Code Changes for Tie-Down Systems

Substantial changes to tie-down systems have been made by ICC Evaluation Service. Elongation limits must include rod, bearing plates, shrinkage compensators and tie-downs. In addition a Δ_r limit has been added to shrinkage compensating devices. This paper details the new requirements.

AC 155. Tie Downs: "…design of hold-downs used in series shall account for the cumulative deformation of all hold-downs (tie-downs) within said series." **(AC 155, July 1, 2010, section 6.2.6.3.)**

AC 316. Shrinkage Compensators now includes:

Δ_r "Average travel and seating increment" **(AC 316 section 1.4.7).**

Δ_r is independent of load and is always added in full. **(AC 391 section 3.1.1).**

Important Note: Δ_r can vary from a low of 0.000" (screw devices) up to 0.180" (ratchets)

AC 391. Tie Down Systems elongation limits between reaction points of: 0.180" for the rod and 0.250" for the system. (The system limit of 0.250" includes bending of double top plates. When applied to shear walls I expect the system limit to drop to 0.200".) **(AC 391 section 3.2.1.1 and 3.2.2.2)**

Required elongation items shall include the total of:

a. Rod elongation based on net tensile area. **(AC 391 section 3.2.1.1).**

b. Plate crushing assuming bearing deformation of **0.040** inch at the compression design value and a linear load deformation relationship. **(AC 391 section 3.2.1.2).**

c. Displacements for tie downs shall be at the corresponding load. (X2 for two)

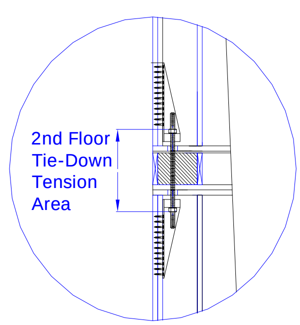
d_1. Shrinkage Compensation displacement at required load. **(See AC 316 above)**

d_2 Shrinkage Compensation Δ_r added in full.

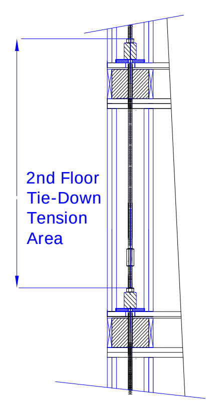
Comparing Systems The graph (next page) compares the load-deflection of three "identical" systems. These include a bracket system, rod system with screw Tud and a rod system with a ratchet Tud.

Component			Rod + Screw d_a	Tie-Downs d_a	Rod + Ratchet d_a
			System & Tud Elongation		
Rod	A36 (A307)	Per Code	0.092	0.018	0.092
Bearing Plate	AF&PA	Bearing 625 psi	0.036	Not Used	0.036
Tie-Down (AC155)	Tested Component		Not Used	0.244	Not Used
Shrinkage (or)	Calculated		0.000	0.250	0.000
Tud (AC316)	Sec. 6.0.5 Elongation		0.014	None	0.031
	Sec. 6.0.6 Δ_R, **Avg travel**		0.002		0.111
Strength	Limit		**11,000**	**11,000**	**11,000**
	Demand/Capacity Ratio		**89%**	**93%**	**89%**
Elongation	Calculated (d_a): **Sum**		**0.143**	**0.512**	**0.269**
	System D/C Ratio		**80%**	**286%**	**150%**

