_a - 7.2 + 3.6 = 0$

$\Longrightarrow M_a = -3.6\ k - ft$

$\sum M_b = 0$

$\Longrightarrow M_b - 0.4 * 6 = 0$

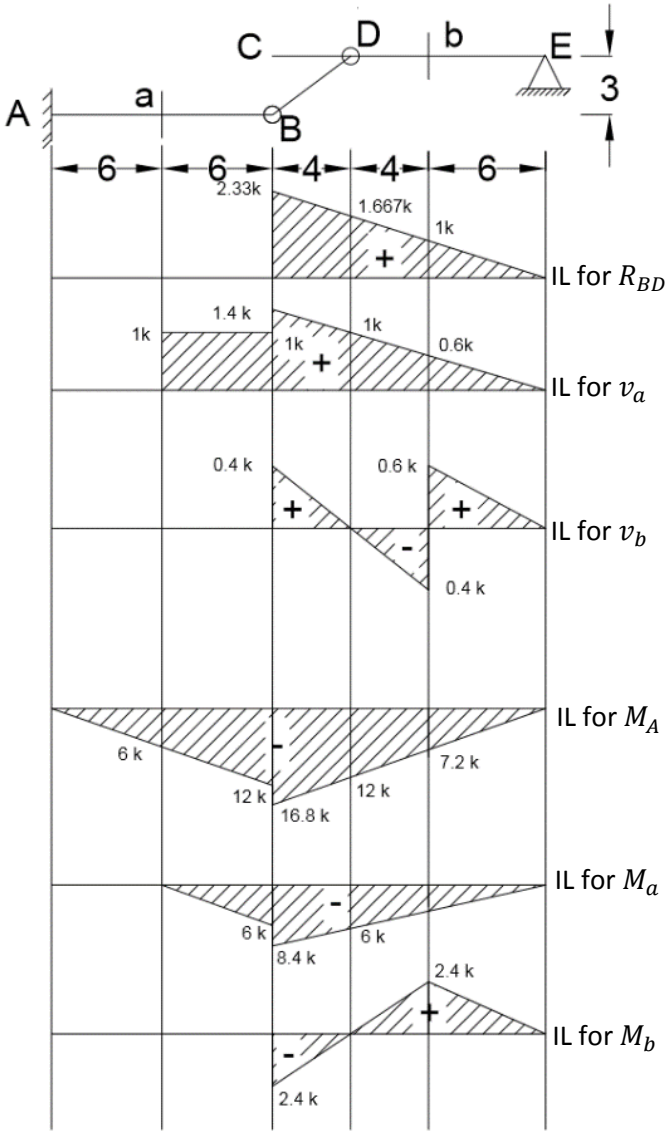
$\Longrightarrow M_b = 2.4\ k - ft$

When 1k at point E:

$R_{BD} = R_E = A_y = 0k$

$M_A = M_a = M_b = 0$

$V_a = V_b = 0\ k$



Problem 12

Draw ILD for RBD, MF, Va, Vb, Ma, Mb

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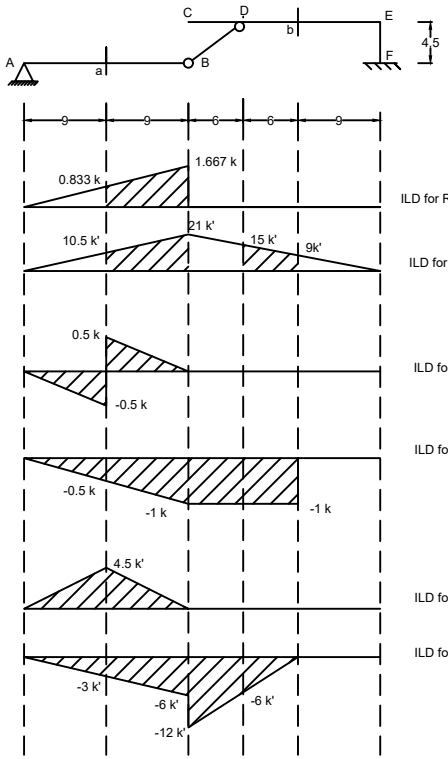
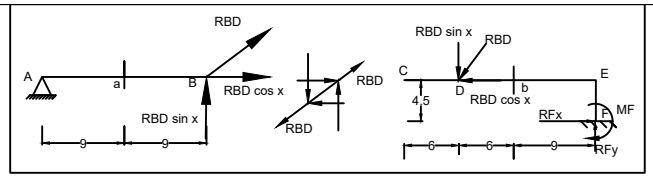
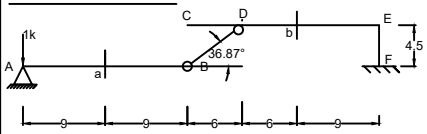




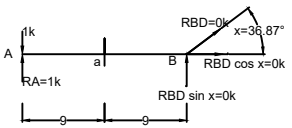
When 1 k at A



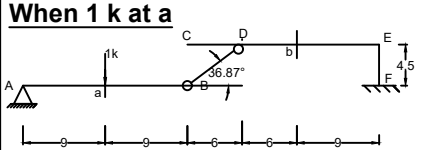
$\sum MB = 0$
$\Rightarrow RA = 1$ k
$\sum Fy = 0$
$\Rightarrow RBD \sin 36.87° = 0$k
$\Rightarrow RBD = \frac{0}{\sin 36.87°} = 0$k
$\Rightarrow RBD \cos 36.87° = 0$k

Va= 0 k
Vb= 0k

Ma= 0k'
Mb= 0k'

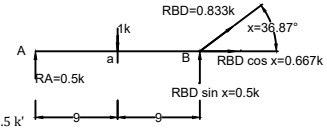


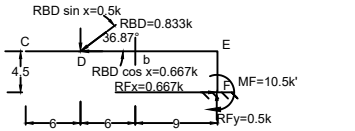
When 1 k at a

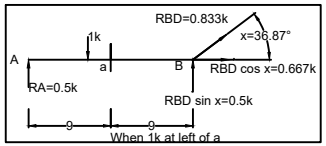


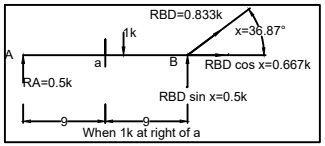
$\sum MB = 0$
$\Rightarrow RA*18 - 9*1 = 0$
$\Rightarrow RA = 0.5$ k
$\sum Fy = 0$
$\Rightarrow RBD \sin 36.87° = 0.5$k
$\Rightarrow RBD = \frac{0.5}{\sin 36.87°} = 0.833$k
$\Rightarrow RBD \cos 36.87° = 0.667$k
MF= 0.5*15+ 0.667*4.5= 10.5 k'

Va= -0.5 k(When 1k at left of a)
Va= 0.5k(When 1k at right of a)
Vb= -0.5k
Ma= 0.5*9= 4.5k'
Mb= -3k'

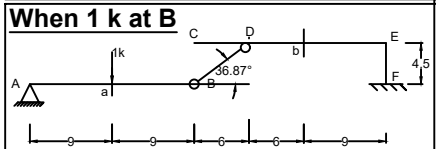








When 1 k at B



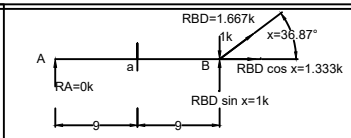
$\sum MB = 0$
$\Rightarrow RBD \sin 36.87° * 18 - 9*1 = 0$
$\Rightarrow RBD \sin 36.87° = 1$ k
$\Rightarrow RBD = \frac{1}{\sin 36.87°} = 1.667$k
$\Rightarrow RBD \cos 36.87° = 1.333$k

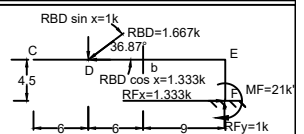
$\sum Fy = 0$
$\Rightarrow RA = 0$k

MF= 1*15+ 1.333*4.5= 21 k'

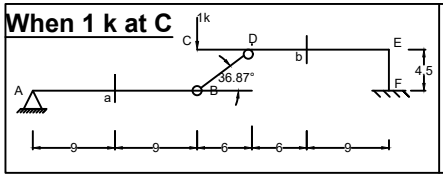
Va= 0 k
Vb= -1k

Ma= 0k'
Mb= -6k'





When 1 k at C



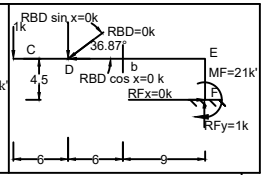
$RBD \sin 36.87° = 0$
$\Rightarrow RBD = \frac{0}{\sin 36.87°} = 0$k
$\Rightarrow RBD \cos 36.87° = 0$k

