



Technical Bulletin 09-02 Tie-Down Systems-Shrinkage and Backlash Effects

May 29, 2009

TIE-DOWN SYSTEMS-NO SHRINKAGE OR BACKLASH.
THE GRAPH TO THE RIGHT COMPARES SYSTEMS FOR DEFLECTION WHEN SHRINKAGE AND SHRINKAGE COMPENSATOR BACKLASH ARE NOT A FACTOR OR ARE NOT CONSIDERED.

EXCEPT FOR STANDARD HOLD DOWNS, ALL SYSTEMS CAN MEET A 1/8" DEFLECTION LIMIT.

ON PAPER ALL SYSTEMS LOOK GOOD.

TIE-DOWN SYSTEMS COMPARED

WHEN BUILDING SHRINKAGE AND SETTLING ARE INCLUDED IN THE ANALYSES, SYSTEMS WITHOUT SHRINKAGE COMPENSATORS HAVE A LARGE HANDICAP. BASED ON WHAT WE KNOW SYSTEMS 1, 2 AND 5 HAVE LOST AT LEAST 40% OF THEIR LATERAL CAPACITY.

SYSTEM #3 INCLUDES A ROD-RATCHETING SHRINKAGE COMPENSATOR. THIS DEVICE HAS A LOOSENESS IN EXCESS OF 0.145".

SYSTEM #4 A ROD SYSTEM WITH A SCREW TYPE DEVICE. GIVEN THE 1/4" SHRINKAGE, SYSTEM #4 IS THE ONLY SYSTEM THAT COMPLYES WITH A SYSTEM DESIGN LIMIT OF 1/8".

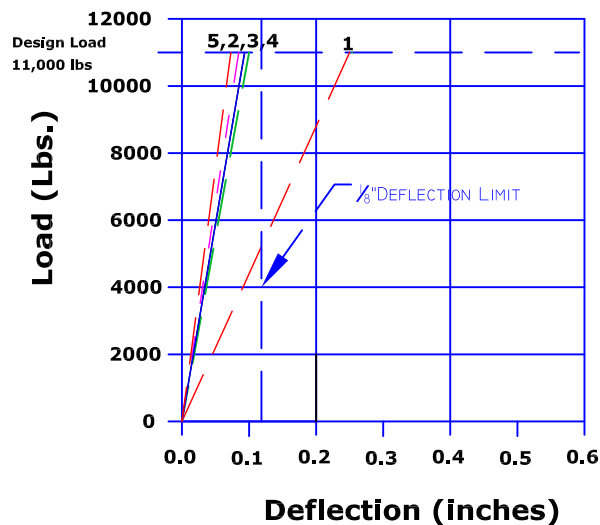
IF THE DEFLECTION LIMIT IS SET AT 0.200" THEN SYSTEM #3 THE ROD-RATCHETING SYSTEM, COULD MEET REQUIREMENTS. HOWEVER, IT SHOULD BE DOWN RATED TO A 6,000 CAPACITY TO MEET STRETCH REQUIREMENTS.

TIE-DOWN SYSTEMS ROCKING WALL VIDEO

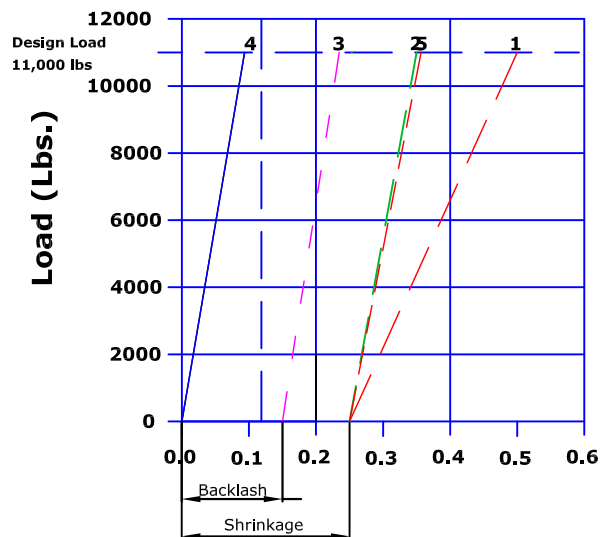
MANY ENGINEERS, CONTRACTORS AND BUILDERS DO NOT RULLY UNDERSTAND THE NEGATIVE EFFECT SHRINKAGE AND BACKLASH MAY HAVE ON SHEARWALS. TO AID THAT UNDERSTANDING, PLEASE GO TO [HTTP://COMMINSMFG.COM/VIDEO_DEMO_PAGE_1.HTM](http://comminsmfg.com/video_demo_page_1.htm) AND WATCH A TEST OF PRODUCT FUNCTION. THE VIDEO SHOWS THREE DIFFERENT ROD SYSTEMS WITH AND WITHOUT SHRINKAGE AND BACKLASH.

AUTOTIGHT-THE LEADER IN VERTICAL CONNECTIONS.

