

STEEL STRONG-WALL®: Uplift Equations

EQUATIONS FOR CALCULATING UPLIFT FORCES AT BASE OF FIRST-STORY WALL

(Based on limiting concrete bearing on a 3½" wide base plate at the edge of the concrete)

These equations may be used to calculate uplift forces at the base of the 1st-story wall to aid Designers in developing anchorage solutions other than those shown on pages 32-36.

NEW Equations have been revised and are based on a rectangular compression stress block.

2.5 ksi concrete

$$12 \text{ in. wall } T = \left[28.1 - \sqrt{788 - 5.95(3.4P + Vhk)} \right] - P$$

$$15 \text{ in. wall } T = \left[36.1 - \sqrt{1301 - 5.95(4.6P + Vhk)} \right] - P$$

$$18 \text{ in. wall } T = \left[45.0 - \sqrt{2025 - 5.95(6.1P + Vhk)} \right] - P$$

$$21 \text{ in. wall } T = \left[53.9 - \sqrt{2908 - 5.95(7.6P + Vhk)} \right] - P$$

$$24 \text{ in. wall } T = \left[62.8 - \sqrt{3950 - 5.95(9.1P + Vhk)} \right] - P$$

3.5 ksi concrete

$$12 \text{ in. wall } T = \left[39.3 - \sqrt{1545 - 8.33(3.4P + Vhk)} \right] - P$$

$$15 \text{ in. wall } T = \left[50.5 - \sqrt{2550 - 8.33(4.6P + Vhk)} \right] - P$$

$$18 \text{ in. wall } T = \left[63.0 - \sqrt{3968 - 8.33(6.1P + Vhk)} \right] - P$$

$$21 \text{ in. wall } T = \left[75.5 - \sqrt{5699 - 8.33(7.6P + Vhk)} \right] - P$$

$$24 \text{ in. wall } T = \left[88.0 - \sqrt{7741 - 8.33(9.1P + Vhk)} \right] - P$$

4.5 ksi concrete

$$12 \text{ in. wall } T = \left[50.5 - \sqrt{2554 - 10.71(3.4P + Vhk)} \right] - P$$

$$15 \text{ in. wall } T = \left[64.9 - \sqrt{4216 - 10.71(4.6P + Vhk)} \right] - P$$

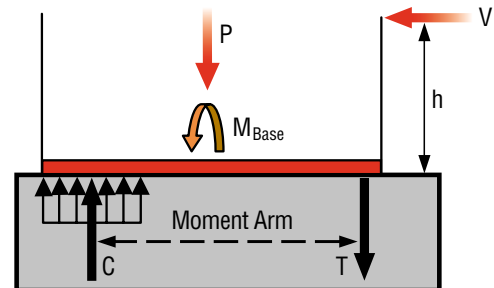
$$18 \text{ in. wall } T = \left[81.0 - \sqrt{6560 - 10.71(6.1P + Vhk)} \right] - P$$

$$21 \text{ in. wall } T = \left[97.1 - \sqrt{9421 - 10.71(7.6P + Vhk)} \right] - P$$

$$24 \text{ in. wall } T = \left[113.1 - \sqrt{12,797 - 10.71(9.1P + Vhk)} \right] - P$$

Notes:

- Equations may be used to calculate uplift forces at the base of first-story walls on concrete foundations.
- Equations are based on the design methodology contained in AISC Steel Design Guide 1 – Base Plate and Anchor-Rod Design, second edition using a rectangular compression stress block.



Forces at Base of Wall

T = Resulting anchorage tension (uplift) force (kips)

V = Design shear (kips)

P = Total vertical load (kips)

h = Wall height (inches)

k = 1.0 for all applications except Garage Portal Systems

For Garage Portal Systems using the SSWP-KT Portal Kit:

k = 0.80 for SSW12

k = 0.85 for SSW15

k = 0.90 for SSW18

For two-story stacked applications, substitute M_{base} for Vh:

$$Vh = M_{base} \left(\frac{12}{1000} \right) \text{ kip-in}$$

Where M_{base} = Design moment at base of wall (ft-lbs)

EXAMPLE 1 – Single-Story SSW:

Given:

- SSW18x9 wall on 2.5 ksi concrete
- 2006 International Building Code®, Seismic
- Design Shear (V) = 2.0 kips < 2.15 kips ($V_{allowable}$)
- P (Vertical Load) = 1.0 kip
- h = Wall height = 105.25"
- k = 1.0

$$T = \left[45.0 - \sqrt{2025 - 5.95(6.1P + Vhk)} \right] - P$$

$$T = \left[45.0 - \sqrt{2025 - 5.95(6.1 \times 1 + 2.0 \times 105.25 \times 1.0)} \right] - 1.0 = \underline{16.9 \text{ kips}}$$

EXAMPLE 2 – Two-Story Stacked SSW Condition:

Given:

- See Two-Story Design Example on page 28
- SSW18x9-STK wall on 2.5 ksi concrete
- 2006 International Building Code®, Wind
- M_{base} = 17,550 ft-lbs. (Moment at base of two-story stacked wall)
- $Vh = 17,550 \times \left(\frac{12}{1000} \right)$ kip-in = 210.6 kip-in
- P (Vertical Load) = 2.0 kips
- k = 1.0

$$T = \left[45.0 - \sqrt{2025 - 5.95(6.1P + Vhk)} \right] - P$$

$$T = \left[45.0 - \sqrt{2025 - 5.95(6.1 \times 2 + 210.6 \times 1.0)} \right] - 2 = \underline{16.6 \text{ kips}}$$