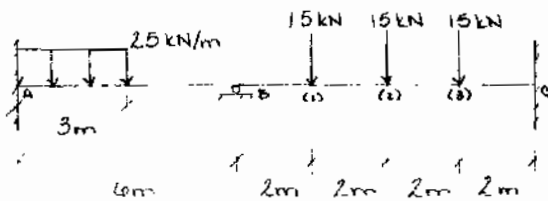


(Problem 12-1) Determine the moments at the supports. EI is constant. Assume B is a roller and A and C are fixed.



$\frac{48.5}{50} = 3$

FIXED END MOMENTS

$FEM_{AB} = \frac{wL^2}{12} (6L^2 - 8aL + 3a^2) = \frac{25(36)}{12(6)^2} (6(36) - 8(3)(6) + 3(3)^2) = 51.5625 \text{ kN m } \uparrow$
 $FEM_{BA} = -\frac{wL^2}{12} (4L - 3a) = -\frac{25(36)}{12(6)^2} (4(6) - 3(3)) = -23.4375 \text{ kN m } \downarrow$

$FEM_{BC1} = \frac{PL^2}{L^2} = \frac{15(2)(6)^2}{8^2} = 10.875 \text{ kN m } \uparrow$
 $FEM_{BC2} = \frac{PL}{8} = \frac{15(6)}{8} = 15 \text{ kN m } \uparrow$
 $FEM_{BC3} = \frac{PL^2}{L^2} = \frac{15(6)(2)^2}{8^2} = 5.625 \text{ kN m } \uparrow$
 } $FEM_{BC} = 37.5 \text{ kN m } \uparrow$

$FEM_{CB1} = -\frac{PL^2}{L^2} = -\frac{15(2)^2(6)}{8^2} = -5.625 \text{ kN m } \downarrow$
 $FEM_{CB2} = -\frac{PL}{8} = -\frac{15(6)}{8} = -15 \text{ kN m } \downarrow$
 $FEM_{CB3} = -\frac{PL^2}{L^2} = -\frac{15(6)(2)^2}{8^2} = -10.875 \text{ kN m } \downarrow$
 } $FEM_{CB} = -37.5 \text{ kN m } \downarrow$

DISTRIBUTION FACTORS

$DF_{BA} = \frac{1/6}{1/6 + 1/8} = 0.571$

$DF_{BC} = \frac{1/8}{1/6 + 1/8} = 0.429$

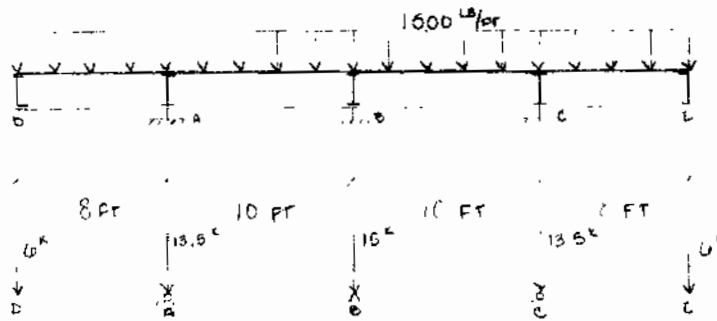
TABLE

NUMBER	AB	BA	BC	CB
DIST. FACTORS		0.571	0.429	
FEMs	51.5625	-23.4375	37.5	-37.5
BALANCE B		8.0297	-6.0328	
CARRYOVER	-4.0149			3.0164
FINAL	47.5476	-31.4072	31.4672	-40.5164

$M_A = M_{AB} = 47.5476 \text{ kN m } (+) \rightarrow$
 $M_C = M_{CB} = -40.5164 \text{ kN m } (-) \rightarrow$

M_A
 M_C

(Problem 12-6) Determine the moments at A, B, and C and then draw the moment diagram for the girder DE. EI is constant. Assume the support at B is a pin and A and C are rollers. The distributed load rests on simply supported floor boards that transmit the load to the floor beams.



