Collaborating With

Understanding Single Element Test Performance
An Evaluation of E72/E564/E2126
Evaluation of BWPs Through Assembly Testing

Why Evaluate the Testing? Page 54 MAT107 eCourseV09-2007 AWC

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Wall Bracing Materials & Methods

- Relative shear strength of the bracing methods is unknown
  - Lateral force resisting capacity of wall bracing is more a function of the overturning restraint than the shear capacity of the material.
  - Since braced walls don't have explicit overturning restraint, it is difficult to determine shear capacity.
    - Implicit overturning restraint provided by dead loads, overlapped nailing, etc.
    - Shear capacity highly affected by the dead load of the wall and the structure above.

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This is a relatively formal way to say that we're not sure exactly what resistance to lateral loads are being provided by prescriptive bracing. We know from experience that it works under the limitations of conventional construction. However, since the wall isn't formally designed and it lacks elements of a shear wall, such as connections to the foundation or floor, it's hard to quantify the resistance to any exact degree.

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Why Evaluate the Testing? Page 55 MAT107 eCourseV09 -2007 AWC

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Wall Bracing Materials & Methods

Bracing method	Estimated Allowable Shear
1. Let-in diagonal 1x4	0 – 100 plf?
2. 5/8-in. diagonal boards	300 plf?
3. 3/8-in. WSP	220 plf?
4. 1/2-in. fiberboard	180 plf?
5. 1/2-in. gypsum board	100 plf?
6. 1/2-in. particleboard	140 plf?
7. 7/8-in. PC stucco	180 plf?
8. 7/16-in. hardboard	Unknown?

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In a formal shear wall design, we can quantify the shear resistance in bracing material; in fact, the code provides those numbers for everything but let-in bracing. But because the overall resistance to racking in conventional construction isn't completely understood, we don't know exactly what shear resistance is being provided by the bracing material itself. Here are some estimates of the shear strength of the 8 allowed bracing materials applied according to the IRC. The widely varying numbers explain why different materials must be provided in different amounts.

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Why Evaluate the Testing?

LIGHT-FRAME SHEAR WALL LENGTH AND OPENING EFFECTS

By Marcia Patton-Mallory,[1] A. M. ASCE, Ronald W. Wolfe,[2] Lawrence A. Soltis,[3] M. ASCE, and Richard M. Gutkowski,[4] M. ASCE

ABSTRACT: Standard methods of testing the racking capacity of light-frame walls are inefficient and may give erroneous estimates of shear wall performance. This study is concerned with improving the data base for racking resistance of light frame walls with plywood and gypsum sheathings. The shear resistance of small walls sheathed with gypsum was compared to that of full-sue walls. Results of both tests indicated that racking strength was linearly proportional to wall length. Contributions of sheathing layers and panel sections appear to be additive, and length of wall sections containing door and window openings may be neglected in determining racking resistance of conventional walls. One notable difference in the performance of these racking tests involved the effect of panel length on racking stiffness. Stiffness of small walls increased linearly with length while the stiffness of full-size walls increased nonlinearly. Knowledge that gypsum wallboard can contribute to shear wall performance and that it is additive to the resistance of plywood sheathing should be helpful to building designers and code officials.

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[4]Assoc. Prof., Dept. of Civ. Engrg., Colorado State Univ., Ft. Collins, Colo. 80523.

Note.—Discussion open until March 1, 1986. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on November 29, 1984. This paper is part of the *Journal of Structural Engineering*, Vol. 111, No. 10, October, 1985. ASCE, ISSN 0733-9445/85/0010-2227/$01.00. Paper No. 20098.

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Why Evaluate the Testing?

The full-size tests (ASTM E 564) were an attempt to simulate actual wall performance. Ultimate racking loads for this set of 8 by 8 ft walls (2.4 by 2.4 m) was approximately 140 lb/ft (2.04 kN/m). This is lower than ultimate racking loads measured using ASTM E 72, since the design loads from ASTM E 72 (which are only a fraction of ultimate load) are in the range of 100 lb/ft (1.46 kN/m) (7, 19). Tests by Dishongh and Fowler (2) of gypsum walls with sheathing on both sides (one side gypsum stapled to the wood frame, the other side glued and stapled), which were tied into roof, floor, and sidewalls simulating mobile home construction, had racking strengths of approximately 400 lb/ft (5.84 kN/m).

The current ASTM E 72 test does not represent a shear wall in a structure. This study shows smaller, less expensive tests could be used instead of ASTM E 72 to predict relative ultimate racking strengths of different sheathing materials. The alternative test method, ASTM E 564 produces results that cannot easily be compared between researchers. However, ASTM E 564 may be a better indicator of shear wall performance in a structure.

Available information suggests that gypsum does contribute significantly to the shear resistance of light-frame walls. However, available test data are limited and variations in test procedures make it difficult to support conclusions from results of independent studies. There are trends indicating the racking resistance of walls increases with uninterrupted wall length, and that walls with sheathing on both sides are stronger than walls with a single sheathing. Researchers need more precise information to extend the wall racking theories to longer walls, and to walls with sheathing on both sides of the wood frame.

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ASTM E72/E564 Testing – $^{15}/_{32}$" WSP & Anchor Bolt Hold-Down – 162 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the anchor bolt due to applied lateral load rotating the BWP.

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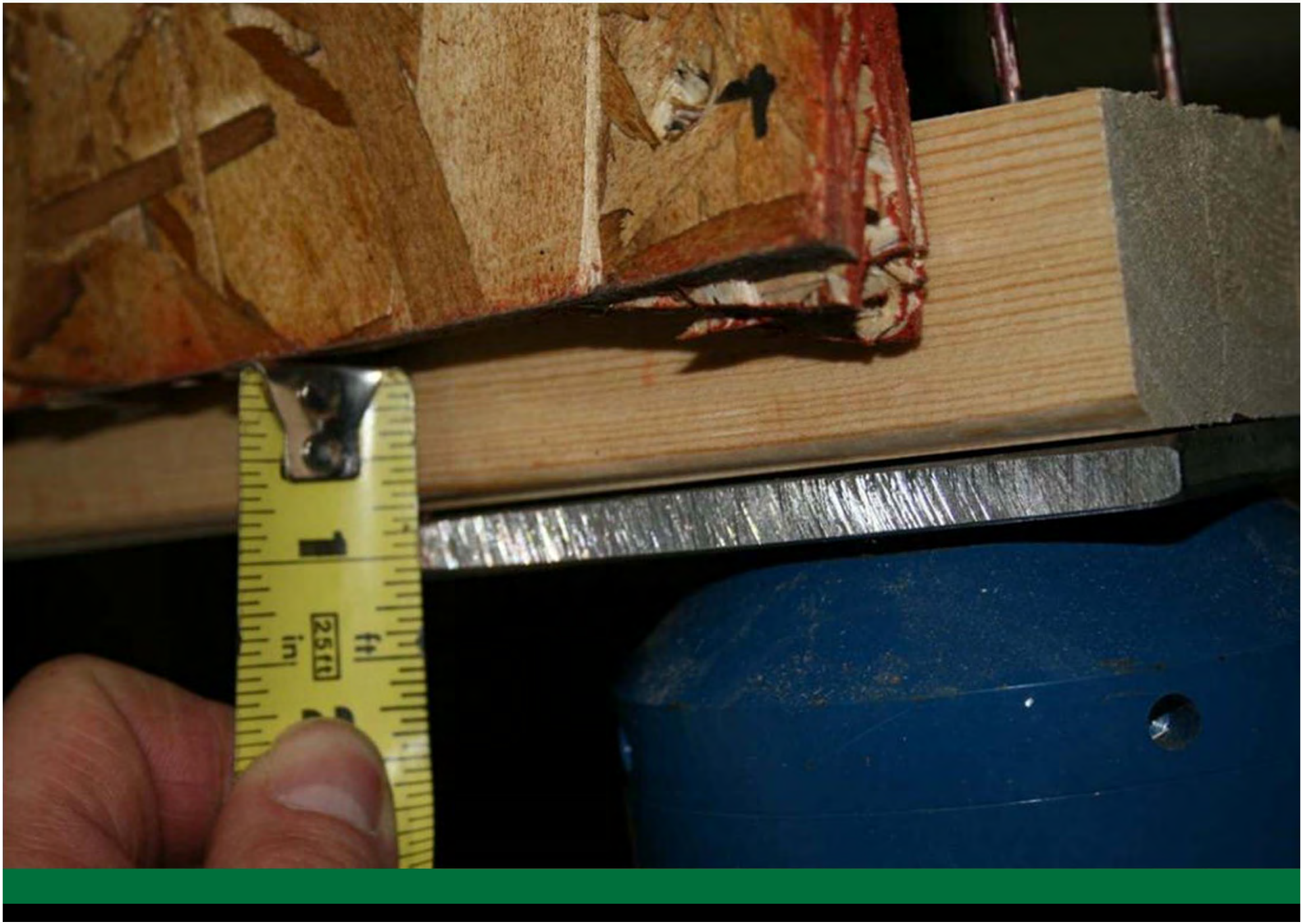

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ASTM E72/E564 Testing – $^{15}/_{32}$" WSP & 4,200-lb Hold-Down Connector – 555 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate and diagonally into the panel due to hold-down applied load increasing nail capacity.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the hold-down connector due to applied lateral load rotating the BWP.
- Hold-down connectors holding the stud tight to the bottom plate.

