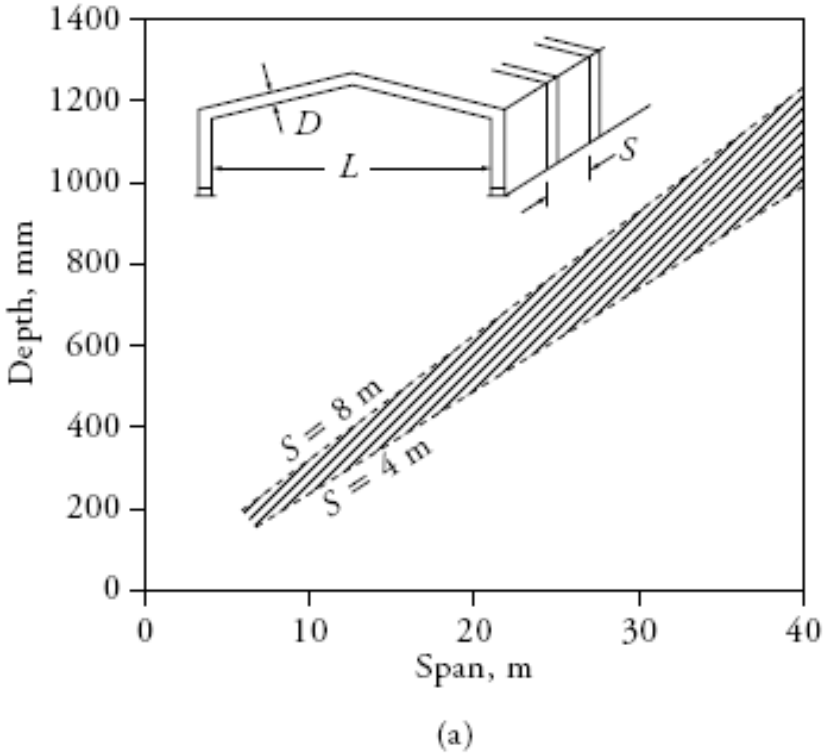
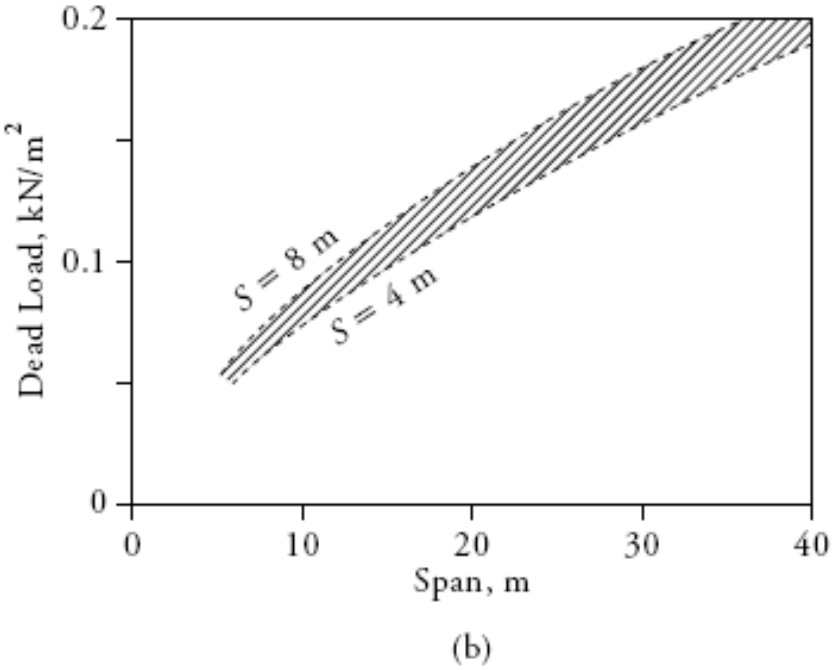
Portal frames

- Used extensively for framing of single-storey buildings.
- Cost-effective for short to medium span framing system.
- Low structural depth, clean appearance and ease of coating maintenance.
- Resistance to vertical and lateral loads through frame action.