$\sum Fy = 0$
$\Rightarrow RF = 0$k

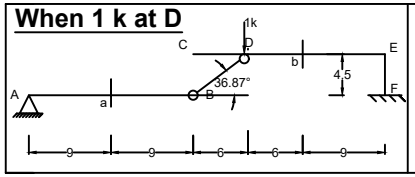
MF= 1*21= 21 k'

Va= 0 k
Vb= -1k

Ma= 0k'
Mb= -21+ 9= -12k'



When 1 k at D



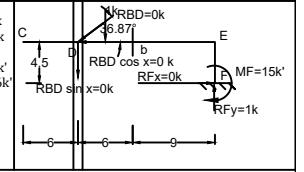
$RBD \sin 36.87° = 0$
$\Rightarrow RBD = \frac{0}{\sin 36.87°} = 0$k
$\Rightarrow RBD \cos 36.87° = 0$k

$\sum Fy = 0$
$\Rightarrow RF = 0$k

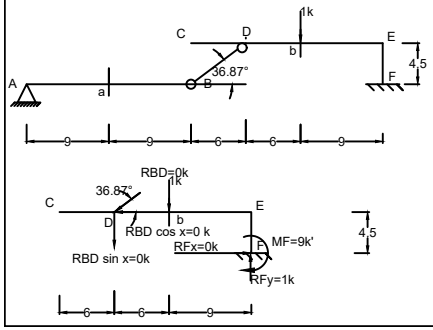
MF= 1*15= 15 k'

Va= 0 k
Vb= -1k

Ma= 0k'
Mb= -6k'



When 1 k at b



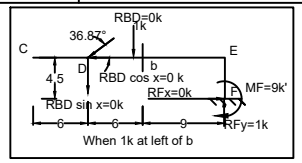
$RBD \sin 36.87° = 0$
$\Rightarrow RBD = \frac{0}{\sin 36.87°} = 0$k
$\Rightarrow RBD \cos 36.87° = 0$k

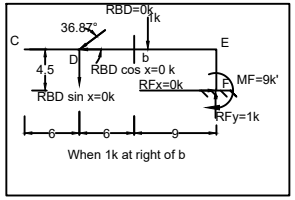
$\sum Fy = 0$
$\Rightarrow RF = 0$k

MF= 1*9= 9 k'

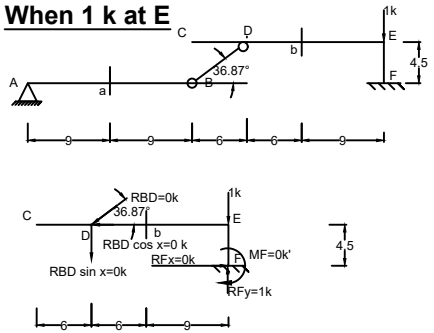
Va= 0 k
Vb= -1k(When 1k at left of b)
Vb= 0k(When 1k at right of b)

Ma= 0k'
Mb= 0k'





When 1 k at E



$RBD \sin 36.87° = 0$
$\Rightarrow RBD = \frac{0}{\sin 36.87°} = 0$k
$\Rightarrow RBD \cos 36.87° = 0$k

$\sum Fy = 0$
$\Rightarrow RF = 0$k

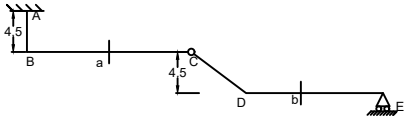
MF= 0 k'

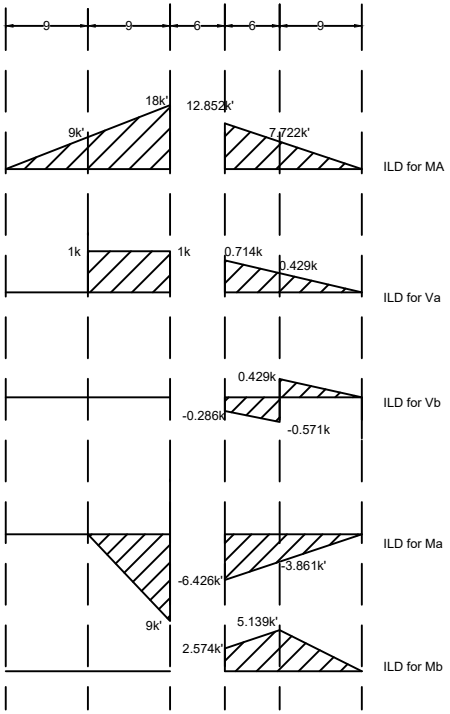
Va= 0 k
Vb= 0k

Ma= 0k'
Mb= 0k'

Problem 13

Draw ILD for MA, Va, Vb, Ma, Mb

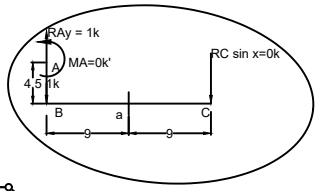


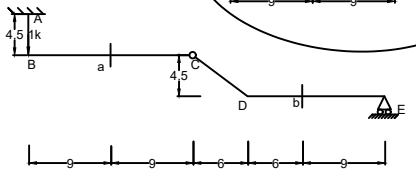


As at left side of link there is a fixed support so the link transmits the load from right to left.

The load transmitted from right to left should be considered minor.

When 1 k at B



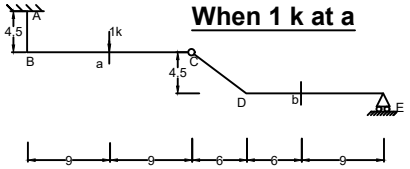


Taking, RC sin 36.87° as minor
RC sin 36.87° 0k
RAy= 1 k
MA= 0k'

Va= 0 k
Vb= 0k

Ma= 0k'
Mb= 0k'

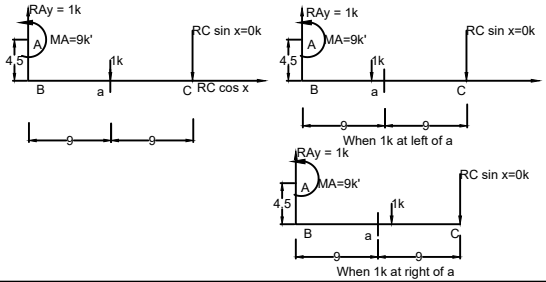
When 1 k at a



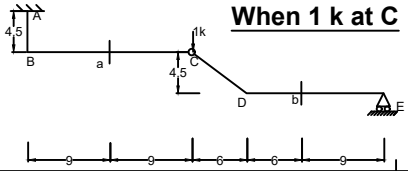
Taking, RC sin 36.87° as minor
RC sin 36.87° 0k
RAy= 1 k
MA= 9k'

Va= 0 k(When 1k at left of a)
Va= 1k(When 1k at right of a)
Vb= 0k

Ma= 0k'
Mb= 0k'



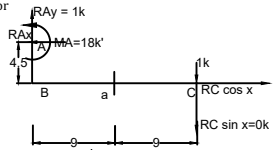
When 1 k at C



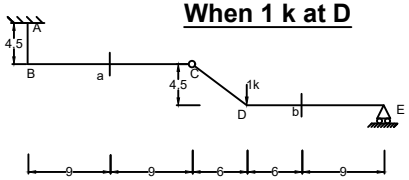
Taking, RC sin 36.87° as minor
RC sin 36.87° 0k
RAy= 1 k
MA= 18k'

Va= 1 k
Vb= 0k

Ma= -9k'
Mb= 0k'



When 1 k at D



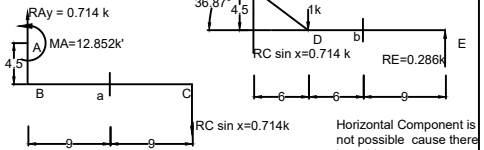
∑ME= 0
⇒RC sin 36.87*21-15*1= 0
⇒RC sin 36.87= 0.714 k= RAy
⇒RC cos 36.87° 0 RAx Roller

∑Fy 0
⇒RE= 0.286 k

MA= 12.852k'

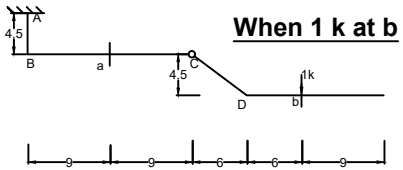
Va= 0.714 k
Vb= -0.286k

Ma= -6.426k'
Mb= 2.574 k'