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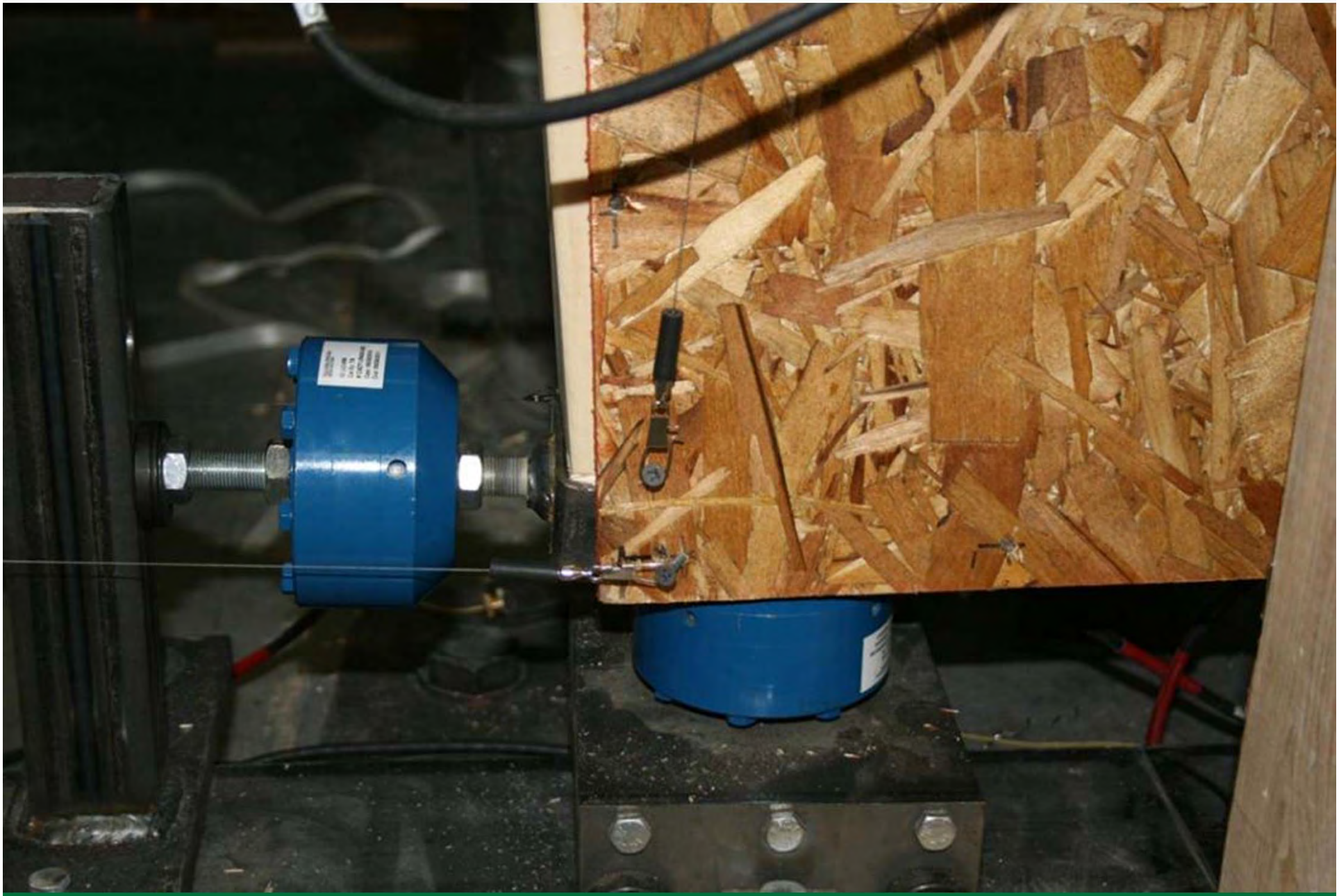

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SB-22R

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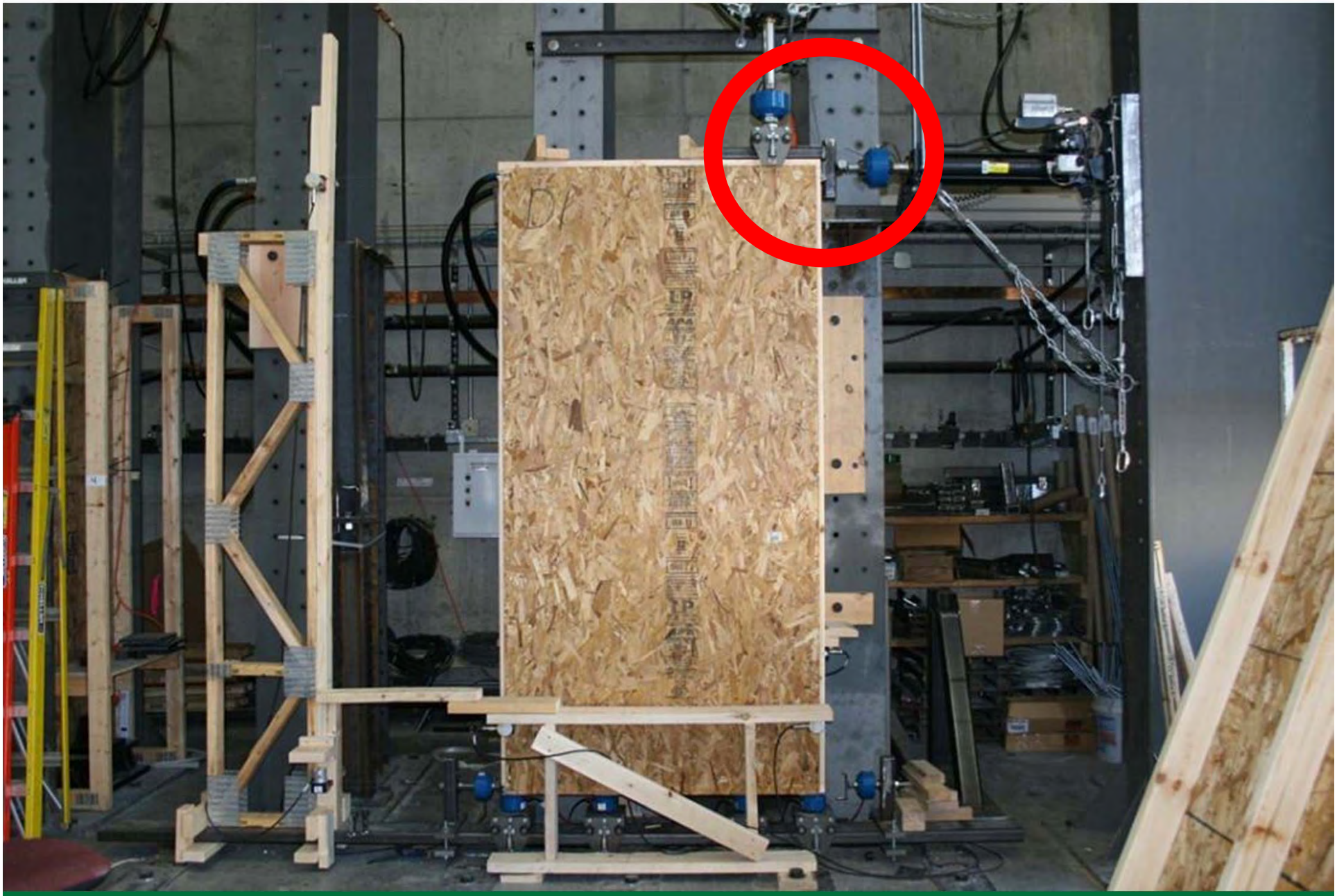
ASTM E72/E564 – $^{15}/_{32}$" WSP – 3,300-lb Applied Vertical Load Testing – 615 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate and diagonally into the panel due to vertically applied load increasing nail capacity.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud with 3,300-lb vertical load with applied lateral load rotating the BWP.
- Gravity load holding the BWP lead stud down and increasing lateral load carrying capacity accordingly.



