

10.5 Structural Design Calculations for SF10 Series

ALLOWABLE AXIAL LOADS (POUNDS PER FOOT)

WALL HEIGHT (FEET)

4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"
43,509	42,646	41,590	40,343	38,903	37,272	35,449	33,434	31,227	28,828

SF10 SERIES

REBAR @ 10" ON CENTER - VERTICAL

VERTICAL REINFORCING STEEL	ALLOWABLE MOMENT .9Asfy(d-a/2) (ft - lbs. / ft)	ALLOWABLE SHEAR (.85)2√f'c bd (lbs / ft)	a	d	WALL WEIGHT (PCF)
#4 CENTERED	2114	2223	.63	3.25	74.1
#4 ON EDGE	3194	3250	.63	4.75	74.1
#5 CENTERED	4219	2223	1.46	3.25	74.1
#5 ON EDGE	6625	3207	1.46	4.687 5	74.1
#6 CENTERED	-	-	-	-	-
#6 ON EDGE	7341	2822	2.07	4.125	74.1

f'c = 2,000 psi

Horizontal reinforcing steel = #4 @ 10" on center

fy = 40,000 psi for #3 and #4 reinforcing steel

fy = 60,000 psi for #5 and larger reinforcing steel

ALLOWABLE AXIAL LOADING

$$fP = 0.55 f f_c A_y [1 - (Kl_c / 32 h)^2]$$

Where :

- f = 0.70
- f_c = 2000 psi
- A_g = 6.5 inches x 9 inches (reduced 25% due to the 2.5 inch
58.50 inches² wide bridges @ 10" on center)
- K = 0.80 - Restrained against rotation at the top and bottom
- h = 6.5 inches

Wall Height

$$4'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(48)/(32)(6.5))^2] = 43509 \text{ lbs/ft}$$

$$5'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(60)/(32)(6.5))^2] = 42646 \text{ lbs/ft}$$

$$6'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(72)/(32)(6.5))^2] = 41590 \text{ lbs/ft}$$

$$7'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(84)/(32)(6.5))^2] = 40343 \text{ lbs/ft}$$

$$8'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(96)/(32)(6.5))^2] = 38903 \text{ lbs/ft}$$

$$9'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(108)/(32)(6.5))^2] = 37272 \text{ lbs/ft}$$

$$10'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(120)/(32)(6.5))^2] = 35449 \text{ lbs/ft}$$

$$11'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(132)/(32)(6.5))^2] = 33434 \text{ lbs/ft}$$

$$12'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(144)/(32)(6.5))^2] = 31227 \text{ lbs/ft}$$

$$13'-0'' \quad fP = (0.55)(.70)(2000)(58.50)[1 - (.80(156)/(32)(6.5))^2] = 28828 \text{ lbs/ft}$$

SF10 SERIES

#4 @ 10" O.C. - CENTERED

$$f_y = 40,000 \text{ psi}$$

$$f_c = 2,000 \text{ psi}$$

$$A_s = 12/10 (.20) = 0.24 \text{ in}^2/\text{ft}$$

$$b = 9 \text{ inches (reduced 25% for bridge width)}$$

$$d = 6.5 \text{ inches} / 2 = 3.25 \text{ inches}$$

DESIGN MOMENT

$$a = A_s f_y / .85 f_c b = (0.24)40,000 / .85 (2000) 9 = 0.6275$$

$$fM_u = .9 A_s f_y (d - a/2)$$

$$fM_u = .9 (.24) 40,000 (3.25 - 0.6275 / 2)$$

$$fM_u = 25369.20 \text{ inch - pounds} = \underline{\underline{2114 \text{ ft - lbs}}}$$

DESIGN SHEAR

$$\underline{\underline{fV_u = .85 \cdot 2 \cdot \sqrt{f_c} (b) d = .85 (2) \sqrt{2000} (9) 3.25 = 2223 \text{ lbs}}}$$