Preliminary Design

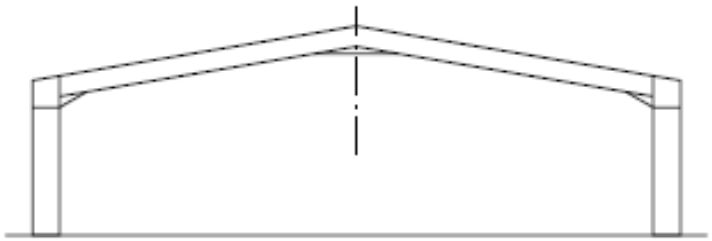




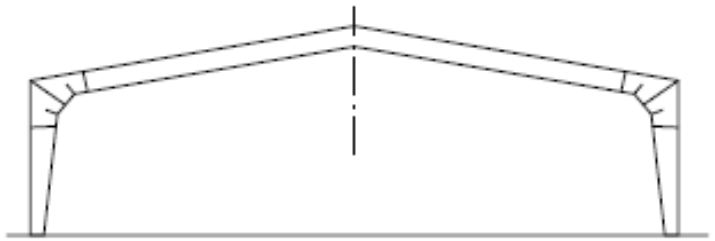
usual range of rafter depths

Dead load of rafters expressed as kN/m^2; wind Region A

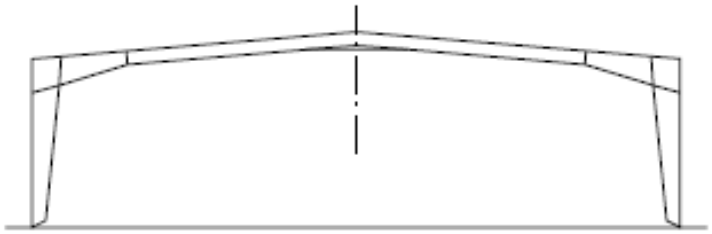
Type of Portal Frames for Industrial Building



