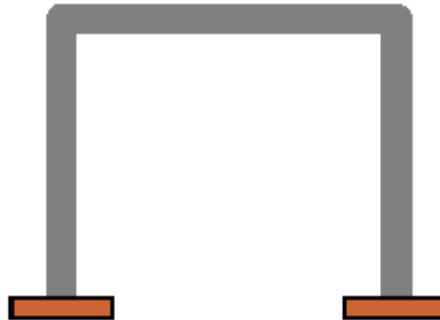
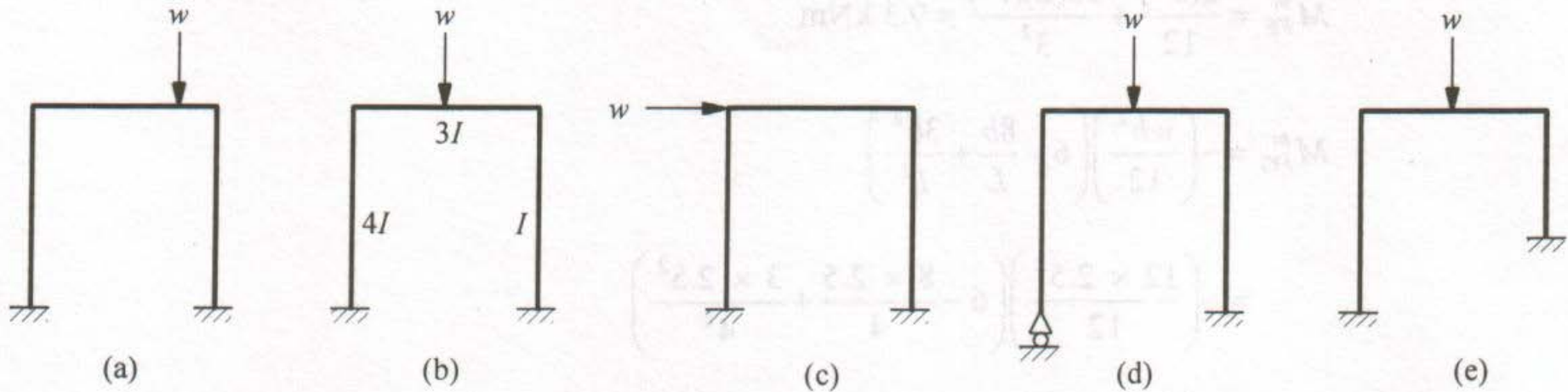


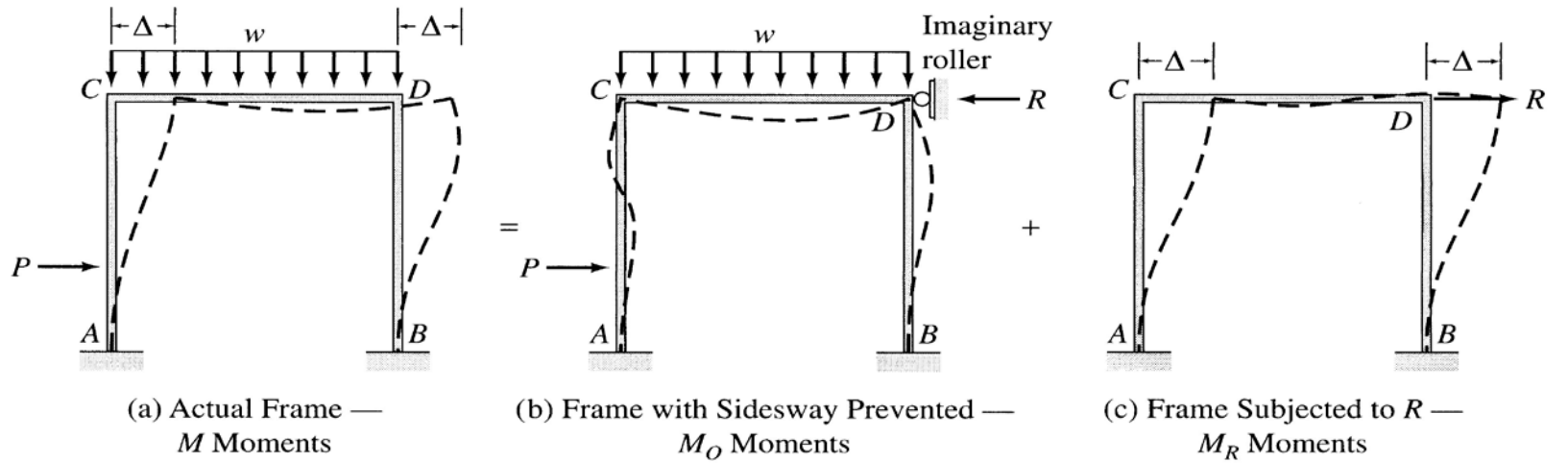
Moment Distribution for Frames: Sidesway