SF10 SERIES

#4 @ 10" O.C. - ON EDGE

$$f_y = 40,000 \text{ psi}$$

$$f_c = 2,000 \text{ psi}$$

$$A_s = 12/10 (.20) = 0.24 \text{ in}^2/\text{ft}$$

$$b = 9 \text{ inches (reduced 25% for bridge width)}$$

$$d = 6.5 - (1.5 + .50/2) = 4.75 \text{ inches}$$

DESIGN MOMENT

$$a = A_s f_y / .85 f_c b = (0.24)40,000 / .85 (2000) 9 = 0.6275$$

$$fM_u = .9 A_s f_y (d - a/2)$$

$$fM_u = .9 (.24) 40,000 (4.75 - 0.6275 / 2)$$

$$fM_u = 38329.20 \text{ inch - pounds} = \underline{\underline{3194 \text{ ft - lbs}}}$$

DESIGN SHEAR

$$\underline{\underline{fV_u = .85 2\sqrt{f_c} (b)d = .85 (2)\sqrt{2000} (9) 4.75 = 3250 \text{ lbs}}}$$

SF10 SERIES

#5 @ 10" O.C. - CENTERED

$$f_y = 60,000 \text{ psi}$$

$$f_c = 2,000 \text{ psi}$$

$$A_s = 12/10 (.31) = 0.372 \text{ in}^2/\text{ft}$$

$$b = 9 \text{ inches (reduced 25% for bridge width)}$$

$$d = 6.5 / 2 = 3.25 \text{ inches}$$

DESIGN MOMENT

$$a = A_s f_y / .85 f_c b = (0.37)60,000 / .85 (2000) 9 = 1.45882$$

$$fM_u = .9 A_s f_y (d - a/2)$$

$$fM_u = .9 (.372) 60,000 (3.25 - 1.45882 / 2)$$

$$fM_u = 50633 \text{ inch - pounds} = \underline{\underline{4219 \text{ ft - lbs}}}$$

DESIGN SHEAR

$$\underline{\underline{fV_u = .85 \cdot 2 \cdot \sqrt{f_c} (b) d = .85 (2) \sqrt{2000} (9) 3.25 = 2223 \text{ lbs.}}}$$

SF10 SERIES

#5 @ 10" O.C. - ON EDGE

$$f_y = 60,000 \text{ psi}$$

$$f_c = 2,000 \text{ psi}$$

$$A_s = 12/10 (.31) = 0.372 \text{ in}^2/\text{ft}$$

$$b = 9 \text{ inches (reduced 25% for bridge width)}$$

$$d = 6.5 - (1.5 + .625/2) = 4.6875 \text{ inches}$$

DESIGN MOMENT

$$a = A_s f_y / .85 f_c b = (0.372)60,000 / .85 (2000) 9 = 1.4588$$

$$fM_u = .9 A_s f_y (d - a/2)$$

$$fM_u = .9 (.372) 60,000 (4.6875 - 1.4588 / 2)$$

$$fM_u = 79510.08 \text{ inch - pounds} = \underline{\underline{6625 \text{ ft - lbs}}}$$

DESIGN SHEAR

$$\underline{\underline{fV_u = .85 \cdot 2 \cdot \sqrt{f_c} (b) d = .85 (2) \sqrt{2000} (9) 4.6875 = 3207 \text{ lbs.}}}$$

SF10 SERIES

#6 @ 10" O.C. - ON EDGE

$$f_y = 60,000 \text{ psi}$$

$$f_c = 2,000 \text{ psi}$$

$$A_s = 12/10 (.44) = 0.528 \text{ in}^2/\text{ft}$$

$$b = 9 \text{ inches (reduced 25% for bridge width)}$$

$$d = 6.5 - (2.0 + .75/2) = 4.1250 \text{ inches}$$

DESIGN MOMENT

$$a = A_s f_y / .85 f_c b = (0.528)60,000 / .85 (2000) 9 = 2.0706$$

$$fM_u = .9 A_s f_y (d - a/2)$$

$$fM_u = .9 (.528) 60,000 (4.125 - 2.0706 / 2)$$

$$fM_u = 88093 \text{ inch - pounds} = \underline{\underline{7341 \text{ ft - lbs}}}$$

DESIGN SHEAR

$$\underline{\underline{fV_u = .85 \cdot 2 \cdot \sqrt{f_c} (b) d = .85 (2) \sqrt{2000} (9) 4.125 = 2822 \text{ lbs.}}}$$