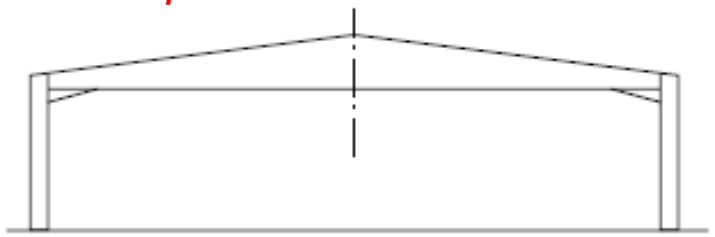
(a) *Constant cross-section*



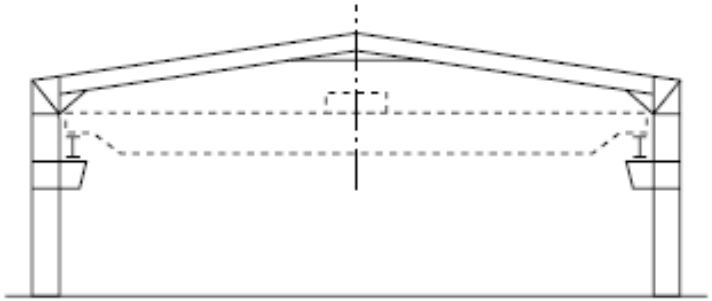
(b) *Tapered column*



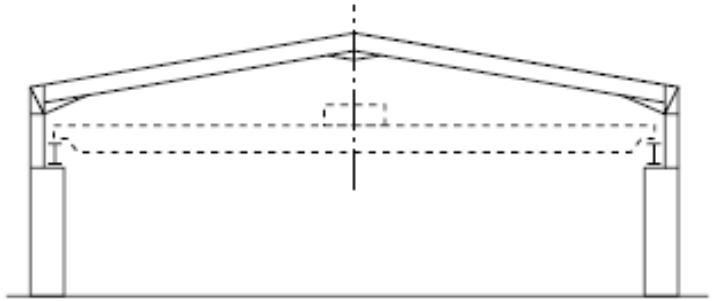
(c) *Tapered column and knee joint*



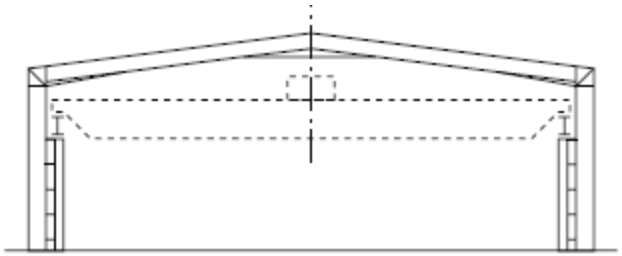
(d) *Tapered rafter*



(e) *Portal with column crane runway brackets*

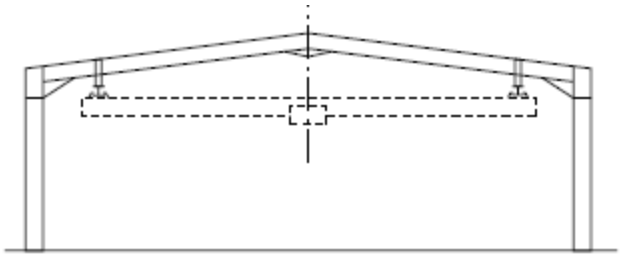


(f) *Stepped column portal*



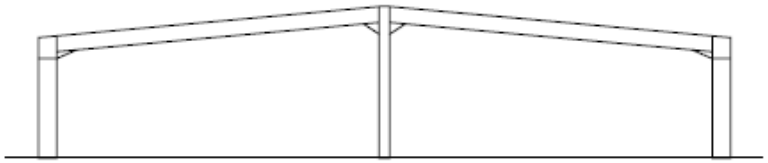
(g)

Separate crane post

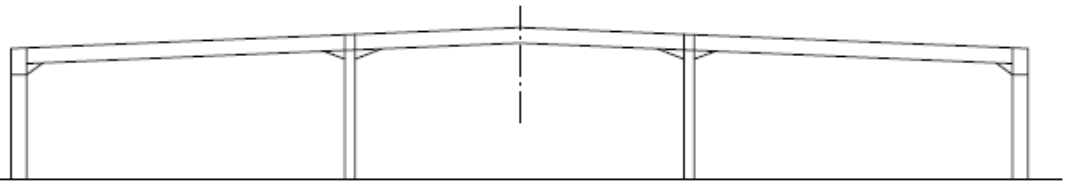


(h)

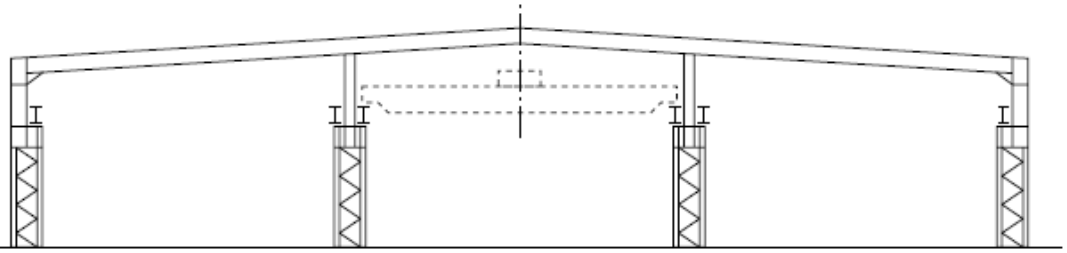
Rafter hung crane runways



(i)



(j)