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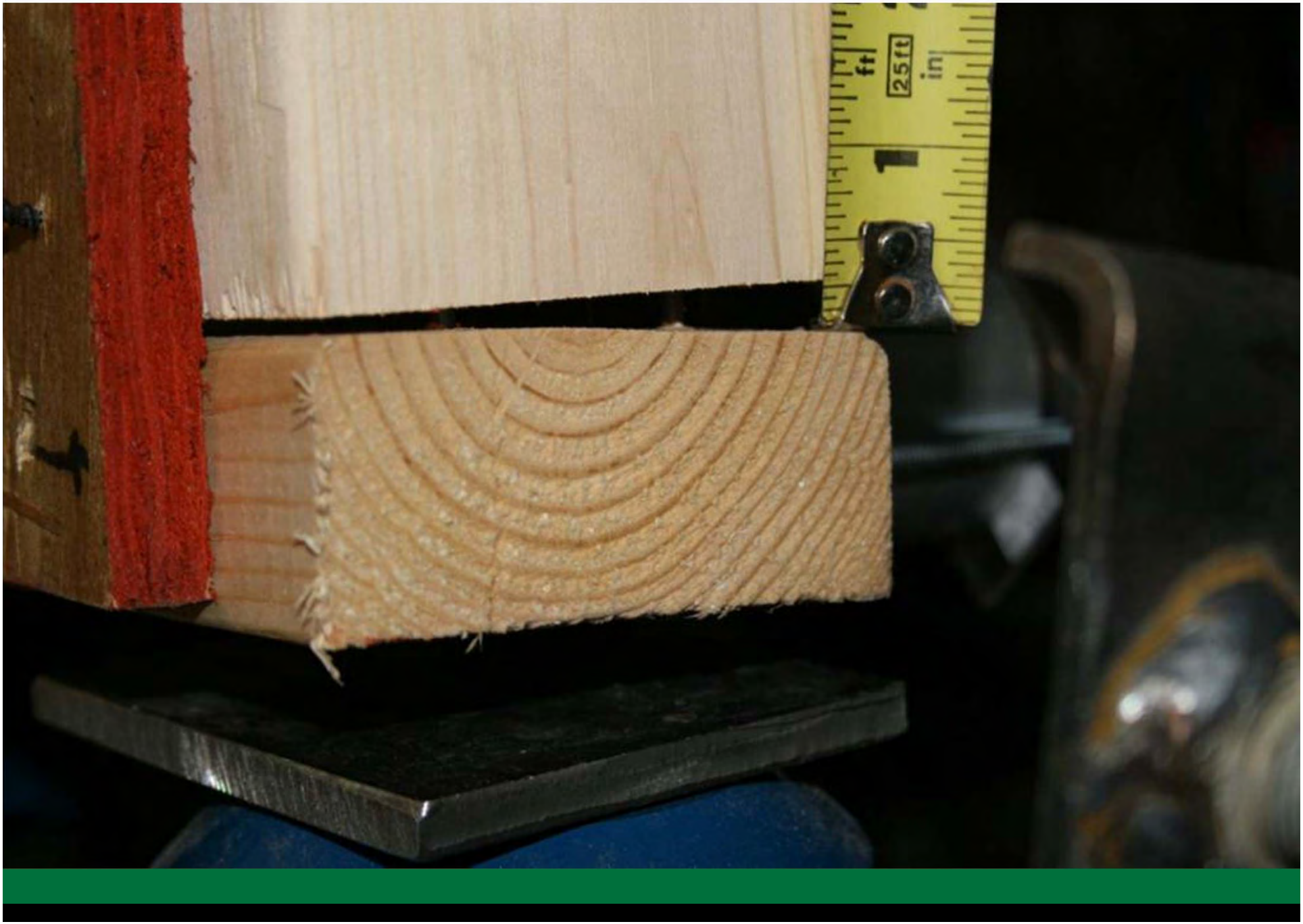
ft
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LC-064

STANLEY
Life Guard
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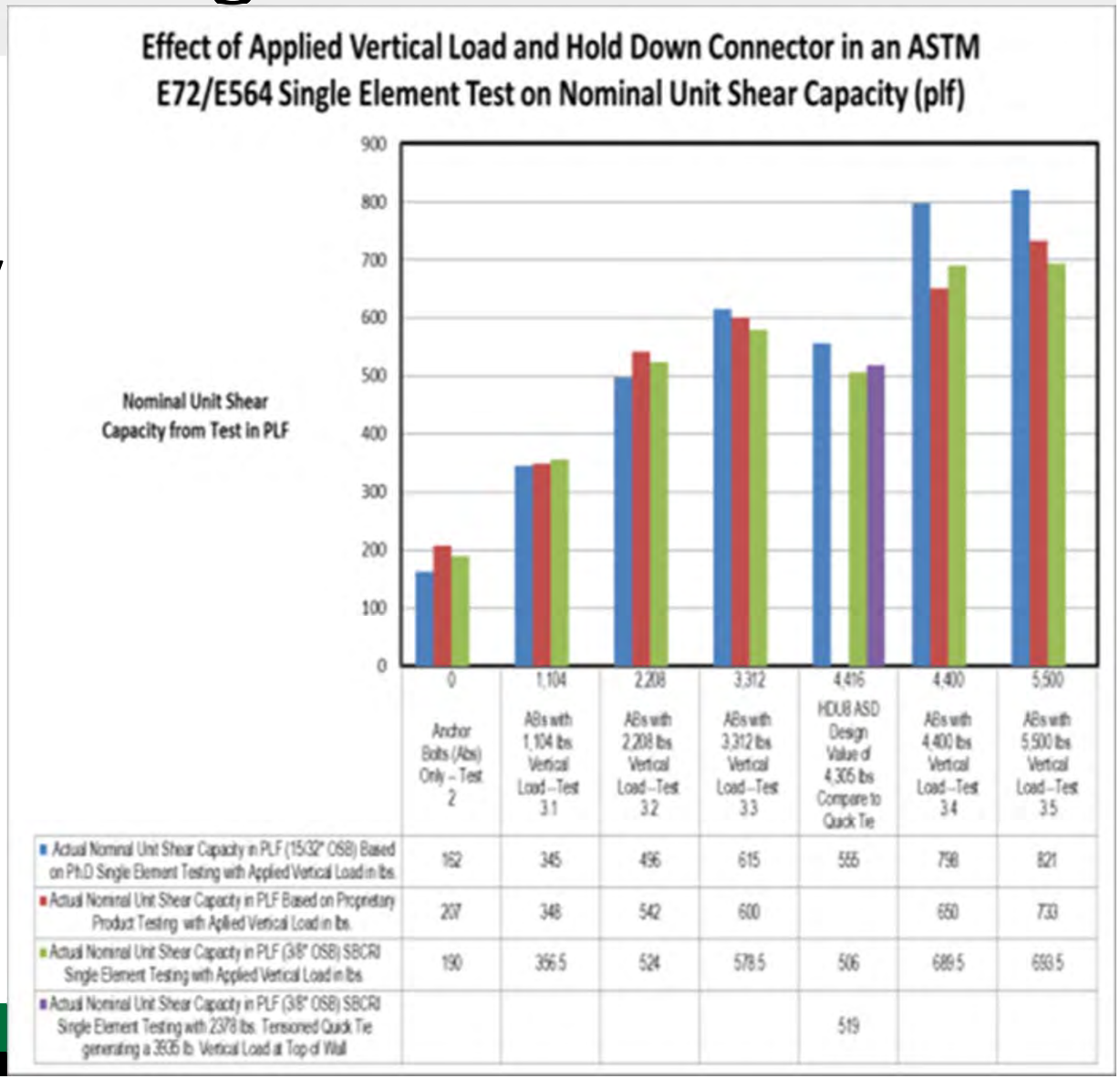
STANLEY
LC-064

ASTM E72/E564/E2126 Single Element Testing Effect

- Test boundary conditions have a huge design value impact.
- Qualtim can provide any design value desired for a BWP up to a natural applied vertical load BWP capacity limit.
- Don't design professionals deserve accurate and transparently derived BWP design values?



	0 Anchor Bolts (Abs) Only – Test 2	1,104 ABs with 1,104 lbs Vertical Load – Test 3.1	2,208 ABs with 2,208 lbs Vertical Load – Test 3.2	3,312 ABs with 3,312 lbs Vertical Load – Test 3.3	4,416 HDU8 ASD Design Value of 4,305 lbs Compare to Quick Tie	4,400 ABs with 4,400 lbs Vertical Load – Test 3.4	5,500 ABs with 5,500 lbs Vertical Load – Test 3.5
Actual Nominal Unit Shear Capacity in PLF (15/32" OSB) Based on PhD Single Element Testing with Applied Vertical Load in lbs.	162	345	496	615	555	798	821
Actual Nominal Unit Shear Capacity in PLF Based on Proprietary Product Testing with Applied Vertical Load in lbs.	207	348	542	600		650	733
Actual Nominal Unit Shear Capacity in PLF (3/8" OSB) SBCRI Single Element Testing with Applied Vertical Load in lbs.	190	356.5	524	578.5	506	689.5	693.5
Actual Nominal Unit Shear Capacity in PLF (3/8" OSB) SBCRI Single Element Testing with 2378 lbs. Tensioned Quick Tie generating a 3935 lb. Vertical Load at Top of Wall					519		

ASTM E72/E564/E2126 Single Element Testing Effect

- Applied axial load (i.e. gravity load from above or any load pulling the wall top plate down) significantly benefits BWP strength.
- Standard hold-downs do not follow the same trend line.
  - Testing shows HDs provide BWP strength increases that are 30% less.
  - A 2,000-lb axial load has a restrained BWP factor of 0.68.
  - A 2,000-lb HD has a restrained BWP factor of 0.5.