Kerangka menjadi huyung disebabkan beberapa faktor seperti yang berikut:

- (a) beban tidak simetri,
- (b) keratan rentas anggota tidak seragam (nilai momen sifatekun berbeza),
- (c) ada daya ufuk,
- (d) geometri struktur yang tidak simetri, misalnya sokong tidak sama, dan
- (e) ketinggian anggota tidak sama.





$$M = M_O + M_R$$

$$M_R = \left(\frac{R}{Q} \right) M_Q$$

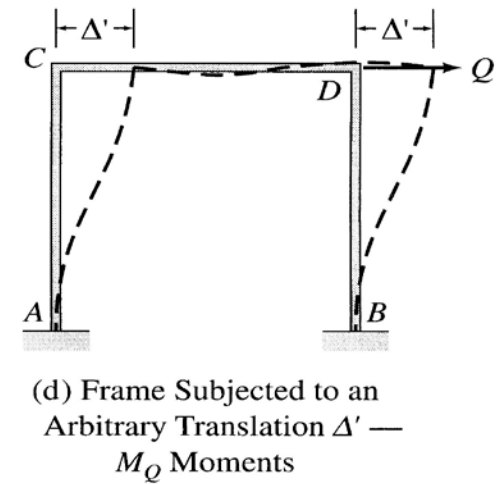


FIG. 17.14

$$M = M_O + \left(\frac{R}{Q} \right) M_Q$$

Example (from Aslam Kassimali)

Example 17.8: Determine the member end moments for the frame shown in Fig. 17.15(a) by using the moment-distribution method.