Horizontal Component is not possible cause there is no hinge support

When 1 k at b



∑ME= 0
⇒RC sin 36.87*21-9*1= 0
⇒RC sin 36.87= 0.429 k= RA

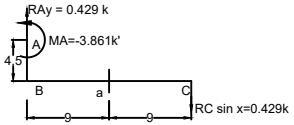
⇒RC cos 36.87° 0k RAx

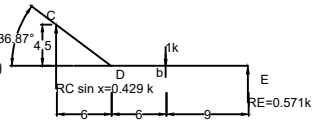
∑Fy 0
⇒RE= 0.571 k

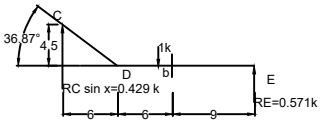
MA= 0.429*18= 7.722k'

Va= 0.429 k
Vb= -0.571k(When 1k at left of b)
Vb= 0.429 k(When 1k at right of b)

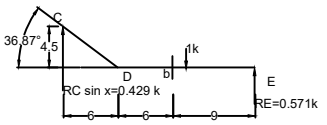
Ma= 0.429*9= -3.861k'
Mb= 0.571*9= 5.139 k'





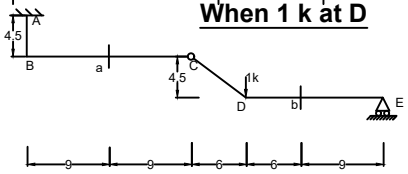


When 1k at left of b



When 1k at right of b

When 1 k at D



∑ME= 0
⇒RC sin 36.87*21-0*1= 0
⇒RC sin 36.87= 0 k= RAy
⇒RC cos 36.87° 0 RAx Roller

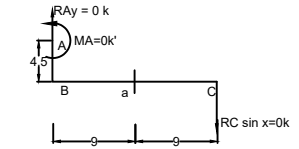
∑Fy 0
⇒RE= 1 k

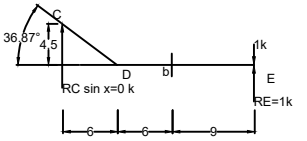
MA= 0k'

Va= 0 k
Vb= 0k

Ma= 0k'
Mb= 0k'

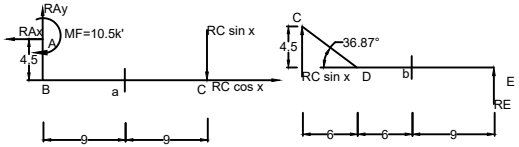
Horizontal Component is not possible cause there is no hinge support





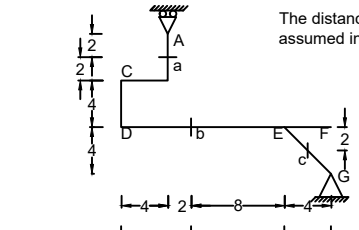
What is going on at the link???

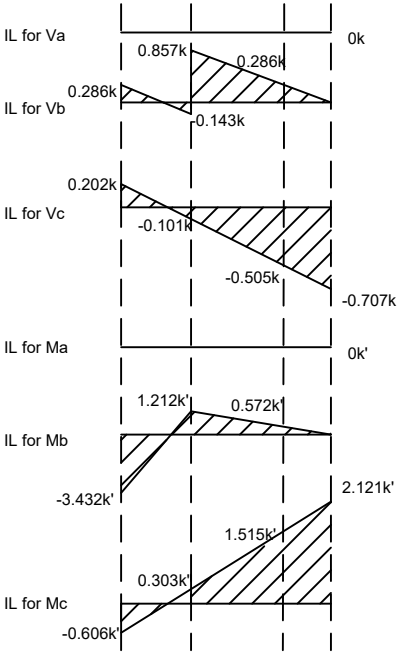
Horizontal force need not to be counted as right side of link/ hinge is roller. let us assume the internal hinge as link :)

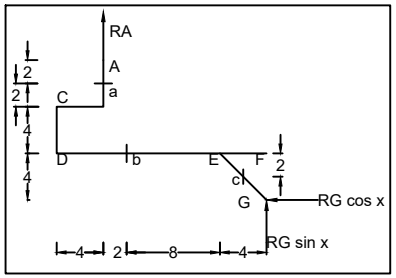


Problem 14:
Draw ILD for Va,Vb,Vc,Ma,Mb,Mc if the unit load moves from D to F.

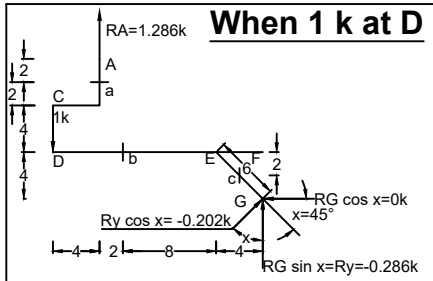
The distance of A from b is not given in assignment if assumed infinitesimal influence line would be different.







When 1 k at D



∑MG= 0
⇒RA*14-18*1= 0
⇒RA= $\frac{18}{14}$ = 1.286 k

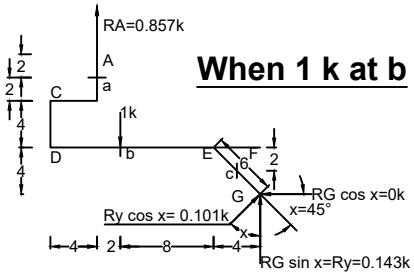
∑Fx=0
⇒RG cos 45° 0k

∑Fy=0
⇒RA RG sin 45° 1k
⇒RG sin 45° -0.286k

Va= 0 k
Vb= 0.286k
Vc= -Ry cos 45° - -0.202 0.202k

Ma= 0k'
Mb= -0.286*12= -3.432k'
Mc= (-0.202*3)= -0.606k'

When 1 k at b



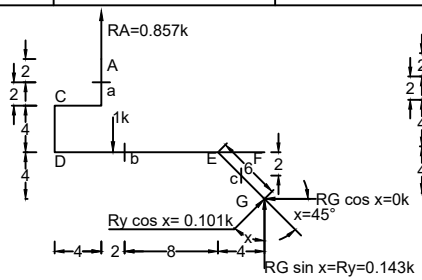
∑MG= 0
⇒RA*14-12*1= 0
⇒RA= $\frac{12}{14}$ = 0.857 k

∑Fx=0
⇒RG cos 45° 0k

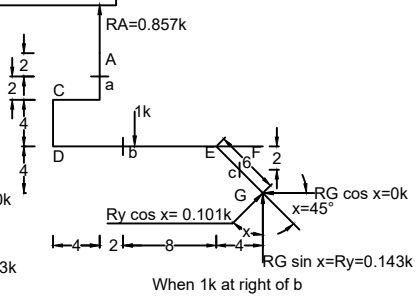
∑Fy=0
⇒RA RG sin 45° 1k
⇒RG sin 45° 0.143k

Va= 0 k
Vb= -0.143k(When 1k at left of b)
Vb= 0.857k(When 1k at left of b)
Vc -Ry cos 45° - 0.101 -0.101k

Ma= 0k'
Mb= 0.101*12= 1.212k'
Mc= (0.101*3)= 0.303k'

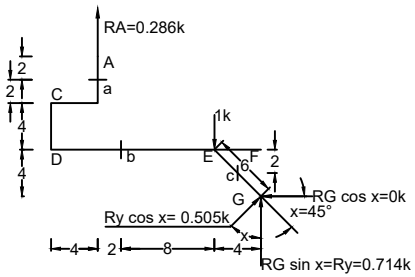


When 1k at left of b



When 1k at right of b

When 1 k at E



∑MG= 0
⇒RA*14-4*1= 0
⇒RA= $\frac{4}{14}$ = 0.286 k

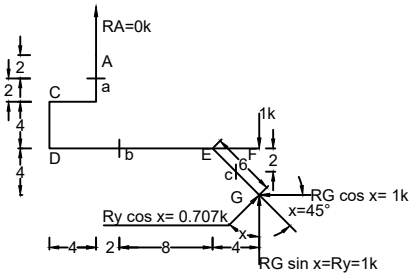
∑Fx=0
⇒RG cos 45° 0k

∑Fy=0
⇒RA RG sin 45° 1k
⇒RG sin 45° 0.714k

Va= 0 k
Vb= 0.286k
Vc -Ry cos 45° -0.505k

Ma= 0k'
Mb= 0.286*2= 0.572k'
Mc= (0.505*3)= 1.515k'