**System Comparisons
Load vs Deflection**
(Shrinkage, Backlash not evaluated)



System Comparisons Load vs Deflection
(Shrinkage & Backlash Evaluated)



Legend Deflection (inches)

- 1. Standard Hold Downs
Screw Attached - - - - -
- 2. Rod system
No Take-Up - - - - -
- 3. Rod System
Rod Ratchet Take-Up - - - - -
- 4. Rod System
Screw Take-Up _____
- 5. Strap Tie-Downs - - - - -

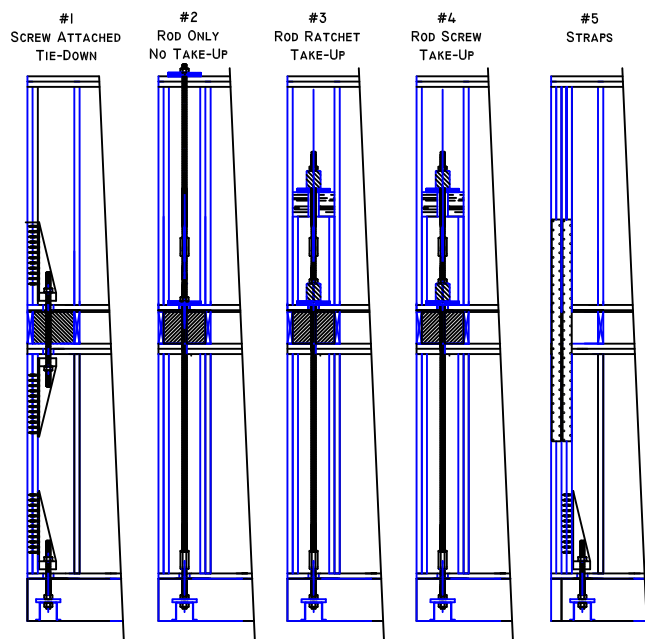


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TIE-DOWN SYSTEMS CONNECT SHEAR WALLS TO THE FOUNDATION. TIE-DOWN SYSTEMS MUST HAVE STRENGTH, STIFFNESS, AND RELIABILITY. STRENGTH AND STIFFNESS ARE DEFINED BY MANUFACTURERS, HOWEVER TWO ITEMS OFTEN OVERLOOKED ARE DEVICE LOOSENESS, AND LOOSENESS CAUSED BY SYSTEM SHRINKAGE AND SETTLING. THIS LOOSENESS IS CALLED BACKLASH. SHEAR WALLS MUST RESIST MOVEMENT SEQUENTIALLY IN TWO DIRECTIONS. LOOSENESS CAN DESTROY SHEAR WALL CAPACITY. TESTING SHOWS THAT 0.200" OF SYSTEM LOOSENESS WILL REDUCE SHEAR WALL LATERAL CAPACITY BY 40%. THIS TECHNICAL BULLETIN REVIEWS SYSTEM SLACK AND POTENTIAL CONSEQUENCES. FOR ADDITIONAL INFORMATION PLEASE SEE TECHNICAL BULLETIN 09-01.

TWO STORY TIE-DOWN SYSTEMS



TIE-DOWN SYSTEMS COMPARED

TWO STORY SYSTEMS WERE CHOSEN FOR AN EASY TO UNDERSTAND COMPARISON AND TO ILLUSTRATE THE CONSEQUENCES OF SYSTEM LOOSENESS. FIVE DIFFERENT TIE-DOWN SYSTEMS ARE COMPARED FOR SYSTEM DEFLECTION DUE TO LOAD, SYSTEM LOOSENESS DUE TO SHRINKAGE-SETTLING AND TAKE-UP BACKLASH (INTERNAL LOOSENESS).

THE SYSTEMS ARE:

1. STANDARD HOLD DOWN-SCREW ATTACHED.
2. A ROD SYSTEM WITHOUT SHRINKAGE COMPENSATORS
3. A ROD SYSTEM WITH A RATCHET COMPENSATOR
4. A ROD SYSTEM WITH A SCREW TYPE SHRINKAGE COMPENSATOR
5. A STRAP TIE-DOWN SYSTEM.

COMPARISONS ARE BASED ON A 11,000 POUND DESIGN LOAD, A 1" DIAMETER ROD AND A MODEST SHRINKAGE OF 1/4" (0.250").

DEFLECTION SUMMARY

THE TABLE DETAILS SYSTEM ELONGATION. MOST NUMBERS ARE A SIMPLE CALCULATION OR ARE SUPPLIED FROM A CATALOG. BACKLASH NUMBERS ARE BASED ON TESTING. SHRINKAGE IS DEFINED AT 1/4" PER FLOOR. YOUR SHRINKAGE OR BACKLASH NUMBERS MAY BE DIFFERENT.

Deflection Summary Second Story

	1	2	3	4	5
	HD Screw Attached	Rod Systems			Strap
		No Take-Up	Ratchet Take-Up	Screw Take-Up	Nailed
Rod	0.031	0.068	0.038	0.038	NA
Bearing Plates	NA	0.036	0.036	0.036	NA
Tie-Downs, HD's, Straps	0.274	---	0.000	0.000	0.062
Take-Up Device- Deflection	NA	---	0.013	0.013	NA
Backlash	---	---	0.145	0.000	---
Shrinkage (Effective)	0.250	0.250	0.000	0.000	0.250
Total Elongation	<u>0.555</u>	<u>0.354</u>	<u>0.232</u>	<u>0.087</u>	<u>0.312</u>

Capacity Limit 11,175 12,360 12,360 12,360 11,720
 Note: 2 HD's 2 Straps
 Systems based on: 11,000 pound design load, 1" Dia Rod, Estimated Shrinkage 1/4".