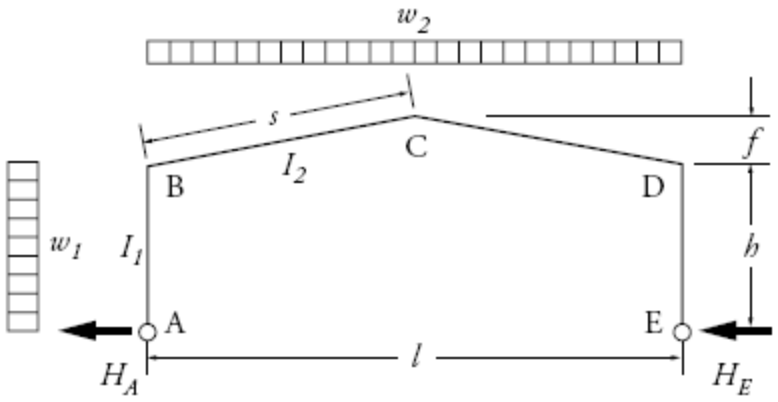
(k)

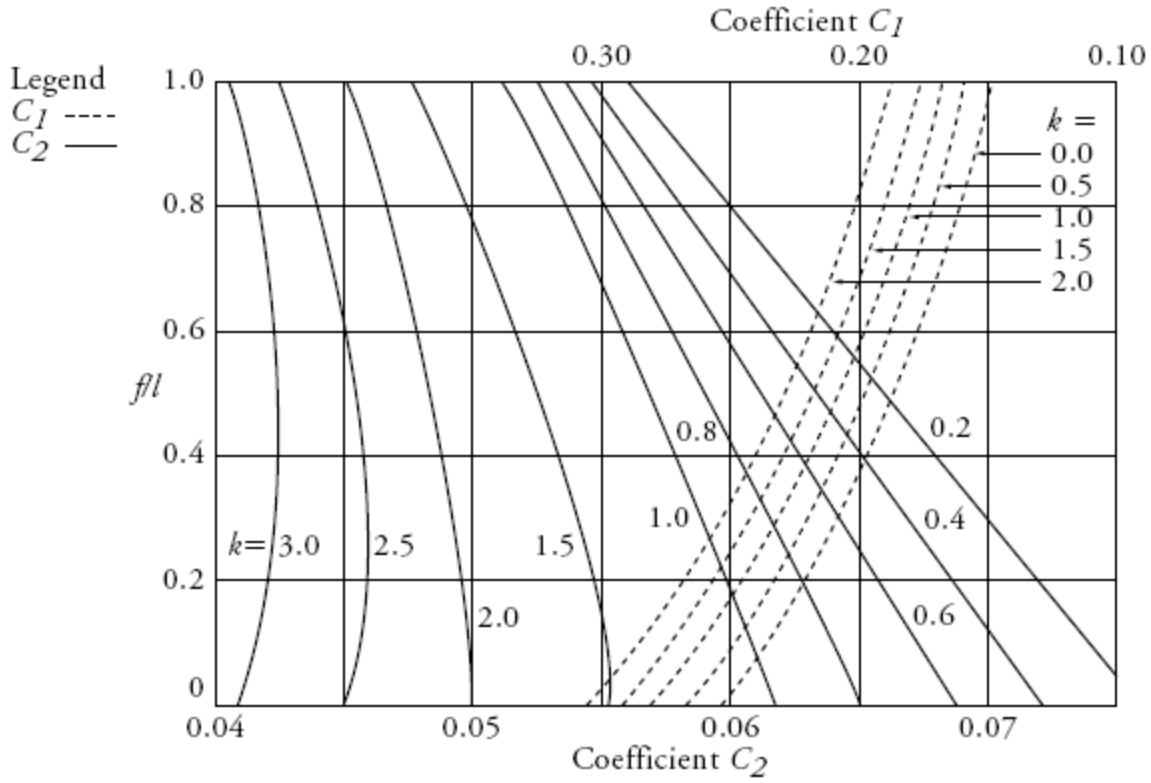
Multiple bays

$$k = I_2 h / I_1 s$$

$$H_E = C_1 w_1 h + C_2 w_2 l^2 / h$$

$$M_D = H_e . h$$

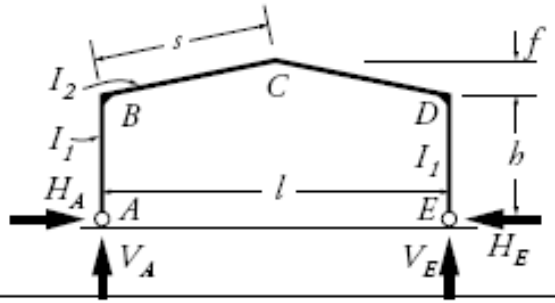




Determine key design action effect

Structural Analysis

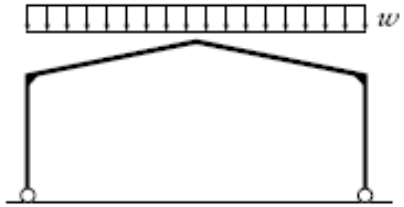
Notation



$$b_1 = \frac{h}{l}\ ;\ f_1 = \frac{f}{h}$$

$$k_1 = \frac{I_2 h}{I_1 s}\ ;\ k_2 = \frac{l}{h}\ ;\ k_3 = f_1^2 + 3f_1 + k_1 + 3$$