FIXED END MOMENTS

$$\begin{aligned}
 FEM_{DA} &= 0 & FEM_{BC} &= 0 \\
 FEM_{AD} &= 6(8) = -48 \text{ K-FT} \downarrow & FEM_{CB} &= 0 \\
 FEM_{AB} &= 0 & FEM_{CE} &= 6(8) = 48 \text{ K-FT} \uparrow \\
 FEM_{BA} &= 0 & FEM_{EC} &= 0
 \end{aligned}$$

DISTRIBUTION FACTORS

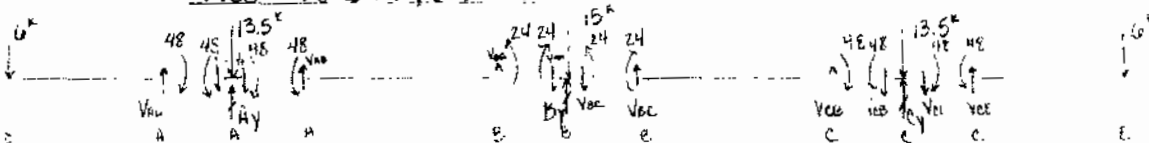
$$\begin{aligned}
 DF_{AD} &= 0 & DF_{BA} &= 0.5 & DF_{CB} &= 1 \\
 DF_{AB} &= 1 & DF_{BC} &= 0.5 & DF_{CE} &= 0
 \end{aligned}$$

TABLE

MEMBER	DA	AD	AB	BA	BC	CB	CE	EC
DIST FACTORS		0	1	0.5	0.5	1	0	
FEM'S	0	-48	0	0	0	0	+48	0
BALANCE			+48			-48		
CARRYOVER				+24	-24			
FINAL	0	-48	+48	+24	-24	-48	+48	0

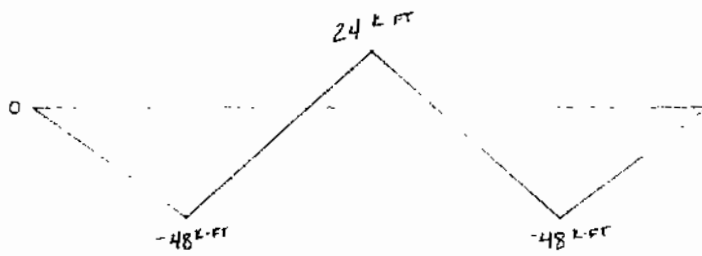
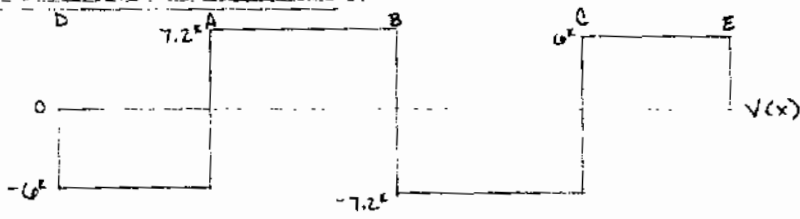
$$\begin{aligned}
 M_{AD} &= -48 \text{ K-FT, (-)} \downarrow < \\
 M_{AB} &= 48 \text{ K-FT, (+)} \uparrow < \\
 M_{BA} &= 24 \text{ K-FT, (+)} \uparrow < \\
 M_{BC} &= -24 \text{ K-FT, (-)} \downarrow < \\
 M_{CB} &= -48 \text{ K-FT, (-)} \downarrow < \\
 M_{CE} &= 48 \text{ K-FT, (+)} \uparrow <
 \end{aligned}$$