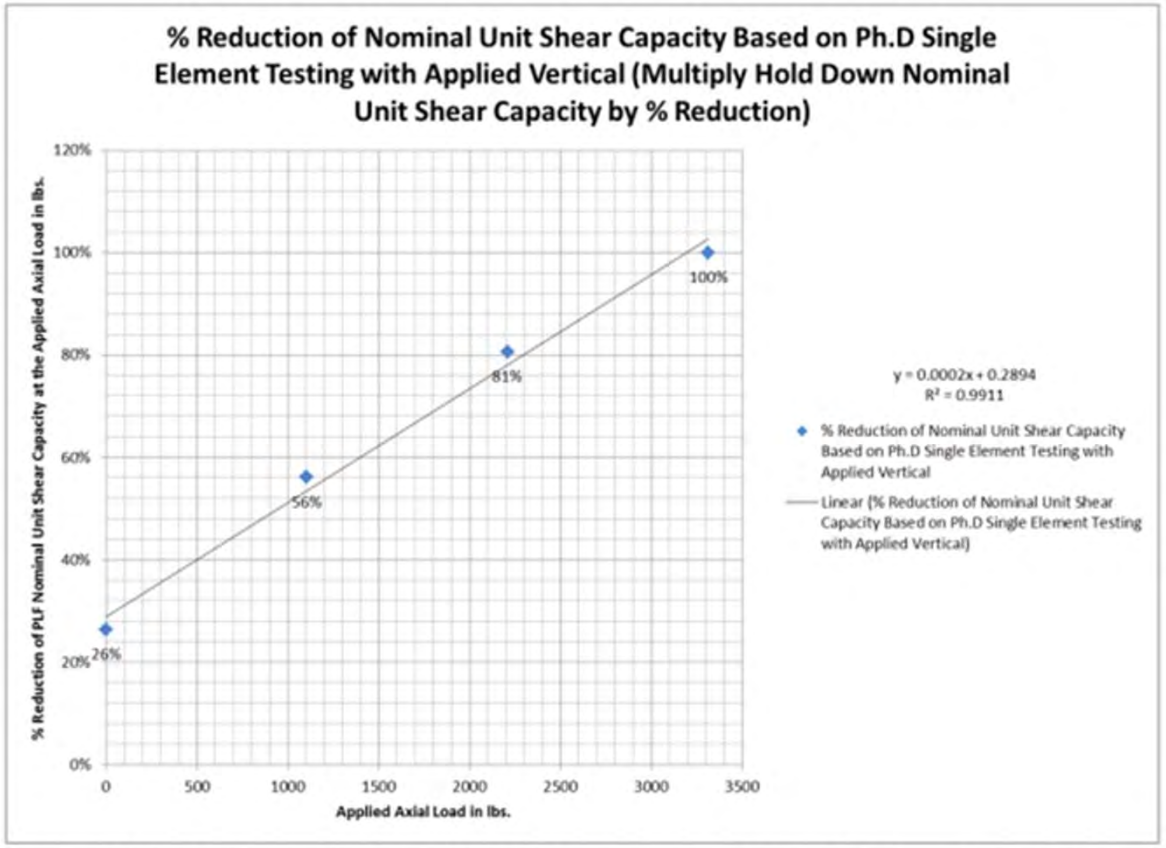


Figure 4: Graphical Representation of the Relationship Between the Applied Axial Load and a Representative Percent Reduction o Nominal Unit Shear Capacity Based on Ph.D. Thesis and Proprietary Single Element Testing (see Figure 3)

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ASTM E72/E564/E2126 Single Element Testing Effect – Confirmed

- According to the Dolan-Toothman Report No. WMEL-2002-03, there are key differences between a fully-restrained and a partially-restrained wall.
- "...Wall specimens using hold-down connections had higher peak load and stiffness values than walls without these connections."
  - "3.6 times higher capacity when comparing OSB with GWB" [i.e., 693 PLF (HD) vs. 191 PLF (a reduction factor of 0.28)]
  - "3.2 times higher capacity when comparing OSB without GWB" [i.e., 553 PLF (HD) vs. 175 PLF (a reduction factor of 0.32]
- "Walls with hold-down connections also had a higher toughness, in that the displacement capacity and energy dissipation characteristics were significantly improved."
- "This performance improvement is due to the more distributed resistance of the sheathing nails in walls with hold-down connections."
- "Walls without hold-down connections concentrated the resistance at the bottom row of nails into the bottom plate."
- "These nails had to resist both the shear and overturning forces when the hold-down connections were not present."
  - WMEL-2002-03, Table 14

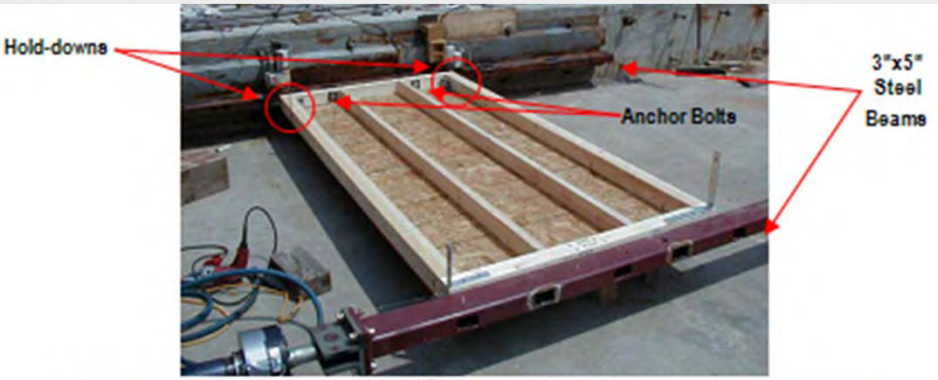

FIGURE 4: Example Setup from 45 Tests Conducted by Dolan and Toothman

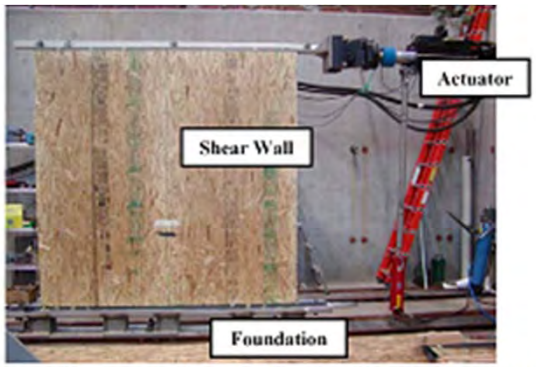

FIGURE 3: Actual Monotonic & Cyclic Testing Frame Conducted by Seaders (Taken from referenced test reports posted on the EWPA website[43])

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ASTM E72/E564/E2126 Single Element Testing Effect – Confirmed

Test	Based on a Fully Restrained Wall	Based on a Unrestrained Wall	ASTM E72/E564/E2126 Single Element Test Partial Restraint Reduction Factor
	Actual Nominal Unit Shear Capacity (plf)		
Seaders (Monotonic)	684 (Stiffened beam and hold down)	271(Stiffened beam and anchor bolts)	0.39
Seaders (Cyclic)	631 (Stiffened beam and hold down)	241(Stiffened beam and anchor bolts)	0.38
Dolan-Toothman (Monotonic)	627 (Stiffened beam and hold down)	194 (Stiffened beam and anchor bolts)	0.31
Dolan-Toothman (Cyclic)	553 (Stiffened beam and hold down)	175 (Stiffened beam and anchor bolts.)	0.32
Ph.D. Thesis (Monotonic)	555 (HDU8 hold down)	162 (anchor bolts only)	0.29
	615 (3,300 lb vertical load)	162 (anchor bolts only)	0.26

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Reconciling ASTM E72/E564/E2126 BWP Single Element Performance to Real Building Performance

Testing Identical BWP Assembly Types In Situ for Benchmarking

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12' x 30' Building Anchor Bolt Testing – $^{3}/_{8}$" and $^{7}/_{16}$" WSP – 4 x 8 Sheet – Confirms the 351 plf of APA/Simpson Testing

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the anchor bolt due to applied lateral load rotating the BWP.

Full Scale Anchor Bolt Testing
What Does APA say?

APA presented its findings in a white paper entitled, *A Review of Large Scale Wood Structural Panel Bracing Tests* to the Building Seismic Safety Council (BSSC) in May 2007 (APA Report)[36].

The APA report summarizes data from a variety of tests on full-scale BWL assemblies using WSPs in conventional construction. Most of the BWLs were 20' long and the isolated BWP segments were in increments of 4' with the least BWP being a 4' x 8' sheet. The stated purpose of the APA report is, "to help evaluate and determine the strength of wood structural panel wall bracing".

One of the key findings from the APA report (based upon 17 $^{7}/_{16}$" WSP BWP tests of varying lengths):

> ...Isolated Method 3 bracing without gypsum has an average peak value of 351 PLF (among 15 tests)[37] and with gypsum of 383 PLF (among 2 tests)[38]...

Furthermore, if one reviews just the tests that have 4' and 8' of isolated bracing, similar to that prescribed by the *IRC*, the average peak load for the six $^{7}/_{16}$" WSP BWP tests is 350 PLF (349.8).

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Full Scale Anchor Bolt Testing
What Does APA say?