Distribution factor

At joint C,

$$DF_{CA} = DF_{CD} = \frac{I/7}{2(I/7)} = 0.5$$

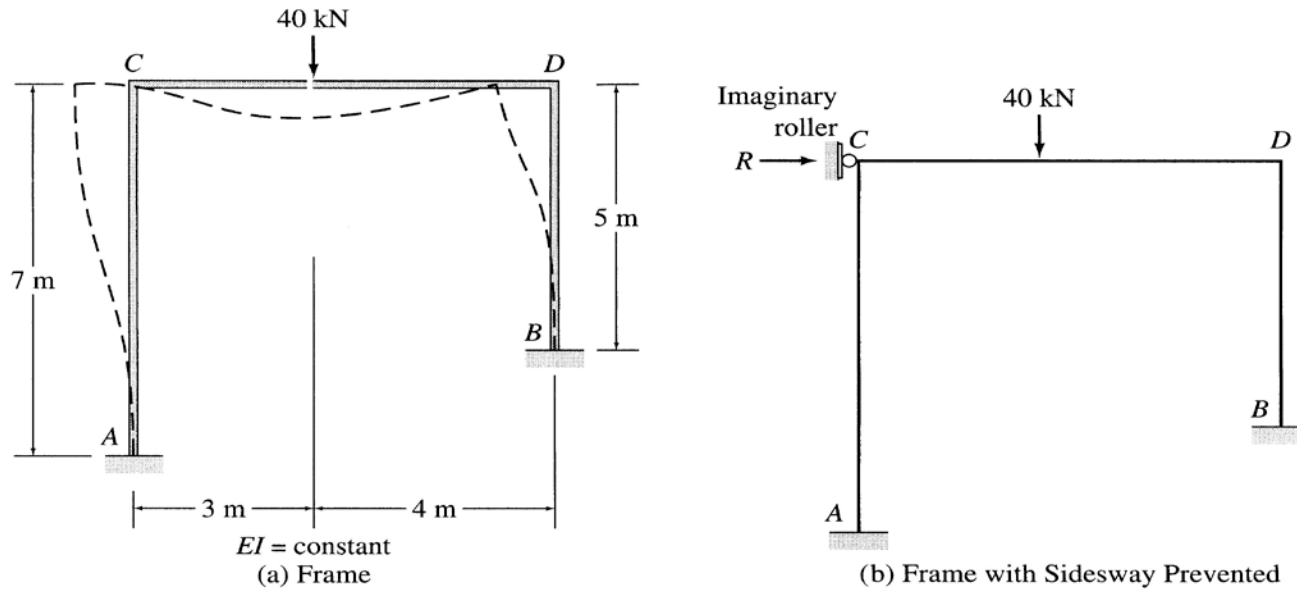
At joint D,

$$DF_{DC} = \frac{I/7}{(I/7) + (I/5)} = 0.417$$

$$DF_{DB} = \frac{I/5}{(I/7) + (I/5)} = 0.583$$

Checks:

$$DF_{DC} + DF_{DB} = 0.417 + 0.583 = 1$$



AC	CA	CD	DC	DB	BD
	0.5	0.5	0.417	0.583	
	-19.6	+39.2	-29.4	+17.1	
- 9.8		-19.6	+12.3		+ 8.6
	- 3.1	+ 6.2	- 9.8	+ 5.7	
- 1.6		- 3.1	+ 4.1		+ 2.9
	- 1.1	+ 2.1	- 1.6	+ 0.9	
- 0.6		- 1.1	+ 0.7		+ 0.5
	- 0.2	+ 0.4	- 0.6	+ 0.3	
		- 0.2	+ 0.3	+ 0.3	
-12	-24	+23.9	-24	+24	+12

(c) Member End Moments for Frame with Sidesway Prevented —
 M_O Moments

FIG. 17.15

Part I: Sidesway Prevented (Fig. 17.15(b)):

$$FEM_{CD} = +39.2 \text{ kNm}$$

$$FEM_{DC} = -29.4 \text{ kNm}$$

$$FEM_{AC} = FEM_{CA} = FEM_{BD} = FEM_{DB} = 0$$

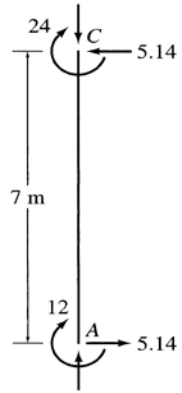
Perform moment distribution process to determine $M_O \rightarrow$ Fig. 17.15(c)

Referring Fig. 17.15(d) and 17.15(e):

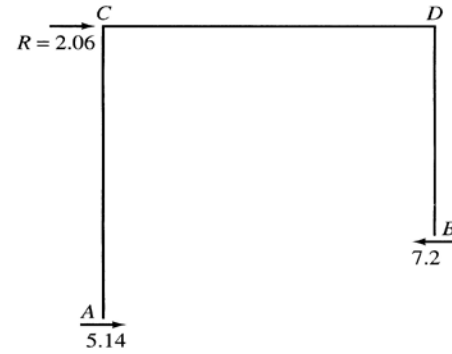
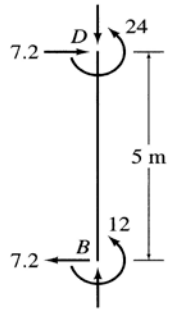
$$+ \rightarrow \sum F_x = 0$$

$$R + 5.14 - 7.2 = 0$$

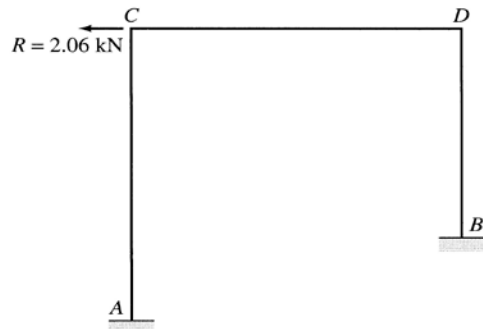
$$R = 2.06 \text{ kN} \rightarrow$$



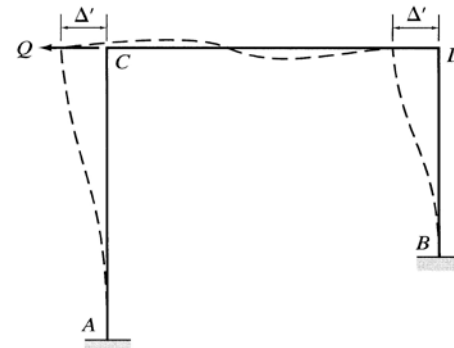
(d)



(e)



(f) Frame Subjected to $R = 2.06 \text{ kN}$ —
 M_R Moments



(g) Frame Subjected to an Arbitrary Translation
 Δ' — M_Q Moments

FIG. 17.15 (contd.)