M_{AD}
 M_{AB}
 M_{BA}
 M_{BC}
 M_{CB}
 M_{CE}

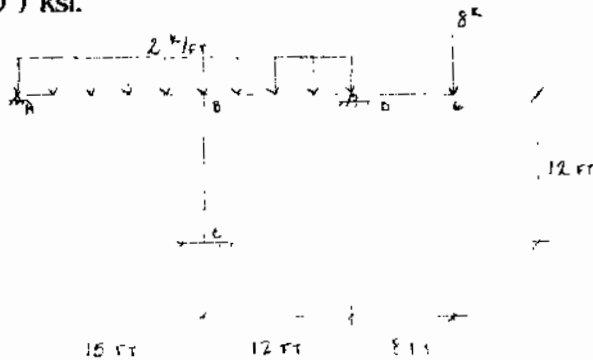


$$\begin{aligned}
 \sum V_{AD} &= 6^k & \sum M_C &= 0 & 24 + 48 + V_{BC}(10) & \\
 \sum V_{CE} &= 6^k & V_{BC} &= -7.2^k & & \\
 \sum M_B &= 0 & 48 + V_{AB}(10) - 24 &= 0 & \sum M_C &= 0 & 24 + 48 - V_{CB}(10) & \\
 V_{AB} &= 7.2^k & V_{CB} &= 7.2^k & A_y &= 26.7^k \uparrow & \\
 \sum M_A &= 0 & 48 + 24 + V_{BA}(10) & & B_y &= 0.6^k \uparrow & \\
 V_{BA} &= -7.2^k & & & C_y &= 26.7^k \uparrow &
 \end{aligned}$$

SHEAR AND MOMENT DIAGRAMS



(Problem 12-13) Determine the internal moments at the supports and draw the moment diagram for ABDE. Assume A is pinned and C is fixed. Take $I=1200 \text{ in}^4$, $E=29(10^3) \text{ ksi}$.



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FIXED END MOMENTS

$$FEM_{AB} = \frac{+wL^2}{12} = \frac{2(15)^2}{12} = +37.5 \text{ k-ft}$$

$$FEM_{BA} = \frac{-wL^2}{12} = \frac{-2(15)^2}{12} = -37.5 \text{ k-ft}$$

$$FEM_{BC} = FEM_{CB} = 0$$

$$FEM_{BD} = \frac{+wL^2}{12} = \frac{2(12)^2}{12} = +24 \text{ k-ft}$$

$$FEM_{DB} = \frac{-wL^2}{12} = \frac{-2(12)^2}{12} = -24 \text{ k-ft}$$

$$FEM_{DE} = +8(8) = +64 \text{ k-ft}$$

$$FEM_{ED} = 0$$

DISTRIBUTION FACTORS

$$DF_{BA} = \frac{I/15(3/4)}{I/15(3/4) + I/12 + I/12} = 0.231$$

$$DF_{BD} = \frac{I/12}{I/15(3/4) + I/12 + I/12} = 0.385$$

$$DF_{BC} = \frac{I/12}{I/15(3/4) + I/12 + I/12} = 0.385$$

$$DF_{DB} = 1$$

$$DF_{DE} = 0$$

TABLE

MEMBER	AB	BA	BC	BD	DB	DE	CE
DIST. FACT.		0.231	0.385	0.385	1	0	
FEM'S	+37.5	-37.5	0	+24	-24	+64	0
BALANCE	-37.5	+3.1185	+5.1975	+5.1975	-40		
CARRYOVER	0	-18.75		-20	+2.5988		+2.5988
BALANCE		+8.9513	+14.9188	+14.9188	-2.5988		
CARRYOVER	0			-1.2994	+7.4594		+7.4594
BAL.		+0.3002	+0.5003	+0.5003	-7.4594		
CO				-3.7296	+0.2502		+0.2502
BAL.		+0.8615	+1.4359	+1.4359	-0.2502		
CO				-0.1251	+0.7180		+0.7180
BAL.		+0.0289	+0.0482	+0.0482	-0.7180		
CO				-0.3590	+0.0241		+0.0241
BAL.		+0.0829	+0.1382	+0.1382	-0.0241		
CO				-0.0121	+0.0091		+0.0091
BAL.		+0.0028	+0.0047	+0.0047	-0.0091		
	0	-42.9039	+22.2436	+20.7184	-64	+64	0