Bracket Tie-Downs

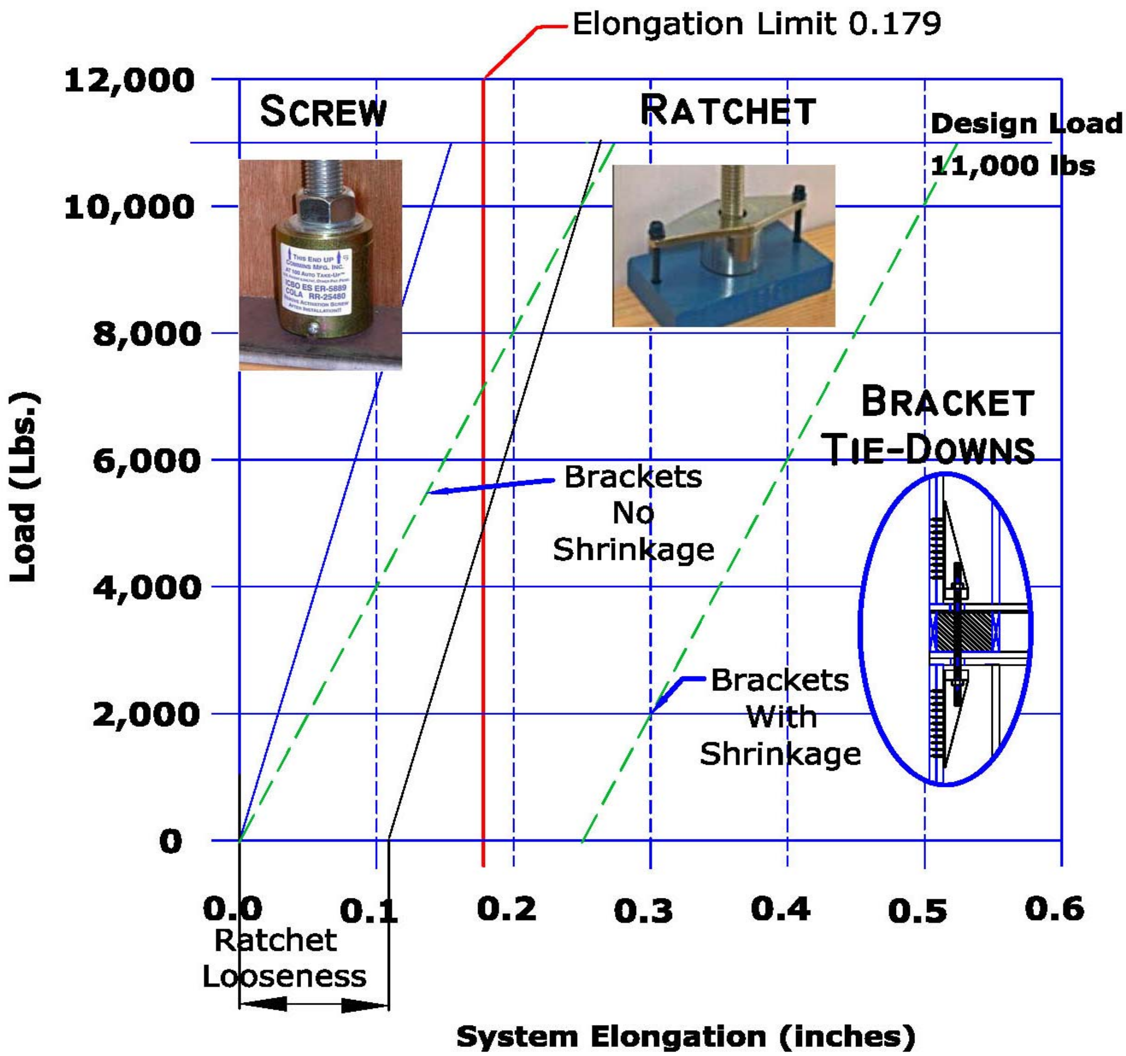


Rod, Shrinkage Compensated Systems



AutoTight Tie-Down Systems

Commins Manufacturing 360-378-9484



Identical loads <u>very</u> different Elongation:

<u>Rod:</u> 11,000 pounds, 7/8" dia. X 10' (or 2')
<u>Bearing Plate</u>: 0.040" deflection at 625 psi (dfl.) adjusted to 0.036"
<u>Tie-Down Bracket</u> deflects 0.131" at 11,781 pounds adjusts to 0.122" at 11 kips.
<u>Deflection</u> **<u>doubles</u>** with two brackets in series.
<u>Shrinkage compensators</u> eliminate shrinkage but add two deflection components
<u>Screw</u> Tud introduces deflection of 0.014" (device) and 0.002" (Δ_R).
<u>Ratchet</u> Tud introduces deflection of 0.031" (device) and 0.111" (Δ_R)

AutoTight Tie-Downs are up to 3 times tighter.