When 1 k at F



∑MG= 0
⇒Ry*14-14*1= 0
⇒Ry= 1 k

∑Fx=0
⇒RG cos 45° 0k

∑Fy=0
⇒RA RG sin 45° 1k
⇒RA= 0k

Va= 0 k
Vb= 0k
Vc -Ry cos 45° -0.707k

Ma= 0k'
Mb= 0k'
Mc= (0.707*3)= 2.121k'

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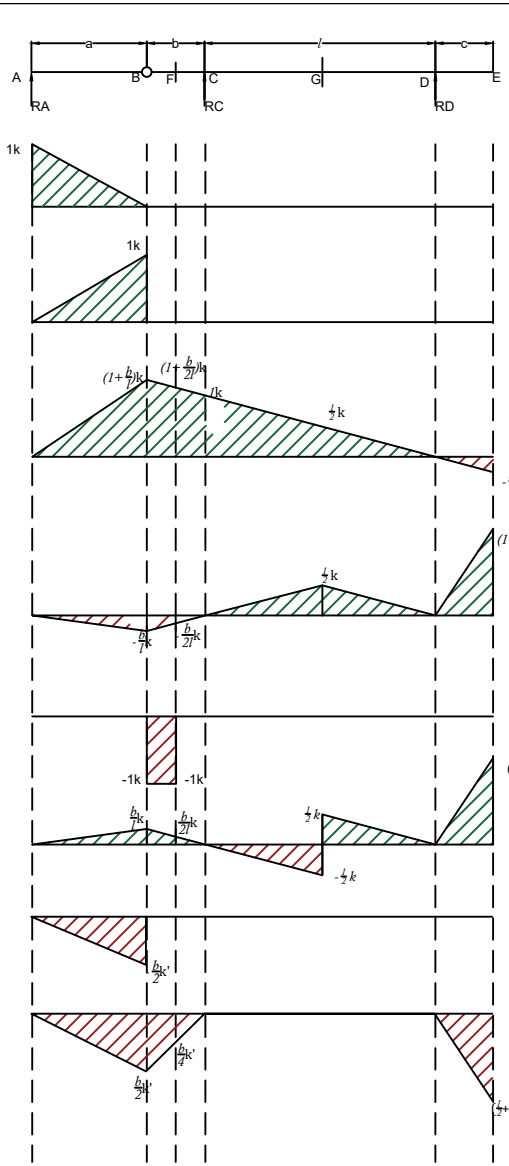
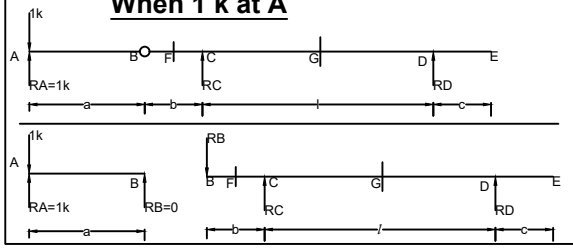


When 1 k at A

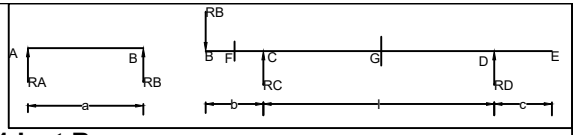


$\sum MB = 0$
$\Rightarrow RA*a - a*1 = 0$
$\Rightarrow RA = \frac{a}{a} = 1\ k$

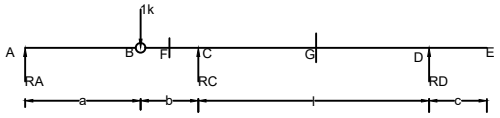
$\sum Fy = 0$
$\Rightarrow RA + RB = 1k$
$\Rightarrow RB = 0k$
for right of link
$RC = RD = 0k$

$VF = 0\ k$
$VG = 0\ k$

$MF = 0k'$
$MG = 0k'$



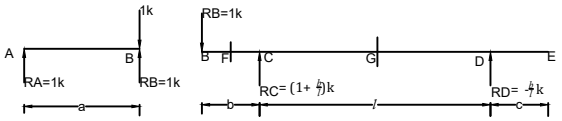
When 1 k at B



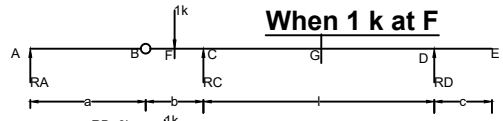
$\sum Fy = 0$
$\Rightarrow RC + RD = RB$
$\Rightarrow RD = -\frac{b}{l}k$

$VF = -1\ k$
$VG = \frac{b}{l}k$

$MF = -1*\frac{b}{2} = -\frac{b}{2}k'$
$MG = -\frac{b}{l}*\frac{l}{2} = \frac{b}{2}k'$



When 1 k at F



$\sum MA = 0$
$\Rightarrow RB*a - a*1 = 0$
$\Rightarrow RB = \frac{a}{a} = 1\ k$

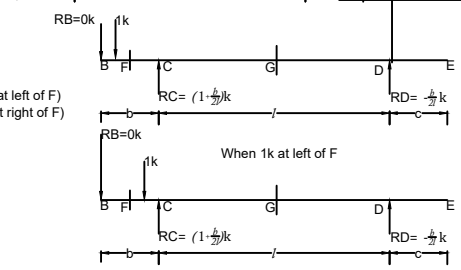
$\sum Fy = 0$
$\Rightarrow RA + RB = 1k$
$\Rightarrow RA = 0k$

for right of link
$\sum MD = 0$
$\Rightarrow (l+b)*1 - RC*l = 0$
$\Rightarrow RC = \frac{l+b}{l} = (1+\frac{b}{l})k$

Rb is minor
for right of link
$\sum MD = 0$
$\Rightarrow (l+\frac{b}{2})*1 - RC*l = 0$
$\Rightarrow RC = (1+\frac{b}{2l})k$
$\sum Fy = 0$
$\Rightarrow RC + RD = 1$
$\Rightarrow RD = -\frac{b}{2l}k$

$VF = -1\ k$ (When 1k at left of F)
$VF = 0\ k$ (When 1k at right of F)
$VG = \frac{b}{2l}k$

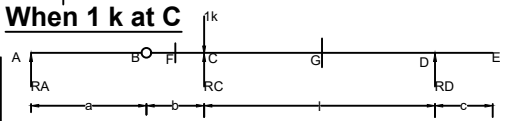
$MF = 0k'$
$MG = -\frac{b}{2l}*\frac{l}{2} = \frac{b}{4}k'$



When 1k at left of F

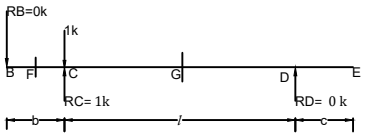
When 1k at right of F

When 1 k at C

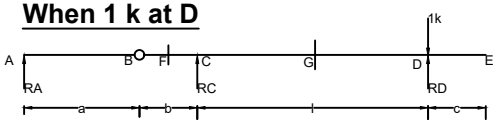


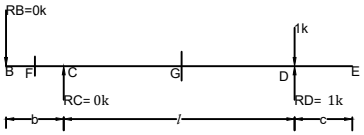
RB is minor
for right of link
$\sum MD = 0$
$\Rightarrow l*1 - RC*l = 0$
$\Rightarrow RC = 1k$
$\sum Fy = 0$
$\Rightarrow RC + RD = 1$
$\Rightarrow RD = 0k$

$VF = 0\ k$
$VG = 0\ k$
$MF = 0\ k'$
$MG = 0\ k'$



When 1 k at D

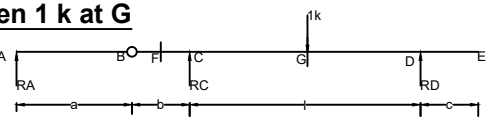




RB is minor
for right of link
$\sum MC = 0$
$\Rightarrow l*1 - RD*l = 0$
$\Rightarrow RD = 1k$
$\sum Fy = 0$
$\Rightarrow RC + RD = 1$
$\Rightarrow RC = 0k$

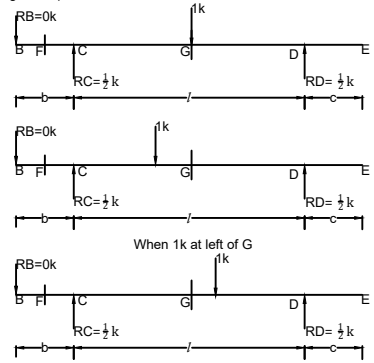
$VF = 0\ k$
$VG = 0\ k$
$MF = 0\ k'$
$MG = 0\ k'$