$$M_{AB} = M_{ED} = 0$$

$$M_{BA} = -42.9039 \text{ k-ft (-)}$$

$$M_{BC} = +22.2436 \text{ k-ft (+)}$$

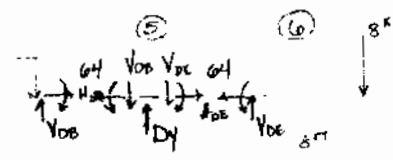
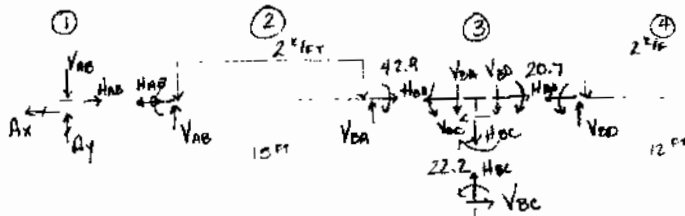
$$M_{BD} = +20.7184 \text{ k-ft (+)}$$

$$M_{DB} = -64 \text{ k-ft (-)}$$

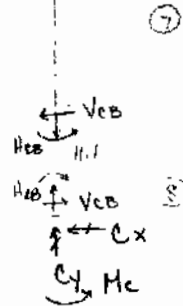
$$M_{DE} = +64 \text{ k-ft (+)}$$

$$M_{CE} = +11.1196 \text{ k-ft (+)}$$

INT. MOMENTS

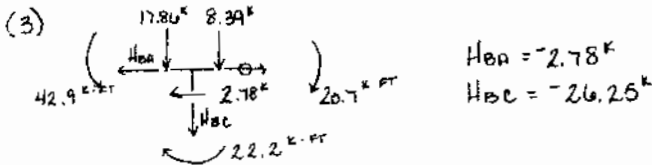


(7) $\sum M_{BC} = 0$
 $22.2 + 11.1 - V_{CB}(12) = 0$
 $\therefore V_{CB} = 2.78^k$
 $\sum F_x = 0$
 $\therefore V_{CB} = 2.78^k$



(2) $\sum M_B = 0 = 42.9 + V_{AB}(15) - 2(15)(7.5)$
 $\therefore V_{AB} = 12.14^k$
 $\sum F_y = 0 \quad V_{AB} + V_{BA} - 2(15) = 0$
 $\therefore V_{BA} = 17.86^k$
 (6) $\sum F_y = 0 \quad V_{DB} = 8^k$
 (4) $\sum M_B = 0 = -20.7 + 64 - V_{DB}(12) + 2(12)(6)$
 $\therefore V_{DB} = 15.61^k$
 $\sum F_y = 0 = V_{DB} + V_{DB} - 2(12)$
 $\therefore V_{DB} = 8.39^k$

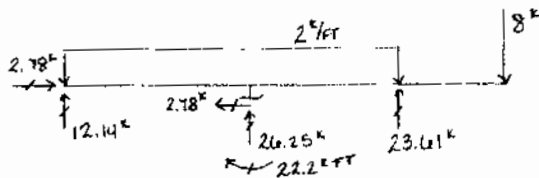
(6) $H_{DE} = 0 \rightarrow H_{BD} = 0$



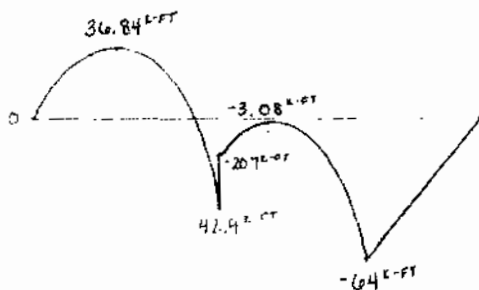
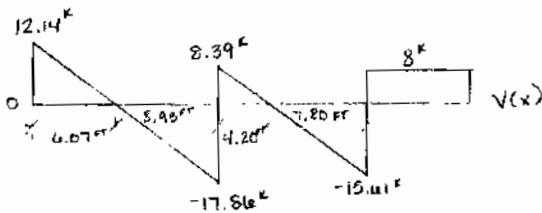
$\therefore H_{CB} = -26.25$

REACTIONS

$M_C = 11.1^k \cdot \text{ft}$
 $C_y = 26.25^k$
 $C_x = 2.78^k$
 $A_y = 12.14^k$
 $A_x = 2.78^k$
 $D_y = 23.61^k$



SHEAR AND MOMENT DIAGRAMS



(Problem 12-16) Determine the moments at the ends of each member of the frame. The members are fixed connected at the supports and joints. EI is the same for each member.

