$$C_{dl} = 1 + 0.15\left(\frac{w_D}{300}\right) \leq 1.15 \qquad \text{Eq 6.5-5}$$

where,

w_D = the net uniform dead load supported at the top of the perforated shear wall (plf) with consideration of wind uplift and factoring in accordance with load combinations of Chapter 3.

Aspect Ratio Adjustment Factor (C_{ar})

The following C_{ar} adjustment factor applies only to the segmented shear wall design method for adjusting the shear resistance of interior and exterior sheathing in accordance with Equation 6.5-2a of Section 6.5.2.2:

$$C_{ar} = \frac{1}{\sqrt{0.5(a)}} \text{ for } 2.0 \leq a \leq 4.0 \qquad \text{Eq 6.5-6}$$

C_{ar} = 1.0 for $a < 2.0$

where,

a is the aspect ratio (height/width) of the sheathed shear wall segment.

6.5.2.4 Overturning Restraint

Section 6.3 and Figure 6.3 address overturning restraint of shear walls in conceptual terms. In practice, the two generally recognized approaches to providing overturning restraint call for

- the evaluation of equilibrium of forces on a *restrained* shear wall segment using principles of engineering mechanics; or
- the evaluation of *unrestrained* shear walls considering nonuniform dead load distribution at the top of the wall with restraint provided by various connections (i.e., sheathing, wall bottom plate, corner framing, etc.).

The first method applies to restrained shear wall segments in both the perforated and segmented shear wall methods. The first segment on each end of a perforated shear wall is restrained in one direction of loading. Therefore, the overturning forces on that segment are analyzed in the same manner as for a segmented shear wall. The second method listed above is a valid and conceptually realistic method of analyzing the restraint of typical residential wall constructions, but it has not yet fully matured. Further, the method’s load path (i.e., distribution of uplift forces to various connections with inelastic properties) is perhaps beyond the practical limits of a designer’s intuition. Rather than presume a methodology based on limited testing (see Section 6.3), this guide does not suggest guidelines for the second approach. However, the second method is worth consideration by a designer when attempting to understand the performance of conventional, "nonengineered" residential construction. Mechanics-based methods to assist in the more complicated design approach are under development.

Using basic mechanics as shown in Figure 6.6, the following equation for the chord tension and compression forces are determined by summing moments about the bottom compression or tension side of a restrained shear wall segment:

$$\sum M_C = 0$$

$$F'_s\,(d)(h) - T\,(x) - D_W\,(\tfrac{1}{2}d) - (w_D)(d)(\tfrac{1}{2}d) = 0$$

$$T = \left(\frac{d}{x}\right)\left(F'_s\,h - \tfrac{1}{2}D_W - \tfrac{1}{2}(w_D)(d)\right) + t \qquad \text{Eq. 6.5-7a}$$

$$\sum M_T = 0$$

$$C = \left(\frac{d}{x}\right)\left(F'_s\,h + \tfrac{1}{2}D_W + \tfrac{1}{2}(w_D)(d)\right) + c \qquad \text{Eq. 6.5-7b}$$

where,

T = the tension force on the hold-down device (lb)

d = the width of the restrained shear wall segment (ft); for segments greater than 4 ft in width, use d = 4 ft.

x = the distance between the hold-down device and the compression edge of the restrained shear wall segment (ft); for segments greater than 4 ft in width, use x = 4 ft plus or minus the bracket offset dimension, if any

F'_s = the design unit shear capacity (plf) determined in accordance with Equation 6.5-2a of Section 6.5.2.2 (for both the PSW and SSW methods)

h = the height of the wall (ft)

D_w = the dead load of the shear wall segment (lb); dead load must be factored and wind uplift considered in accordance with the load combinations of Chapter 3.

w_D = the uniform dead load supported by the shear wall segment (plf); dead load must be factored and wind uplift considered in accordance with the load combinations of Chapter 3.

t = the tension load transferred through a hold-down device, if any, restraining a wall above (lb); if there is no tension load, t = 0

c = the compression load transferred from wall segments above, if any (lb); this load may be distributed by horizontal structural elements above the wall (i.e., not a concentrated load); if there is not compression load, c = 0.

The 4-foot-width limit for *d* and *x* is imposed on the analysis of overturning forces as presented above because longer shear wall lengths mean that the contribution of the additional dead load cannot be rigidly transferred