When 1 k at G



RB is minor
for right of link
$\sum MD = 0$
$\Rightarrow \frac{l}{2}*1 - RC*l = 0$
$\Rightarrow RC = \frac{1}{2}k$
$\sum Fy = 0$
$\Rightarrow RC + RD = 1$
$\Rightarrow RD = \frac{1}{2}k$

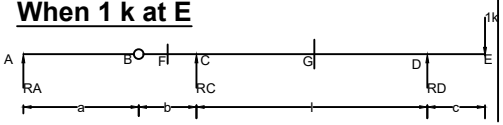
$VF = 0\ k$
$VG = -\frac{1}{2}k$ (When 1k at left of G)
$VG = \frac{1}{2}k$ (When 1k at right of G)
$MF = 0\ k'$
$MG = \frac{1}{2}*\frac{l}{2} = \frac{l}{4}k'$



When 1k at left of G

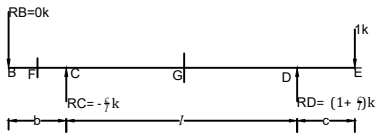
When 1k at right of G

When 1 k at E



RB is minor
for right of link
$\sum MC = 0$
$\Rightarrow (l+c)*1 - RD*l = 0$
$\Rightarrow RD = (1+\frac{c}{l})\ k$
$\sum Fy = 0$
$\Rightarrow RC + RD = 1$
$\Rightarrow RC = -\frac{c}{l}k$

$VF = 0\ k$
$VG = (1+\frac{c}{l})\ k$
$MF = 0\ k'$
$MG = (1+\frac{c}{l})*\frac{l}{2} = (\frac{l}{2}+\frac{c}{2})k'$



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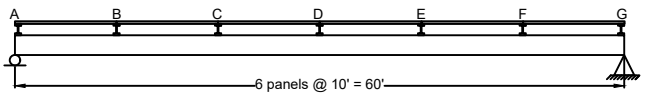
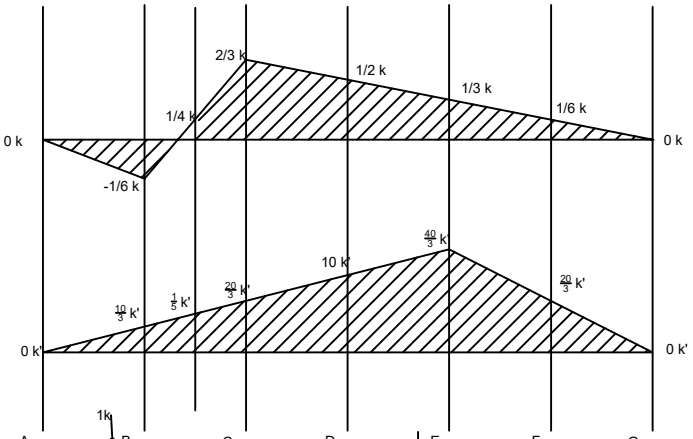
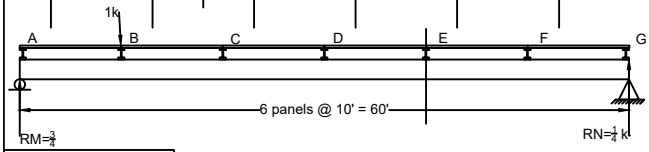
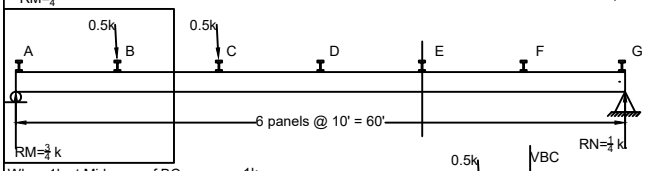
Problem 16
FInd shear in panel BC and moment at E

For a particular position of load, shear force at any point in panel will have same value. Therefore, instead of influence line for shear force at a point, influence line for shear force in a panel is drawn.

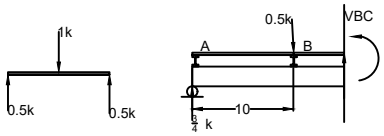








When 1k at Mid span of BC
RM=3/4 k
RN=1/4 k
ME =1/4 *20=1/5 k'
VBC= 1/4 k



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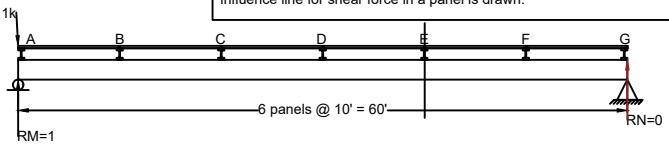
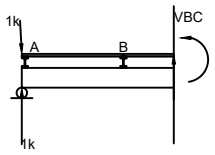
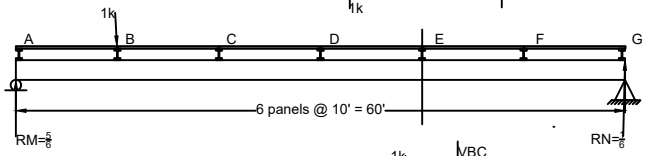
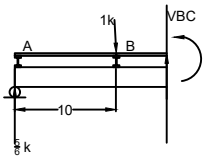


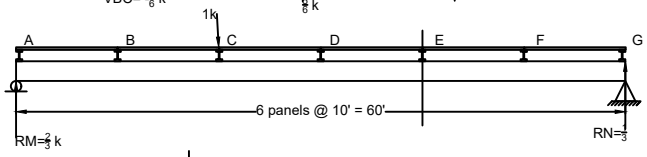
When 1k at 'A'
RM=1k
RN=0k
ME =0k'
VBC= 0k



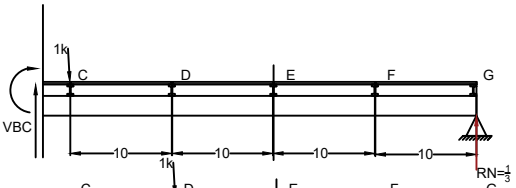


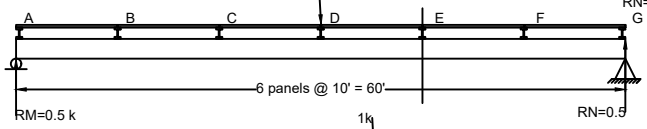
When 1k at B'
RM=5/6 k
RN=1/6 k
ME =1/6 *20=10/3 k'
VBC= -1/6 k



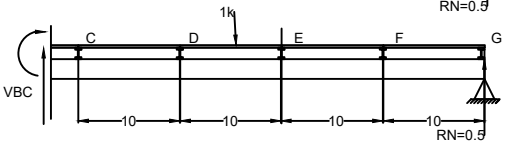


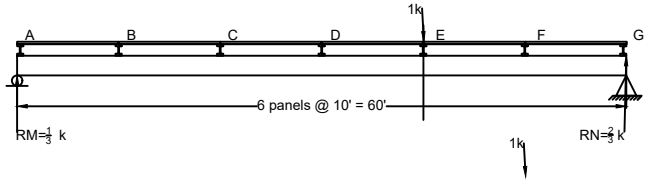
When 1k at C
RM=2/3 k
RN=1/3 k
ME =1/3 *20=20/3 k'
VBC= 2/3 k



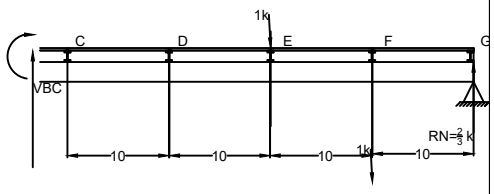


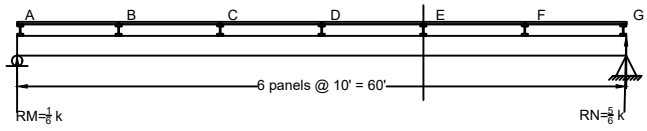
When 1k at D
RM=0.5 k
RN=0.5 k
ME =0.5 *20=10 k'
VBC= 0.5 k



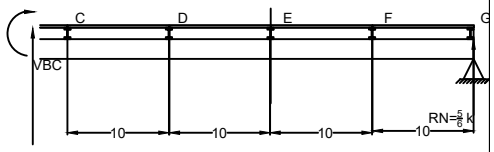


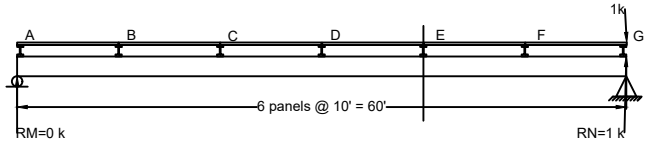
When 1k at E
RM=1/3 k
RN=2/3 k
ME =2/3 *20=40/3 k'
VBC= 1/3 k