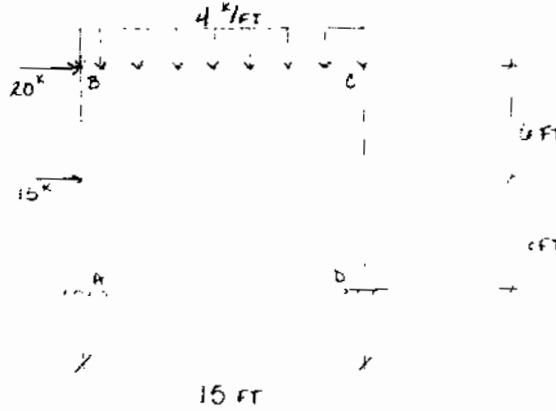
DISTRIBUTION FACTORS

$$DF_{BA} = \frac{7/12}{7/12 + 7/15} = 0.556$$

$$DF_{BC} = \frac{1/15}{7/12 + 1/15} = 0.444$$

$$DF_{CB} = 0.444$$

$$DF_{CD} = 0.556$$



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PART 1: WITHOUT SIDESWAY

$$FEM_{CD} = FEM_{DC} = 0$$

$$FEM_{AB} = \frac{PL}{8} = \frac{12(12)}{8} = +22.5 \text{ k-ft}$$

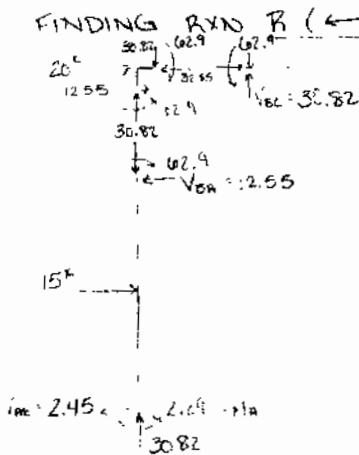
$$FEM_{BA} = -\frac{PL}{8} = -\frac{12(12)}{8} = -22.5 \text{ k-ft}$$

$$FEM_{BC} = \frac{wL^2}{12} = \frac{4(15)^2}{12} = +75 \text{ k-ft}$$

$$FEM_{CB} = -\frac{wL^2}{12} = -\frac{4(15)^2}{12} = -75 \text{ k-ft}$$

MEMBER	AB	BA	BC	CB	CD	DC
DIST. FACT.		0.556	0.444	0.444	0.556	
FEMs	+22.5	-22.5	+75	-75	0	0
BALANCE		-29.19	-23.31	+33.3	+41.7	
CARRYOVER	-14.595		-11.655	-11.655		-20.85
BALANCE		-9.2574	-7.3926	+5.1748	+6.4802	
CARRYOVER	-4.6287		+2.5874	+3.6963		+3.2401
BALANCE		-1.4386	-1.1488	+1.0412	+2.0561	
CARRYOVER	-0.7193		+0.8206	+0.5744		+1.0276
BALANCE		-0.4563	-0.3643	+0.2550	+0.3144	
CARRYOVER	-0.2282		+0.1275	+0.1822		+0.1597
BALANCE		-0.0709	-0.2566	+0.0809	+0.1013	
CARRYOVER	-0.0355		+0.0405	+0.0283		+0.0507
BALANCE		-0.0225	-0.0180	+0.0126	+0.0157	
FINAL	+2.2933	-62.9357	-62.9357	-50.6717	+50.6717	+25.3281