1

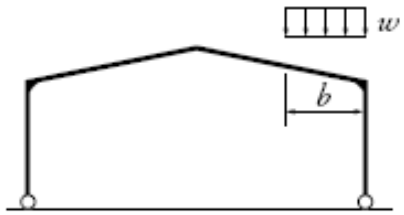


$$H_A = H_E = -\frac{wl^2(1 + 0.625f_1)}{4hk_3}$$

$$V_A = V_E = 0.5wl$$

$$M_B = M_D = -H_A h$$

2

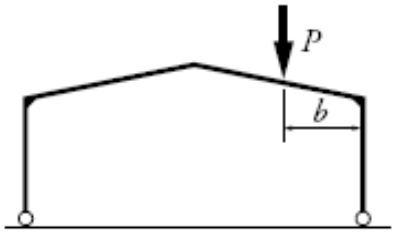


$$H_A = -H_E = \frac{wb^2(6 + 3f_1 - 4b_1 - 2f_1 b_1^2)}{8hk_3}$$

$$V_A = \frac{wb^2}{2l}$$

$$M_B = M_D = -H_A h$$

3



$$H_A = -H_E = \frac{Pb(6 - 6b_1 + 4f_1 b_1 - 3f_1)}{4k_3}$$

$$V_A = \frac{Pb}{l}$$

$$M_B = M_D = -H_A h$$

4

$$H_A = \frac{wh(5k_1 + 6f_1 + 12)}{6k_3}$$

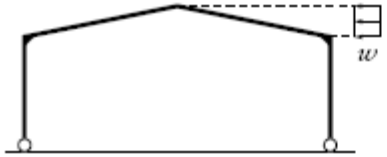
$$H_E = H_A - wh$$

$$V_A = -V_E = \frac{wh^2}{2l}$$