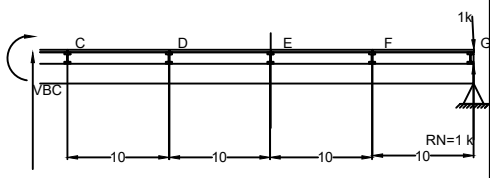


When 1k at F
RM=1/6 k
RN=5/6 k
ME =-1*10+5/6 *20=20/3 k'
VBC=1/6 k





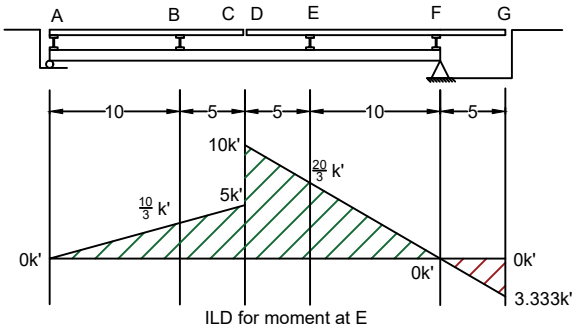
When 1k at G
RM=0 k
RN=1 k
ME =0 k'
VBC= 0 k



Problem 17
Construct ILD for moment of Girder at E?

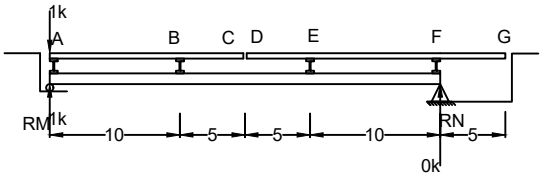
Girder with conventional end supported stringers , panel points are key points where influence line might change slope or have discontinuities.

For unusual stringer arrangement like this, Discontinuities in ILD may occur at key points other than panel points Like "C-D"

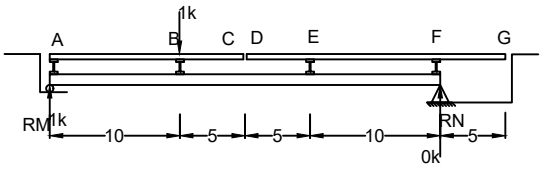


ILD for moment at E

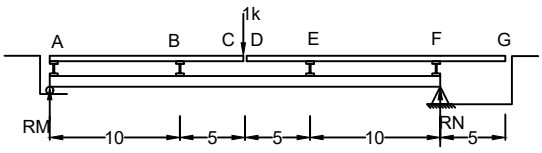
Find moment for 1k at A,C,D,F,G



When 1k at 'A'
RM=1k
RN=0k
ME =0k'



When 1k at B
RM=$\frac{2}{3}$ k
RN=$\frac{1}{3}$ k
ME =$\frac{10}{3}$ k'



When 1k at 'C'
RA=-0.5k
RB=1.5k
RM=0.5k
RN=0.5k
ME =5k'

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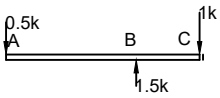
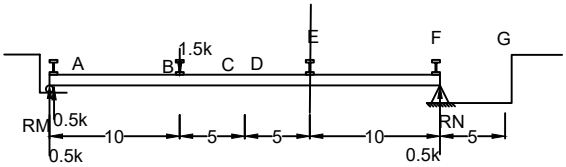
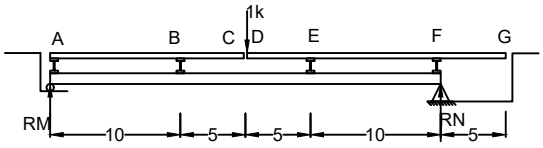
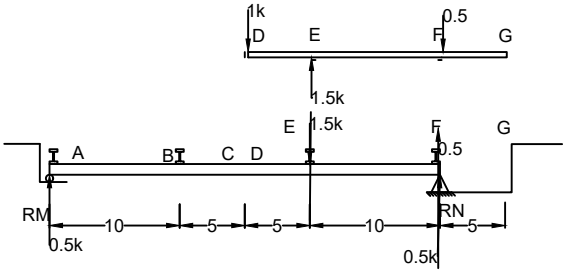
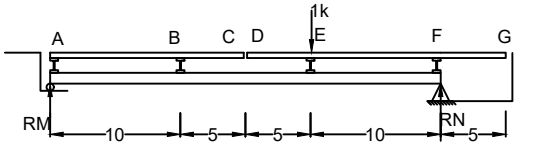






When 1k at 'D'
RF=-0.5k
RE=1.5k
RM=0.5k
RN=0.5k
ME =0.5*10+0.5*10=10k'





When 1k at 'E'
RM=$\frac{1}{3}$ k
RN=$\frac{2}{3}$ k
ME =$\frac{2}{3}$*10=$\frac{20}{3}$ k'

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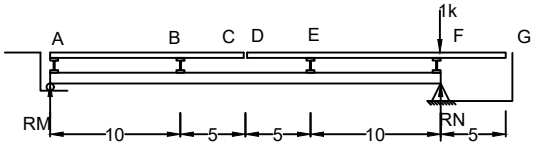
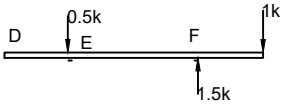
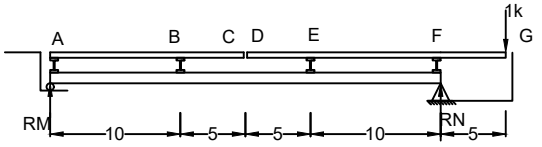
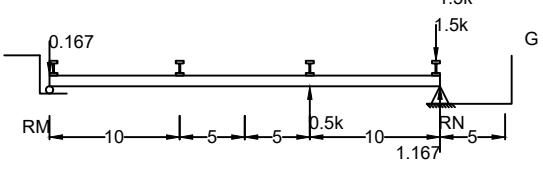


When 1k at F'
RM=0 k
RN=1k
ME =1*10-1*10=0k'



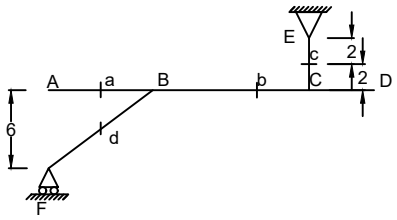


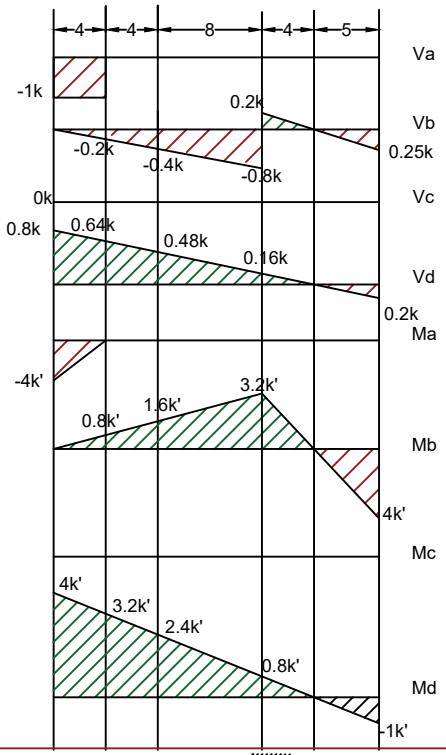
When 1k at G'
RE=-0.5
RF=1.5k
RM=-0.167 k
RN=1.167k
ME =1.167*10-1.5*30=-3.333k'

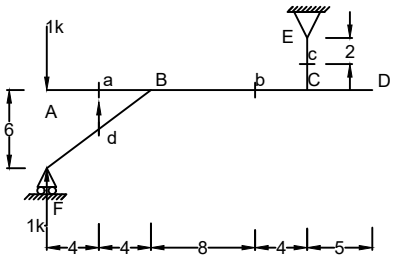


Problem 18

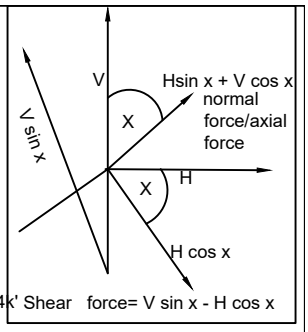
Find Shear and moment a,b,c,d, If load moves from A to D