[36] *A REVIEW OF LARGE SCALE WOOD STRUCTURAL PANEL BRACING TESTS* by Zeno Martin, P.E., Tom Skaggs, Ph.D.., P.E., Ed Keith, P.E., Borjen Yeh, Ph.D., P.E. APA – The Engineered Wood Association (Report to BSSC Bracing Committee May 2007)

Table 3. Summary of test results for isolated wood structural panel wall bracing without gypsum finish.

Row #	Description	Load at 0.5% drift (plf)	Peak Load (plf)	Total Length of Wall (ft)	Total Length of Bracing (ft)	Gyp --	Bracing --	Test Protocol --	Segment Width (ft)	Test # in Ref. --	Reference
25	4-ft wall isolated bracing segment	131	180	4	4	No	Isolated	mono.	4	718&719	Simpson, 2007a
30	20-ft wall isolated bracing segments, "Cabo"	136	204	20	8	No	Isolated	mono.	4	713&714	Simpson, 2007d
19	4-ft wall isolated bracing segment	210	225	4	4	No	Isolated	SPD	4	7	APA, 2006
31	20-ft wall isolated bracing, "Cabo" with 2x10 rim joist	158	238	20	8	No	Isolated	mono.	4	721&722	Simpson, 2007d
43	3D - NW: Cabo, NE: Cabo, SW: Cabo, SE: Cabo (+45)	*177*	256	20	32	No	Isolated	mono.	4	2006744	Simpson, 2007o
47	3D - NW: Cabo, NE: Cabo, SW: Cabo, SE: Cabo (-45)	*168*	265	20	32	No	Isolated	mono.	4	2006732	Simpson, 2007s
28	20-ft wall isolated bracing, "IRC Center"	115	294	20	4	No	Isolated	mono.	4	702&709	Simpson, 2007c
40	3D - W: Cabo, E: Cabo, N: Cabo, S: Cabo (90)	222	363	20	16	No	Isolated	mono.	4	2006715	Simpson, 2007l
39	3D - W: IRC Center, E: IRC Center, N: IRC Center, S: IRC Center (90)	*181*	394	20	8	No	Isolated	mono.	4	2006700	Simpson, 2007k
32	20-ft isolated bracing segment "IRC Side"	147	401	20	4	No	Isolated	mono.	4	710&711	Simpson, 2007e
46	3D - NW: IRC Center, NE: IRC Center, SW: IRC Center, SE: IRC Center (+45)	*177*	420	20	16	No	Isolated	mono.	4	2007001	Simpson, 2007r
29	20-ft wall isolated bracing, "IRC Center" with 2x10 rim joist	172	467	20	4	No	Isolated	mono.	4	723&724	Simpson, 2007c
34	3D - W: Cabo, E: Cabo, N: Cabo, S: Cabo (0)	*281*	469	20	16	No	Isolated	mono.	4	2006716	Simpson, 2007f
38	3D - W: IRC Center, E: IRC Center, N: IRC Center, S: IRC Center (0)	*219*	513	20	8	No	Isolated	mono.	4	2006703	Simpson, 2007j
33	20-ft isolated bracing "IRC Side" with 2x10 rim joist	307	582	20	4	No	Isolated	mono.	4	726&727	Simpson, 2007e
	Average =	**187**	**351**								
	Minimum =	**115**	**180**								
	Maximum =	**307**	**582**								

[37]

Table 6. Summary of test results for isolated wood structural panel wall bracing with gypsum finish.

Row #	Description	Load at 0.5% drift (plf)	Peak Load (plf)	Total Length of Wall (ft)	Total Length of Bracing (ft)	Gyp --	Bracing --	Test Protocol --	Segment Width (ft)	Test # in Ref. --	Reference
3	40-ft wall with isolated bracing	*237*	366	40	12	Yes	Isolated	mono.	4	E	Dolan and Heine, 1997a
6	40-ft wall with isolated bracing	*273*	400	40	12	Yes	Isolated	SPD	4	E	Dolan and Heine, 1997b
	Average =	**255**	**383**								

[38]

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12' x 30' Building Anchor Bolt Testing – $^{3}/_{8}$" WSP – 8 x 8 Sheet – Confirms the 351 plf of APA/Simpson Testing

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the anchor bolt due to applied lateral load rotating the BWP.

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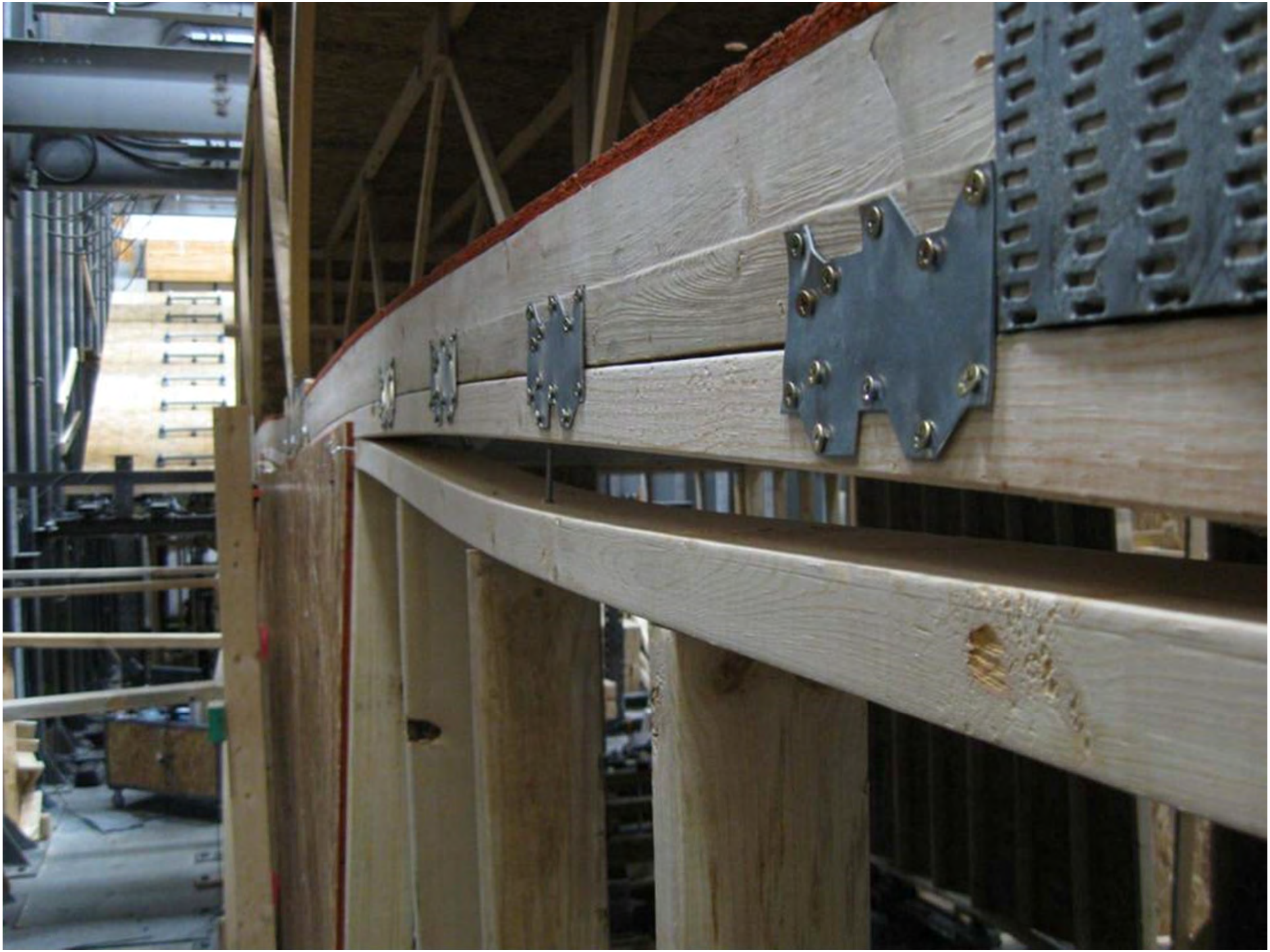

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12' x 30' Building Anchor Bolt Testing – $^{3}/_{8}$" WSP – 8 x 8 Sheet w/GWB – Confirms the 383 plf of APA/Simpson Testing and Generally adding 100 plf for GWB

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the anchor bolt due to applied lateral load rotating the BWP.

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12' x 30' Building – $^{3}/_{8}$" WSP – 4 x 8 Sheet – 4,200-lb Hold-Down Connector Testing – Confirms SDPWS NUSC Value of 515 plf

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the hold-down connector due to applied lateral load rotating the BWP.
- Hold-down connectors holding the stud tight to the bottom plate.

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12' x 30' Building – $^{3}/_{8}$" WSP – 8 x 8 Sheet – 4,200-lb Hold-Down Connector Testing – Confirms SDPWS NUSC Value of 515 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the hold-down connector due to applied lateral load rotating the BWP.
- Hold-down connectors holding the stud tight to the bottom plate.