Part II: Sidesway Permitted (Fig. 17.15(f) and Fig. 17.15(g)):

$$FEM_{AC} = FEM_{CA} = -\frac{6EI\Delta'}{(7)^2} = -\frac{6EI\Delta'}{49}$$

$$FEM_{BD} = FEM_{DB} = -\frac{6EI\Delta'}{(5)^2} = -\frac{6EI\Delta'}{25}$$

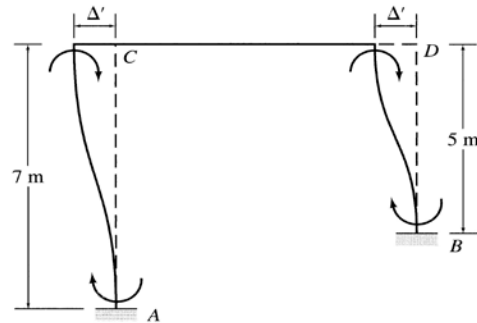
$$FEM_{CD} = FEM_{DC} = 0$$

We arbitrarily assume the fixed-end moment FEM_{AC} to be -50 kNm, that is:

$$FEM_{AC} = FEM_{CA} = -\frac{6EI\Delta'}{49} = -50 \text{ kNm}$$

gives $\Delta' = \frac{408.33}{EI}$

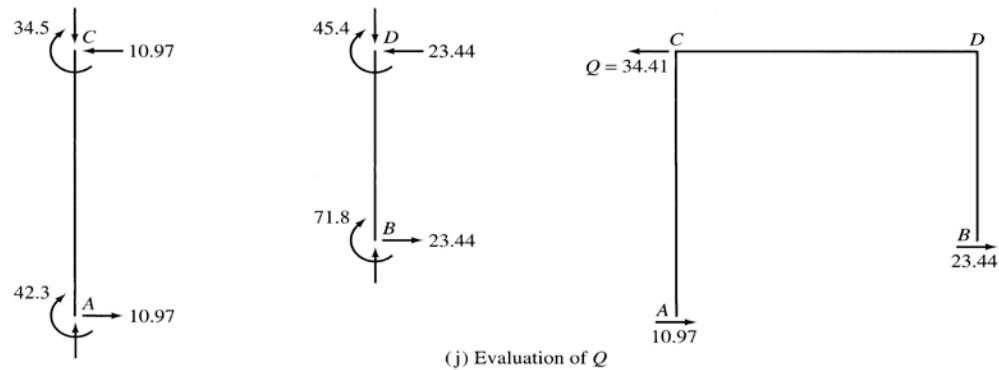
$$FEM_{BD} = FEM_{DB} = -\frac{6(408.33)}{25} = -98 \text{ kNm}$$



(h) Fixed-End Moments Due to Known Translation Δ'

AC	CA	CD	DC	DB	BD
	0.5	0.5	0.417	0.583	
-50	-50			-98	-98
+12.5	+25	+25	+40.9	+57.1	+28.6
- 5.2	-10.3	+20.5	+12.5	- 5.2	- 3.7
+ 0.7	+ 1.3	-10.3	- 5.2	- 7.3	+ 1.5
- 0.3	- 0.6	- 2.6	- 5.2	+ 3	- 0.2
	+ 0.1	+ 1.3	+ 2.2	+ 0.7	
		+ 1.1	+ 0.7	- 0.4	
		- 0.6	- 0.3	+ 0.2	
		- 0.2	- 0.3		
-42.3	-34.5	+34.3	+45.4	-45.4	-71.8

(i) Member End Moments Due to Known Translation Δ' — M_Q Moments



(j) Evaluation of Q

FIG. 17.15 (contd.)

$$+ \rightarrow \sum F_x = 0$$

$$-Q + 10.97 + 23.44 = 0$$

$$Q = 34.41 \text{ kN} \leftarrow$$

Which indicates that the moment M_Q computed in Fig. 17.15(i) are caused by a lateral load $Q=34.41$ kN. Since the moments are linearly proportional to the magnitude of the load, the desired moment M_R due to the lateral load $R=2.06$ kN must be equal to the moments M_Q (Fig. 17.15(i)) multiplied by the ratio $R/Q=2.06/34.41$.