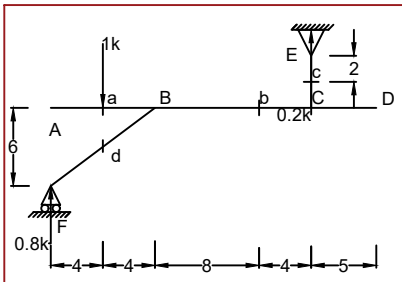






When 1k at A
RF=1k
RE=0k
Va= -1k
Vb=0k
Vc=0k
Vd= $1^* \frac{4}{\sqrt{(4^2+3^2)}}$=0.8k
Ma=-4 k'
Mb=0k'
Mc=0k'
Md=0.8*sqrt(4^2 +3^2) =4k' Shear force= V sin x - H cos x





When 1k at a
RF=0.8k
RE=0.2k
Va= -1k(left)
Va= 0k(right)
Vb=-0.2k
Vc=0k
Vd= $0.8^* \frac{4}{\sqrt{(4^2+3^2)}}$=0.64k
Ma=0 k'
Mb=0.8k'
Mc=0k'
Md=0.64*sqrt(4^2 +3^2)
=3.2k'

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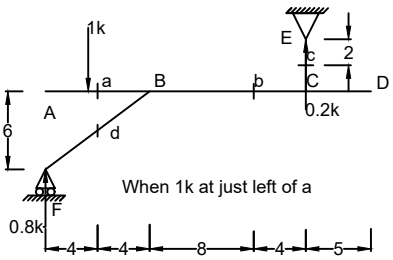
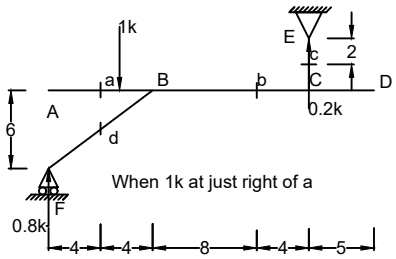
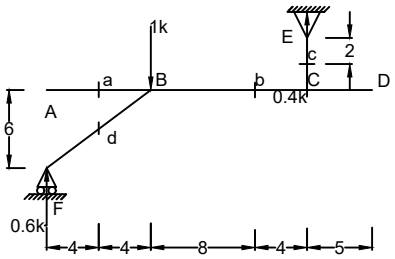


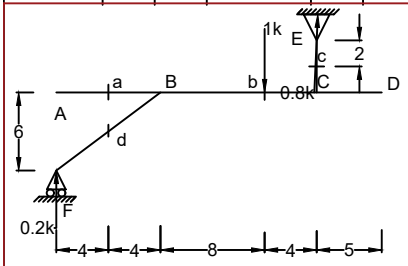
When 1k at just left of a



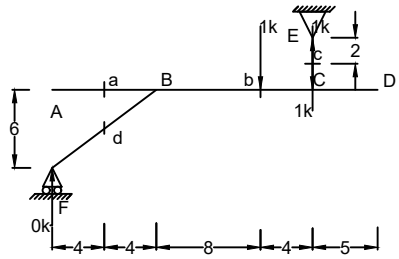
When 1k at just right of a



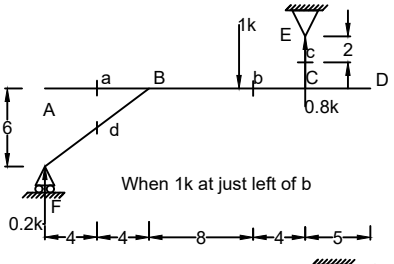
When 1k at B
RF=0.6k
RE=0.4k
Va= 0k
Vb=-0.4k
Vc=0k
Vd= $0.6^* \frac{4}{\sqrt{(4^2+3^2)}}$=0.48k
Ma=0 k'
Mb=1.6k'
Mc=0k'
Md=0.48*sqrt(4^2 +3^2)=2.4k'



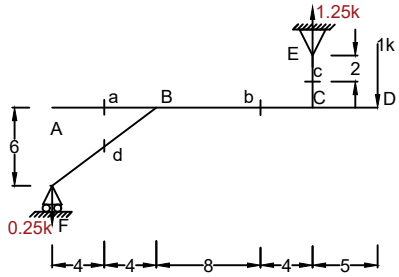
When 1k at b
RF=0.2k
RE=0.8k
Va= 0k
Vb=-0.8k (left)
Vb=0.2k (right)
Vc=0k
Vd= $0.2^* \frac{4}{\sqrt{(4^2+3^2)}}$=0.16k
Ma=0 k'
Mb=3.2k'
Mc=0k'
Md=0.16*sqrt(4^2 +3^2)
=0.8k'



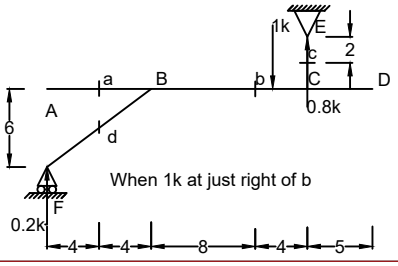
When 1k at C
RF=0k
RE=1k
Va= 0k
Vb=0k
Vc=0k
Vd= 0k
Ma=0 k'
Mb=0k'
Mc=0k'
Md=0k'



When 1k at just left of b



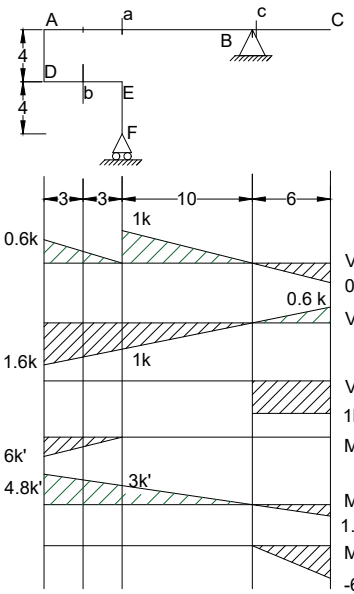
When 1k at D
RF=-0.25k
RE=1.25k
Va= 0k
Vb=-0.25k
Vc=0k
Vd= $-0.25^* \frac{4}{\sqrt{(4^2+3^2)}}$=-0.2k
Ma=0 k'
Mb=-4k'
Mc=0k'
Md=-0.2*sqrt(4^2 +3^2)
=-1k'

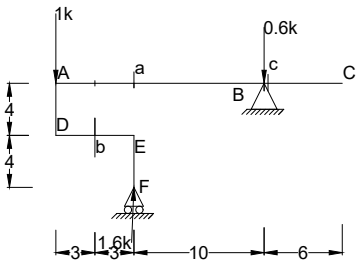


When 1k at just right of b

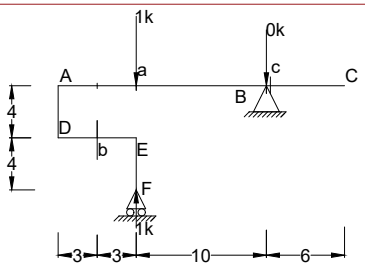
Problem 19

Shear = sum of transeverse forces either left or right of section

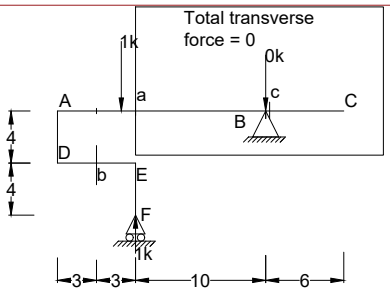




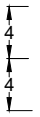
When 1k at A
RF= 1.6 k RB=-0.6k
Va= 0.6k
Vb= -1.6k
Vc= 0k
Ma=-0.6*10=-6k'
Mb=1.6*3=4.8k'
Mc= 0k

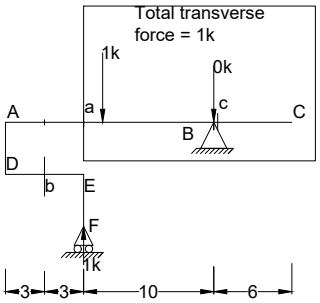


When 1k at a
RF= 1 k RB= 0k
Va=0 k (left)
Va= 1k (right)
Vb= -1k
Vc= 0k
Ma= 0k'
Mb=1*3=3k'
Mc= 0k'