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12' x 30' In Building – $^{3}/_{8}$" WSP – 8 x 8 Sheet w/GWB -- 4,200-lb Hold-Down Connector Testing – Confirm SDPWS NUSC Value of 515 PLF plus confirms the 383 plf of APA/Simpson Testing and generally adding 100 plf for GWB

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate from the perspective of the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the hold-down connector due to applied lateral load rotating the BWP.
- Hold-down connectors holding the stud tight to the bottom plate.

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Reconciling Past Testing, Current Testing, *IRC* & *IBC* Nominal Unit Shear Capacity Values For BWP Design

Proposing BWP Nominal Unit Shear Capacity Values that are Transparent & Realistic & Based on a Rational Testing & Engineering Foundation

Proposed BWP Nominal Unit Shear Capacity Values that are Transparent & Realistic How?

- Use past and current data
  - Seaders,
  - Dolan & Toothman,
  - Ph.D. Thesis under development.
  - SBCRI WSP and Proprietary Testing
- Use an identical logic path as the ICC's AHC-WB
- Generate nominal unit shear capacity values that are similar in construct and magnitude.
- Through transparent engineering judgment, factors on test data and simple math.

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Proposed BWP Nominal Unit Shear Capacity Values that are Transparent & Realistic How?

- Generate a Series of Tables with Factors
- Document #3 -- Evaluation of ASTM E72/E564E2126 Testing, Effect of Boundary Conditions and Reconciliation of ASTM E72/E564E2126 Tested Nominal Unit Shear Capacity (NUSC) Values and WCFM, IRC and IBC/SDPWS NUSC Values
- Document #4 -- Providing a framework for making benchmark-oriented comparisons between:
  - The IRC and the WCFM Nominal Unit Shear Capacity (NUSC) Values;
  - Hold-Down Restraint (restrained) and Anchor Bolt Restraint (unrestrained) NUSC Values;
  - The IBC/SDPWS (restrained) and WCFM (NUSC Values, and
  - IBC/SDPWS (restrained) and Proposed IBC/SDPWS (restrained) NUSC Values
- Document #5 -- Engineering Considerations for BWP Nominal Unit Shear Capacity (NUSC) Values for Use in Design of IRC, WFCM and IBC-SDPWS Braced Wall Lines (BWLs) & Equivalency Factors

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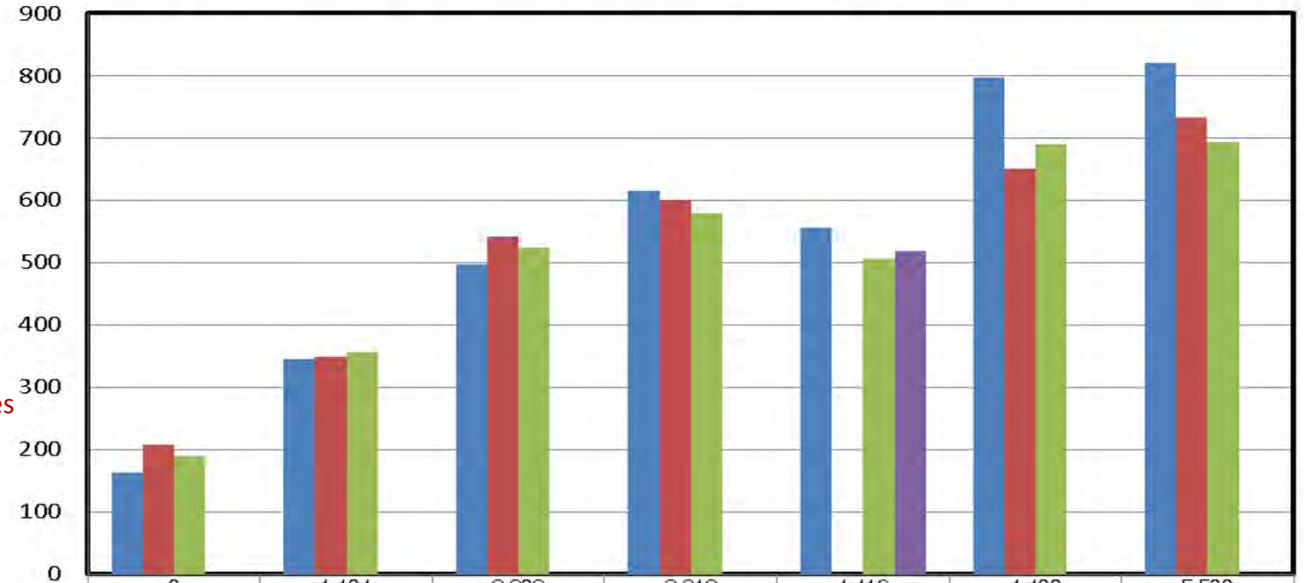
Understanding Hold Down (HD) Connector Performance from Single Element E72/E564 Testing – HD Performance Benchmarking HDU8 & ¼” Quick Tie (QTG)

SBCRI Testing Proves that the AF&PA Statement is True

Effect of Applied Vertical Load and Hold Down Connector in an ASTM Single Element Test on Nominal Unit Shear Capacity (plf)



Nominal Unit Shear Capacity from Test in PLF

What the graph means:

Anchor bolts only provide shear wall capacities of 162, 207 and 190 plf.

A 3,300 lb. gravity load provides shear wall capacities of 615, 600 and 578 plf.

A shear wall using hold down connectors provide capacities of 555 (15/32" OSB) and 506 (3/8" OSB) plf.

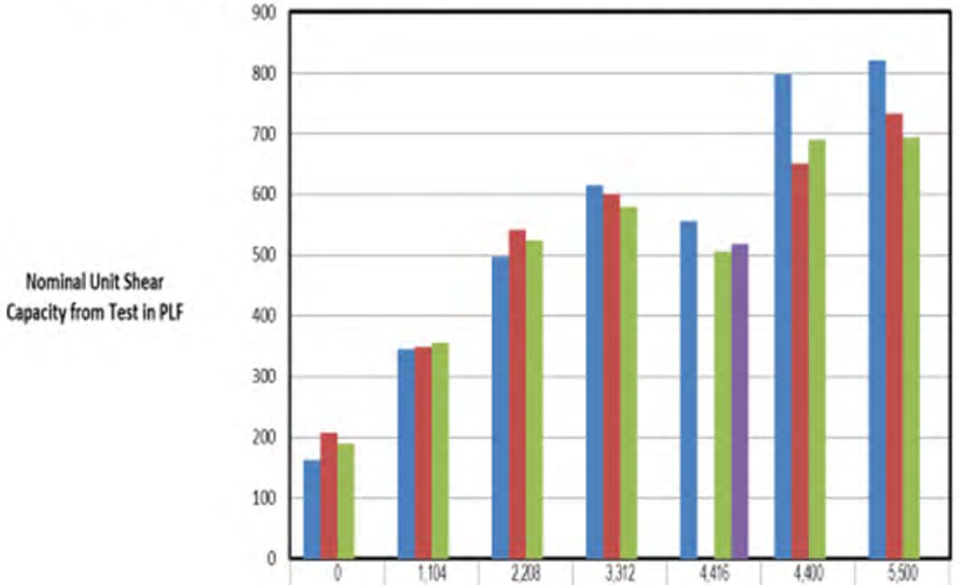
A Quick Tie provides a shear wall capacity of 519 (3/8" OSB) plf.

	0 Anchor Bolts (Abs) Only – Test 2	1,104 ABs with 1,104 lbs. Vertical Load --Test 3.1	2,208 ABs with 2,208 lbs. Vertical Load --Test 3.2	3,312 ABs with 3,312 lbs. Vertical Load --Test 3.3	4,416 HDU8 ASD Design Value of 4,305 lbs Compare to Quick Tie	4,400 ABs with 4,400 lbs. Vertical Load --Test 3.4	5,500 ABs with 5,500 lbs. Vertical Load --Test 3.5
Actual Nominal Unit Shear Capacity in PLF (15/32" OSB) Based on Ph.D Single Element Testing with Applied Vertical Load in lbs.	162	345	496	615	555	798	821
Actual Nominal Unit Shear Capacity in PLF Based on Proprietary Product Testing with Apllied Vertical Load in lbs.	207	348	542	600		650	733
Actual Nominal Unit Shear Capacity in PLF (3/8" OSB) SBCRI Single Element Testing with Applied Vertical Load in lbs.	190	356.5	524	578.5	506	689.5	693.5
Actual Nominal Unit Shear Capacity in PLF (3/8" OSB) SBCRI Single Element Testing with 2378 lbs. Tensioned Quick Tie generating a 3935 lb. Vertical Load at Top of Wall					519		

SBCRI Testing Proves that the AF&PA Statement is True

- Higher applied vertical load increases lateral force resistance.
- Vertical load simulates gravity load and the application/effect of building weight improves shear wall performance.
- Shear capacity has a direct relationship to hold or the structure above with the wall's dead load.