Actual Member End Moments, M

$$M = M_o(\text{Fig.17.15(c)}) + \frac{2.06}{34.41} M_o(\text{Fig.17.15(i)})$$

$$M_{AC} = -12 + \left(\frac{2.06}{34.41} \right) (-42.3) = -14.5 \text{ kNm}$$

$$M_{CA} = -24 + \left(\frac{2.06}{34.41} \right) (-34.5) = -26.1 \text{ kNm}$$

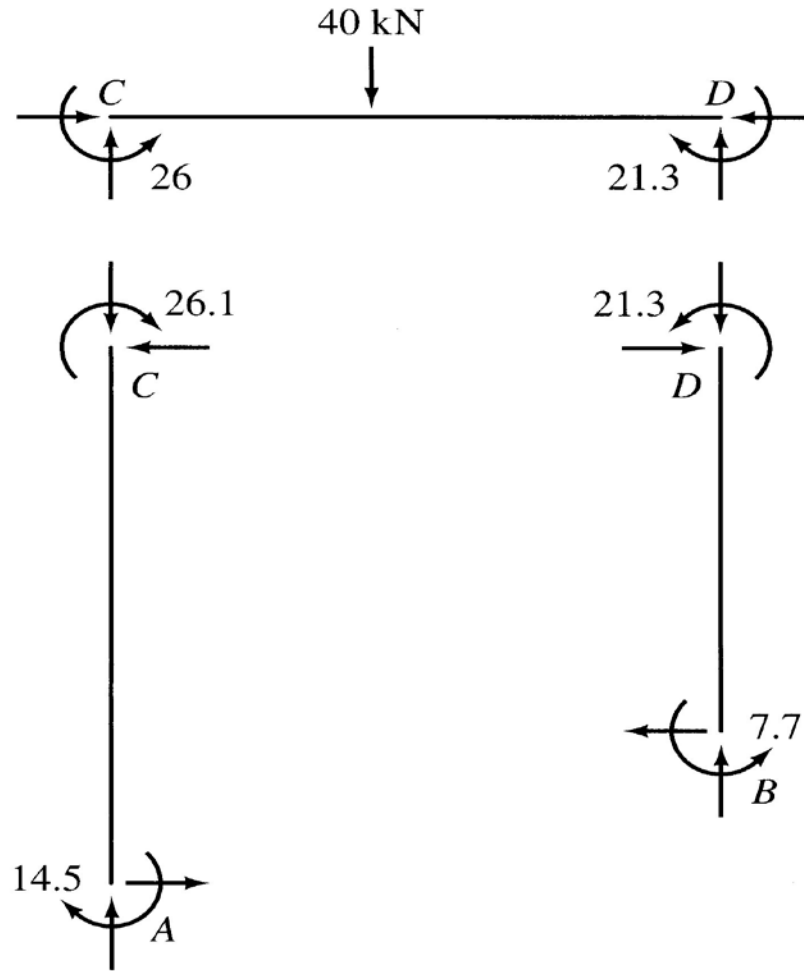
$$M_{CD} = 23.9 + \left(\frac{2.06}{34.41} \right) (34.3) = 26 \text{ kNm}$$

$$M_{DC} = -24 + \left(\frac{2.06}{34.41} \right) (45.4) = -21.3 \text{ kNm}$$

$$M_{DB} = 24 + \left(\frac{2.06}{34.41} \right) (-45.4) = 21.3 \text{ kNm}$$

$$M_{BD} = 12 + \left(\frac{2.06}{34.41} \right) (-71.8) = 7.7 \text{ kNm}$$

These moments are depicted in Fig. 17.15(k).



(k) Actual Member End Moments ($\text{kN} \cdot \text{m}$)

FIG. 17.15 (contd.)