FINDING REACTION R (←)



$$(+ \sum M_B = 0 = -62.9 + 2.29 - V_{CD}(12) + 15(6))$$

$$V_{AB} = 2.45 \text{ k}$$

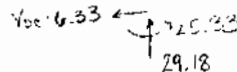
$$(+ \sum M_C = 0 = -62.9 - 4(15)(7.5) - V_{CD}(15) - 50.67)$$

$$V_{CD} = 29.18 \text{ k}$$

$$(+ \sum M_D = 0 = 50.67 - V_{CD}(12) - 6.33)$$

$$V_{CD} = 29.33 \text{ k}$$

$$R = 26.22 \text{ k}$$



5/1/2006

CL-4(c)

ASSIGNMENT # 13

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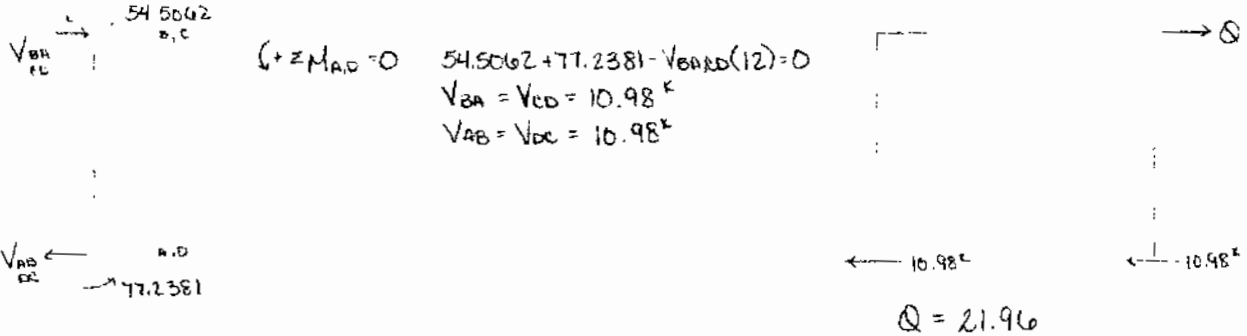
PART 2 : WITH SIDESWAY

$FEM_{BC} = FEM_{CB} = 0$

$FEM_{AB} = FEM_{BA} = FEM_{CD} = FEM_{DC} = \frac{+0.61\Delta}{L^2}$
 ASSUME $\frac{0.61\Delta}{L^2} = 100 \text{ K}$

MEMBER	AB	BA	BC	CB	CD	DC
DIST. TART		0.556	0.444	0.444	0.556	
FEMs	+100	+100	0	0	+100	+100
BALANCE		-55.6	-44.4	-44.4	-55.6	
CARRYOVER	-27.8		-22.2	-22.2		-27.8
BALANCE		+12.3432	+9.8568	+9.8568	+12.3432	
CARRYOVER	+6.1716		+4.9284	+4.9284		+6.1716
BALANCE		-2.7402	-2.1882	-2.1882	-2.7402	
CARRYOVER	-1.3701		-1.0941	-1.0941		-1.3701
BALANCE		+0.6083	+0.4868	+0.4868	+0.6083	
CARRYOVER	+0.3042		+0.2429	+0.2429		+0.3042
BALANCE		-0.1351	-0.1078	-0.1078	-0.1351	
CARRYOVER	-0.0676		-0.0539	-0.0539		-0.0676
BALANCE		+0.0300	+0.0239	+0.0239	+0.0300	
FINAL	+77.2381	+54.5062	-54.5062	-54.5062	+54.5062	+77.2381

FINDING Q (→)



MEMBER END MOMENTS ($M = M_0 + (\frac{R}{8})M_0$)

