

Steel Design 6th edition Segui Solutions Manual

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CHAPTER 2 - CONCEPTS IN STRUCTURAL STEEL DESIGN

2-1

$D = 9$ kips, $L_r = 5$ kips, $S = 6$ kips, $R = 7$ kips, $W = 8$ kips

(a)

1: $1.4D = 1.4(9) = 12.6$ kips

3: $1.2D + 1.6 + 0.5W = 1.2(9) + 1.6(7) + 0.5(8) = 26$ kips

4: $1.2D + 1.0W = 1.2(9) + 1.0(8) = 18.8$ kips

$$\underline{R_u = 26 \text{ kips (combination 3)}}$$

(but the column must be checked for an uplift of 4.7 kips.)

(b)

$$\underline{\phi R_n = 26 \text{ kips}}$$

(c) $R_n = \frac{\phi R_n}{\phi} = \frac{26}{0.90} = 28.9$ kips

$$\underline{R_n = 28.9 \text{ kips}}$$

(d)

3: $D + R = 9 + 7 = 16$ kips

6: $D + 0.75(0.6W) + 0.75(R) = 9 + 0.75(0.6)(8) + 0.75(7) = 17.9$ kips

$$\underline{R_a = 17.9 \text{ kips (combination 6)}}$$

(but the column must be checked for an uplift of 2.6 kips)

(e) $R_n = \Omega R_a = 1.67(17.9) = 29.9$ kips

$$\underline{R_n = 29.9 \text{ kips}}$$

2-2

1: $1.4D = 1.4(9) = 12.6$ kips

3: $1.2D + 1.6S + 0.5W = 1.2(9) + 1.6(6) + 0.5(8) = 24.4$ kips

4: $1.2D + 1.0W + 0.5S = 1.2(9) + 1.0(8) + 0.5(6) = 21.8$ kips

(a)

$$\underline{24.4 \text{ kips (combination 3)}}$$

(b)

$$\underline{\phi R_n = 24.4 \text{ kips}}$$

(c) $R_n = \frac{\phi R_n}{\phi} = \frac{24.4}{0.90} = 27.1$ kips

$$\underline{R_n = 27.1 \text{ kips}}$$

(d)

3. $D + S = 9 + 6 = 15 \text{ kips}$

5. $D + 0.6W = 9 + 0.6(8) = 13.8 \text{ kips}$

6. $D + 0.75(0.6W) + 0.75S = 9 + 0.75(0.6)(8) + 0.75(6) = 17.1 \text{ kips}$

17.1 kips (Combination 6)

(e) $R_n = \Omega R_a = 1.67(17.1) = 28.6 \text{ kips}$

$R_n = 28.6 \text{ kips}$

2-3

(a) Combination 1: $1.4D = 1.4(45) = 63 \text{ ft-kips}$

Combination 2: $1.2D + 1.6L + 0.5L_r = 1.2(45) + 1.6(63) + 0.5(0) = 154.8 \text{ ft-kips}$

$R_u = 155 \text{ ft-kips (combination 2)}$

(b) $R_n = \frac{R_u}{\phi} = \frac{154.8}{0.9} = 172 \text{ ft-kips}$

$R_n = 172 \text{ ft-kips}$

(c) Combination 2: $D + L = 45 + 63 = 108 \text{ ft-kips}$ $R_a = 108 \text{ ft-kips (combination 2)}$

(d) $R_n = \Omega R_a = 1.67(108) = 180 \text{ ft-kip}$

$R_n = 180 \text{ ft-kips}$

2-4

$D = 18 \text{ kips}, L = 2 \text{ kips}$

(a)

1: $1.4D = 1.4(18) = 25.2 \text{ kips}$

2: $1.2D + 1.6L = 1.2(18) + 1.6(2) = 24.8 \text{ kips}$

$R_u = 25.2 \text{ kips (combination 1)}$

(b)

2: $D + L = 18 + 2 = 20 \text{ kips.}$

$R_a = 20 \text{ kips (combination 2)}$

2-5

$D = 21 \text{ psf}, L_r = 12 \text{ psf}, S = 13.5 \text{ psf}, W = 22 \text{ psf upward}$ (*in this particular case, the wind load cannot be reversed, even in those cases where reversal would normally be considered.*)

Treat gravity loads as positive and wind load as negative:

(a)

1: $1.4D = 1.4(21) = 29.4 \text{ psf}$

2: $1.2D + 0.5S = 1.2(21) + 0.5(13.5) = 32.0 \text{ psf}$

3: $1.2D + 1.6S + 0.5W = 1.2(21) + 1.6(13.5) + 0.5(-22) = 35.8 \text{ psf}$

$$1.2D + 1.6S + 0.5L = 1.2(21) + 1.6(13.5) + 0.5(0) = 46.8 \text{ psf}$$

$$\underline{R_u = 46.8 \text{ psf (combination 3)}}$$

(Combination 5, with $R_u = -3.1 \text{ psf}$, would also need to be considered in the design of the roof in order to prevent uplift.)

(b)

3: $D + S = 21 + 13.5 = 34.5 \text{ psf}$

5: $D + 0.6W = 21 + 0.6(-22) = 7.8 \text{ psf}$

6: $D + 0.75(0.6W) + 0.75S = 21 + 0.75(0.6)(-22) + 0.75(13.5) = 21.2 \text{ psf}$

7: $0.6D + 0.6W = 0.6(21) + (-22) = -9.4 \text{ psf}$

$$\underline{R_a = 34.5 \text{ psf (combination 3)}}$$

(Combination 7, with $R_a = -9.4 \text{ psf}$, would also need to be considered in the design of the roof in order to prevent uplift.)