Effect of Applied Vertical Load and Hold Down Connector in an ASTM E72/E564 Single Element Test on Nominal Unit Shear Capacity (plf)



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SBCRI Testing Proves that the AF&PA Engineering Mechanics Works

- Hold down test #1
  - Load cell attached to hold down read 4,416 lbs.
  - 555 plf capacity times 8 equals 4,440 lbs.
- Hold down test #2
  - Load cell attached to hold down read 3,998 lbs.
  - 509 plf capacity times 8 equals 4,048 lbs.
- Quick Tie hold down test #1
  - Load cell attached to QT hold down read 3,935 lbs.
  - 519 plf capacity times 8 equals 4,152 lbs.
- Quick Tie and HDU8 perform identically as hold downs.

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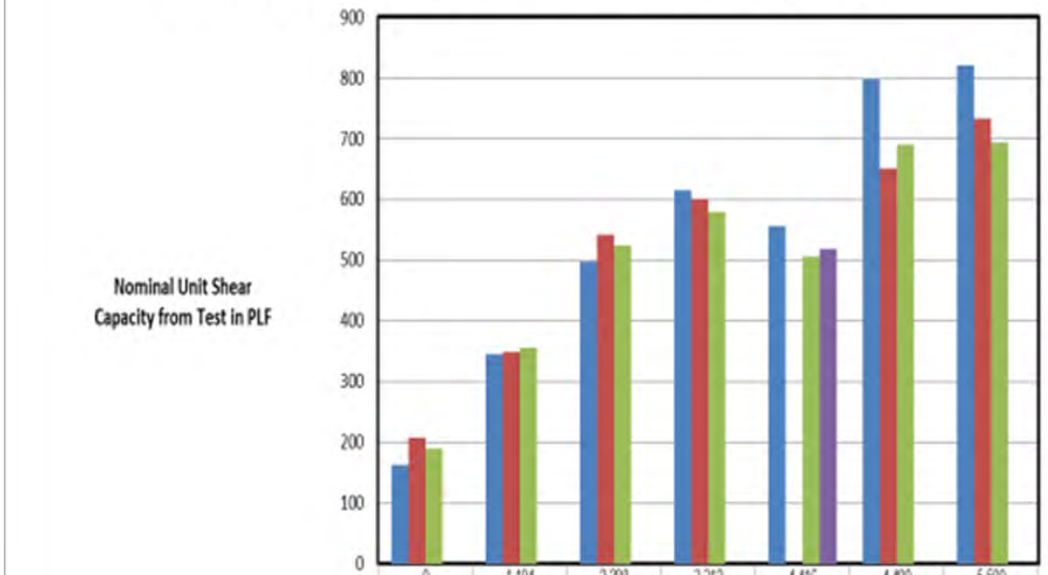
Effect of Applied Vertical Load and Hold Down Connector in an ASTM E72/E564 Single Element Test on Nominal Unit Shear Capacity (plf)



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ASTM E72/E564 Testing – $^{15}/_{32}$" WSP & 4,200-lb Hold-Down Connector – 569 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate and diagonally into the panel due to hold-down applied load increasing nail capacity.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the hold-down connector due to applied lateral load rotating the BWP.
- Hold-down connectors holding the stud tight to the bottom plate.

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IP
APA

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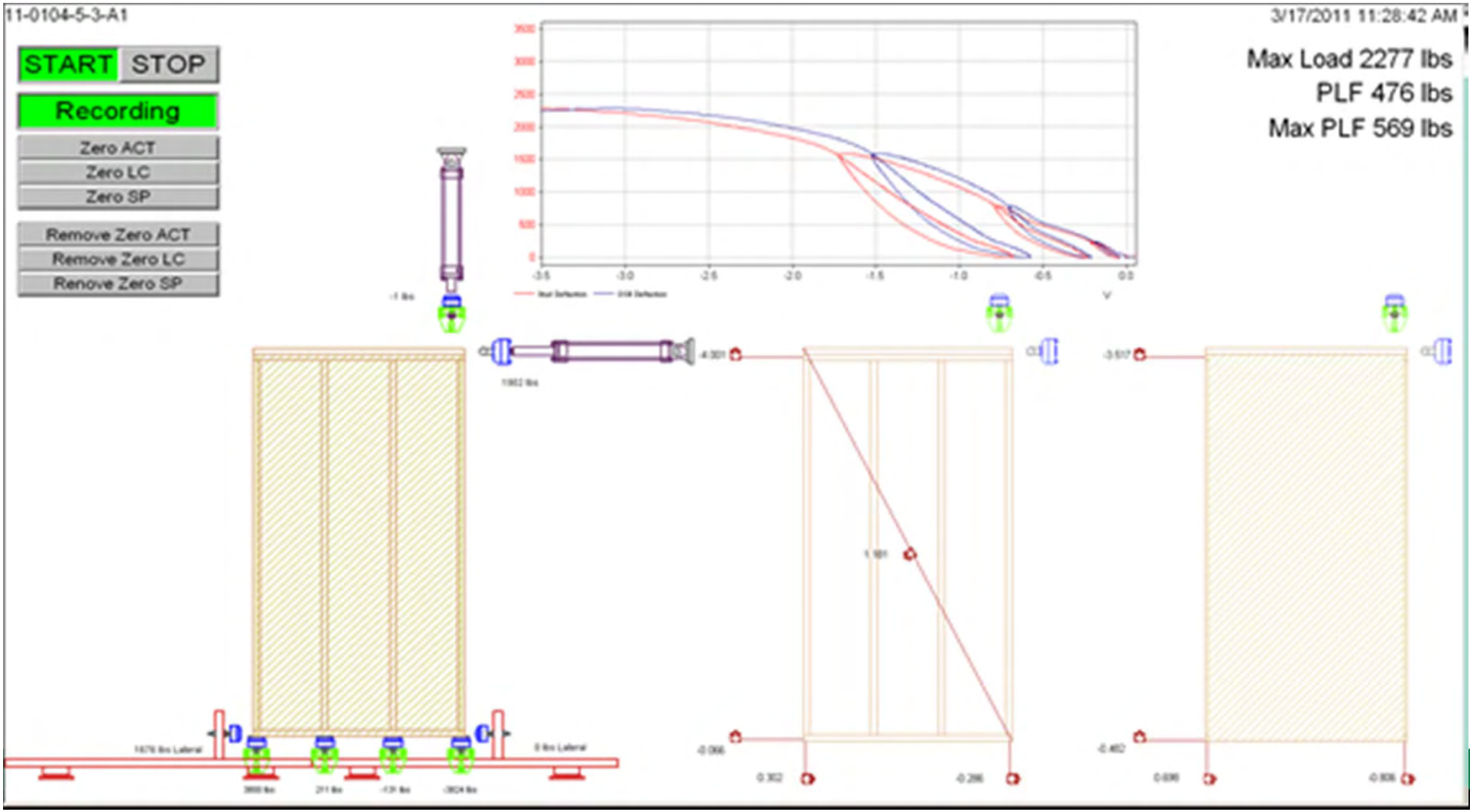
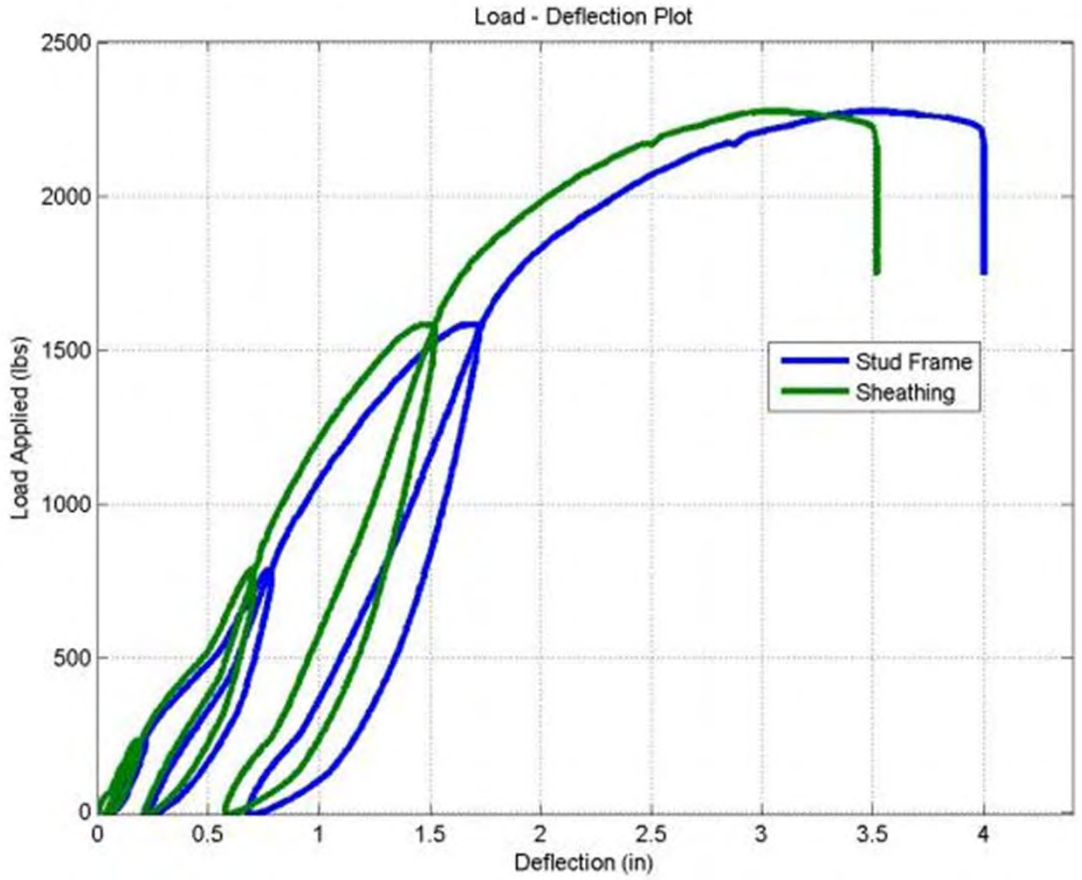
SB-22R

Test #1 of 5 $^{15}/_{32}$" WSP & 4,200-lb Hold-Down Connector – 569 PLF



Test #1 of 5 – $^{15}/_{32}$" WSP & 4,200-lb Hold-Down Connector – 569 PLF
Load Deformation Curve



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ASTM E72/E564 Testing – $^{3}/_{8}$" WSP & 3,935 lb. ¼" Quick Tie (QTG) Hold-Down Connector – 519 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate and diagonally into the panel due to hold-down applied load increasing nail capacity.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the QTG hold-down connector due to applied lateral load rotating the BWP.
- QTG hold-down connectors holding the stud tight to the bottom plate.