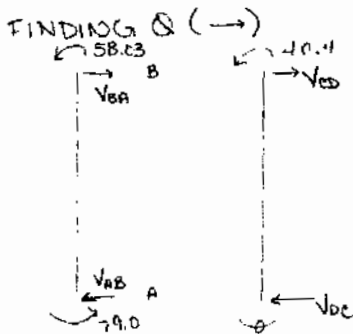
$M_{AB} = 2.2933 + (\frac{26.22}{21.96})(77.2381)$	$\therefore M_{AB} = 95.51 \text{ K-FT, (+)}$	} ← END MOMENTS
$M_{BA} = -62.9357 + (\frac{26.22}{21.96})(54.5062)$	$\therefore M_{BA} = 2.14 \text{ K-FT, (+)}$	
$M_{BC} = 62.9357 + (\frac{26.22}{21.96})(-54.5062)$	$\therefore M_{BC} = -2.14 \text{ K-FT, (-)}$	
$M_{CB} = 50.6717 + (\frac{26.22}{21.96})(-54.5062)$	$\therefore M_{CB} = -115.75 \text{ K-FT, (-)}$	
$M_{CD} = 50.6717 + (\frac{26.22}{21.96})(54.5062)$	$\therefore M_{CD} = 115.75 \text{ K-FT, (+)}$	
$M_{DC} = 25.3281 + (\frac{26.22}{21.96})(77.2381)$	$\therefore M_{DC} = 117.55 \text{ K-FT, (+)}$	

PART 2: WITH SIDESWAY

$FEM_{AB} = FEM_{BA} = FEM_{CD} = FEM_{DC} = \frac{wEL^2}{2}$
 $FEM_{BC} = FEM_{CB} = 0$

ASSUME $\frac{wEL^2}{2} = 100 \text{ k-ft}$

MEMBER	AB	BA	BC	CB	CD	DC
DIST. FACT.		0.4545	0.5455	0.0154	0.3846	
FEMs	+100	+100			+100	+100
BALANCE		-45.45	-54.55	-1.54	-38.48	-100
CARRYOVER	-22.725		-26.77	-27.275	-50	0
BALANCE		+13.985	+16.785	+4.555	+29.720	
CARRYOVER	+6.993		+23.778	+8.592		0
BALANCE		-10.807	-12.971	-5.165	-3.230	
CARRYOVER	-5.404		-2.583	-6.486		0
BALANCE		+1.1740	+1.409	+3.991	+2.495	
CARRYOVER	+0.587		-1.996	-0.705		0
BALANCE		-0.907	-1.089	-0.434	-0.271	
CARRYOVER	-0.454		-0.217	-0.545		0
BALANCE		+0.099	+0.118	+0.326	+0.210	
CARRYOVER	+0.050		+0.168	+0.059		0
BALANCE		-0.076	-0.092	-0.036	-0.023	
CARRYOVER	-0.038		-0.018	-0.046		0
BALANCE		+0.008	+0.010	+0.028	+0.018	
FINAL	79.009	+58.026	-58.026	-40.461	+40.439	0

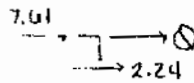


$\sum M_A = 0 = 58.03 + 79.0 - V_B(18) = 0$

$V_B = 7.61 \text{ k}$

$\sum M_D = 0 = 40.4 - V_C(18) = 0$

$V_C = 2.24 \text{ k}$



$\Delta = 9.85 \text{ k}$

MEMBER END MOMENTS $(M = M_0 + (\frac{P}{8})M_0)$

$M_{AB} = 1132.77 + (\frac{199.33}{9.85})(79.009)$

$M_{BA} = -326.503 + \dots (58.026)$

$M_{BC} = +326.503 + \dots (-58.026)$

$M_{CB} = 74.199 + \dots (-40.461)$

$M_{CD} = -74.199 + \dots (+40.439)$

$\therefore M_{AB} = 2250 \text{ k-ft}, (+)$

$\therefore M_{BA} = 494 \text{ k-ft}, (+)$

$\therefore M_{BC} = -494 \text{ k-ft}, (-)$

$\therefore M_{CB} = -498 \text{ k-ft}, (-)$

$\therefore M_{CD} = 498 \text{ k-ft}, (+)$

$\therefore M_{DC} = 0 \text{ k-ft}$

← END M.

Incorrect due to w/o Sidesway values!