$$M_B = H_A h$$

$$M_D = H_E h - \frac{(wh^2)}{2}$$

5



$$H_A = \frac{wf(3 + k_1 + 2.5f_1 + 0.625f_1^2)}{2k_3}$$

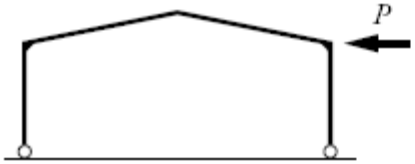
$$H_E = H_A - wf$$

$$V_A = -V_E = \frac{wf(2h + f)}{2l}$$

$$M_B = -H_A h$$

$$M_D = H_E h$$

6



$$H_A = \frac{P(2k_1 + 3f_1 + 6)}{4k_3}$$

$$H_E = H_A - P$$

$$V_A = -V_E = \frac{Ph}{l}$$

$$M_B = -H_A h$$

$$M_D = H_E h$$

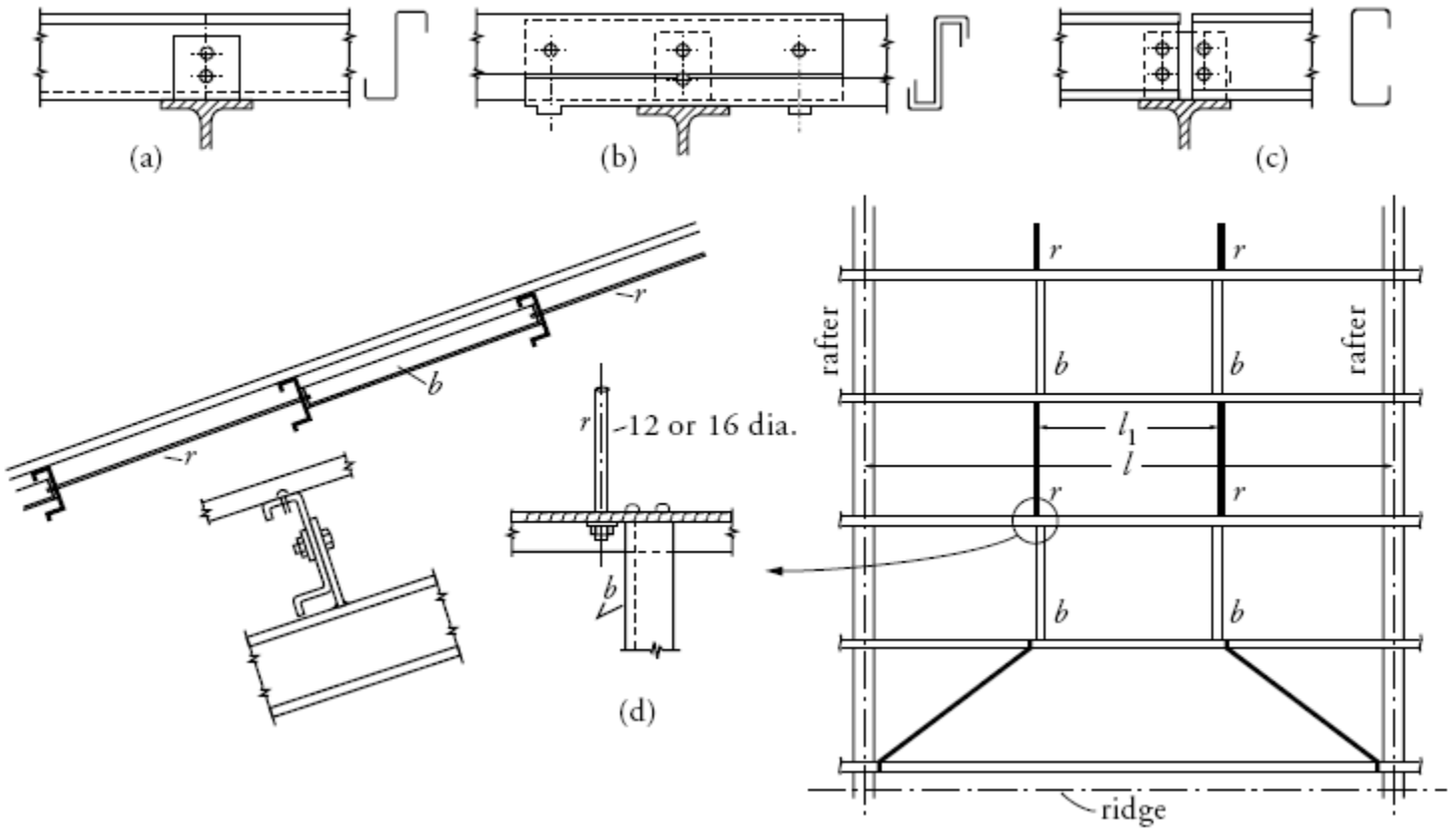
7

Displacement imposed at E:

$$H_A = -H_E = \frac{-1.5\Delta EI_2}{sh^2 k_3}$$

$$M_B = M_E = -H_A h$$

Purlins and Girts



Purlins and Girts