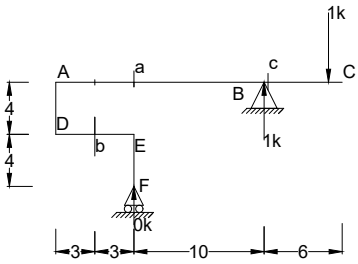


When 1k at just left of a

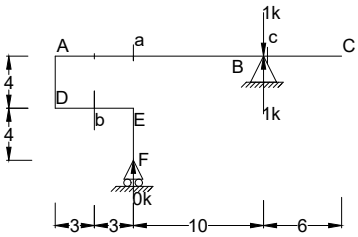




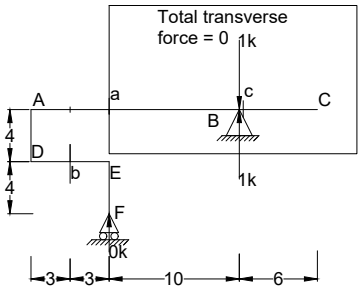
When 1k at just Right of a



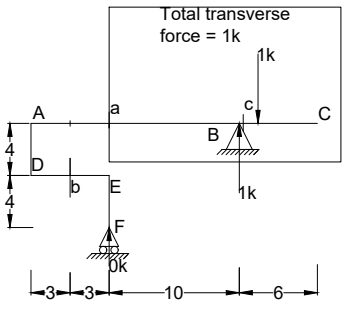
When 1k at B
RF= 0 k RB= 1k
Va=0 k
Vb= 0 k
Vc= 0k
Ma= 0k'
Mb=0 k'
Mc= 0k'



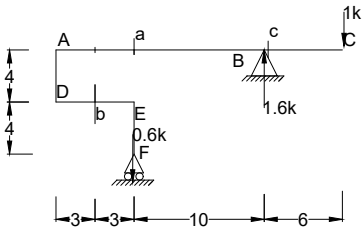
When 1k at c
RF= 0 k RB= 1k
Va=0 k
Vb= 0 k
Vc= 0k(left)
Vc= 1k(Right)
Ma= 0k'
Mb=0 k'
Mc= 0k'



When 1k at just left of c



When 1k at just Right of c



When 1k at C
RF= $\frac{6}{10}$ =0.6 k RB= $\frac{16}{10}$ =1.6 k
Va=-1.6+1=-0.6 k
Vb= 0.6 k
Vc= 1k
Ma= -1*16+1.6*10=0k'
Mb=-0.6*3=-1.8 k'
Mc= -6k'

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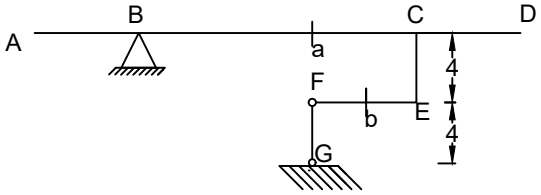
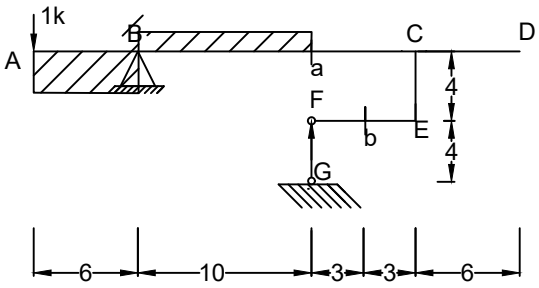
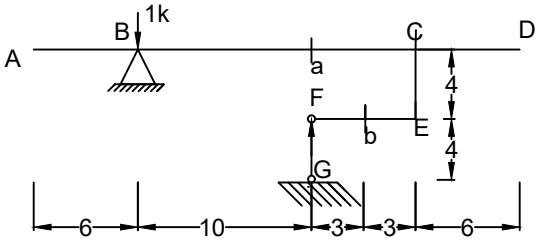
Problem 20

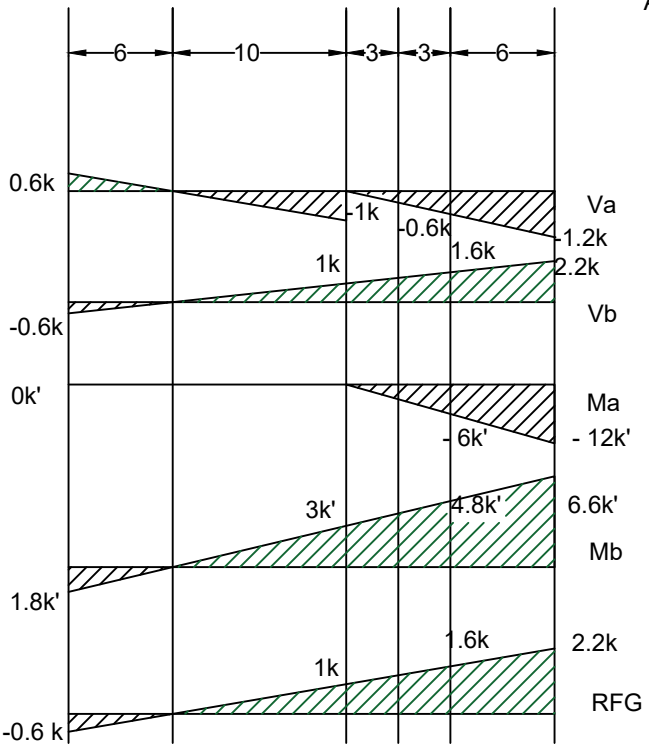


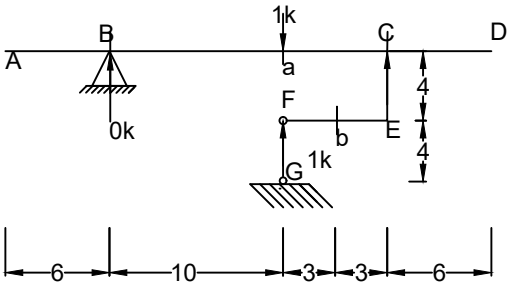


When 1k at A
Va= 1.6 -1 = 0.6k
Vb= -0.6k
Ma=0k'
Mb= 1.8k'
RFG=-0.6 k

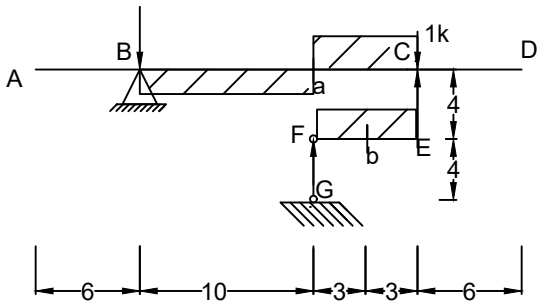


When 1k at B
Va= 0 k
Vb= 0k
Ma=0k'
Mb= 0k'
RFG=0k

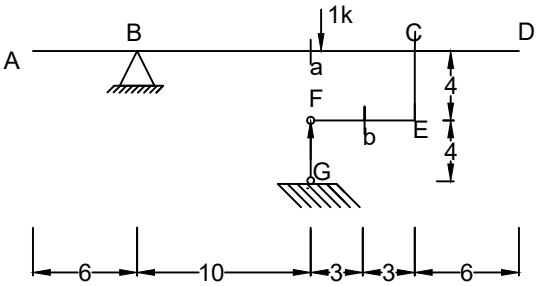




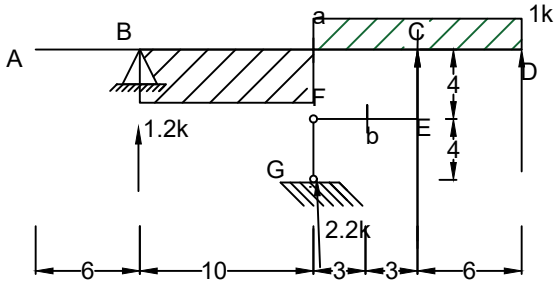
When 1k at a
Va= -1 k(Left of a)
Va= 0 k(Right of a)
Vb= 1k
Ma= 0k'
Mb= 3k'
RFG= 1k



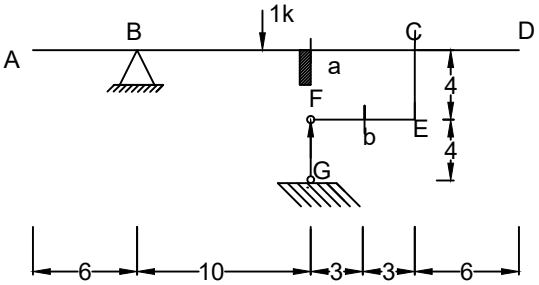
When 1k at C
Rb=-0.6
Va= -0.6 k
Vb=1.6 k
Ma=-6k'
Mb= 4.8k'
RFG=1.6k



When 1k at right of a



When 1k at D
Rb= -1.2
Va= -1.2 k
Vb= 2.2k
Ma=-12k'
Mb= 6.6 k'
RFG=$\frac{22}{10}$ = 2.2k



When 1k at left of a

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