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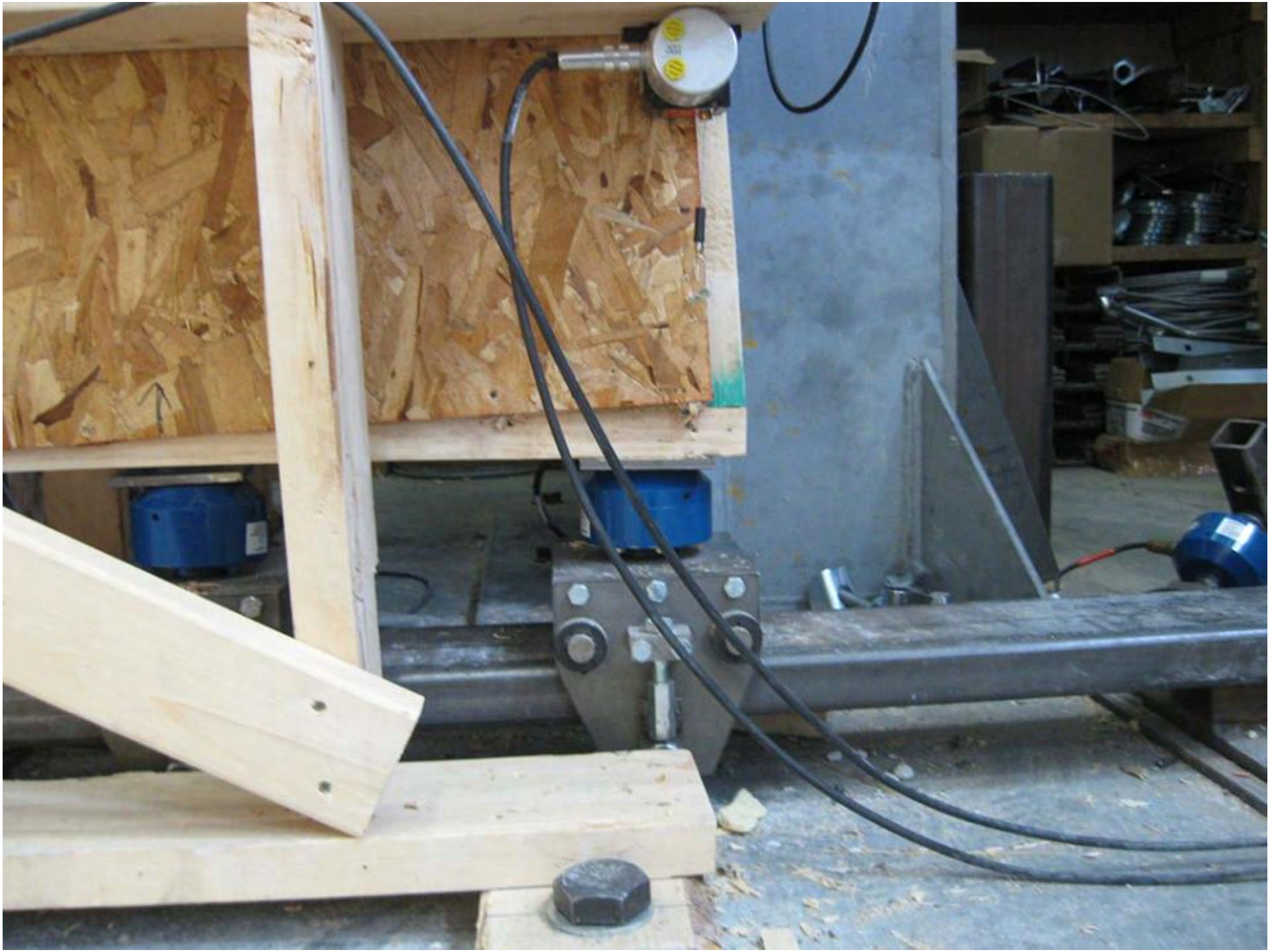

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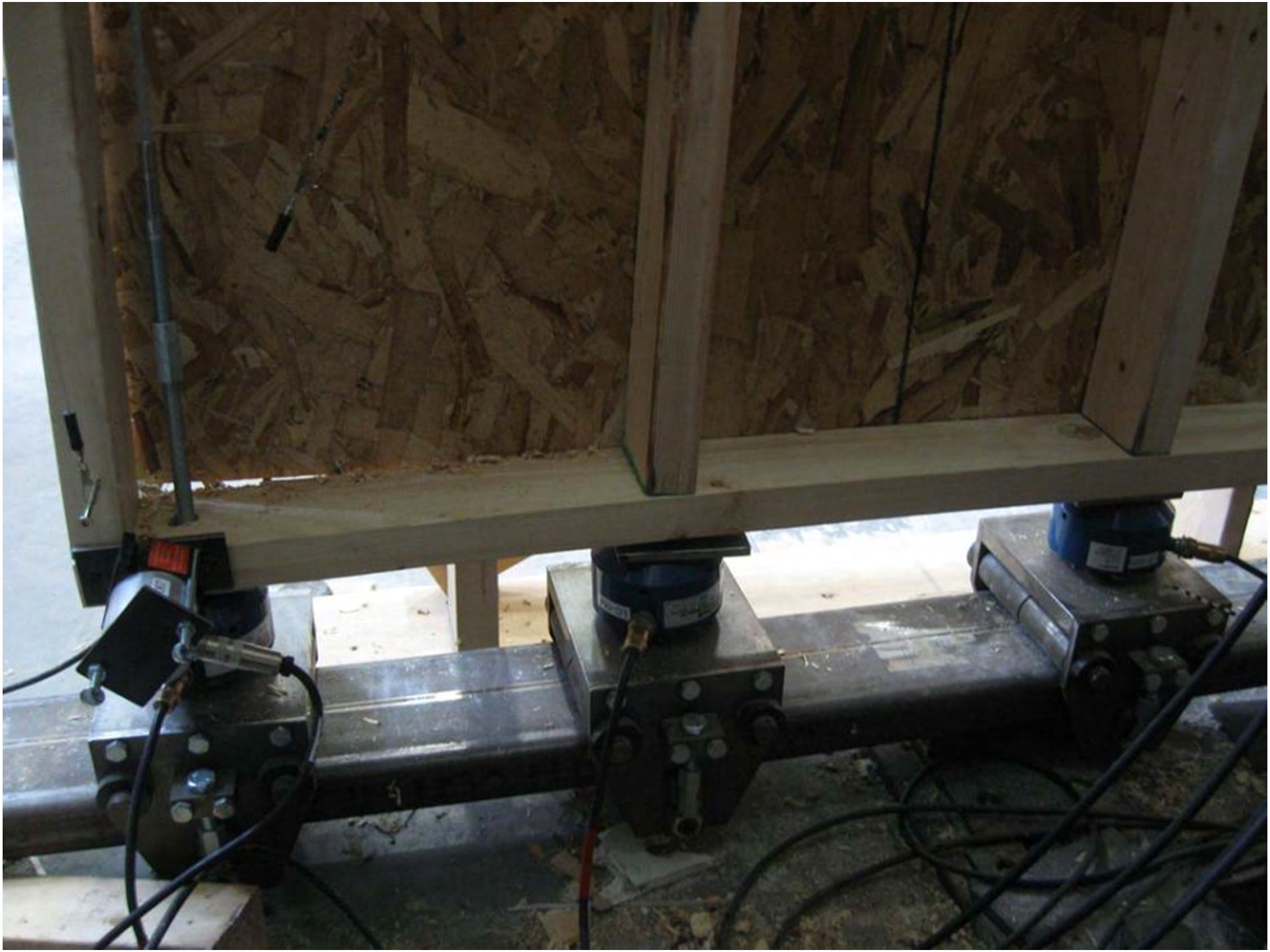

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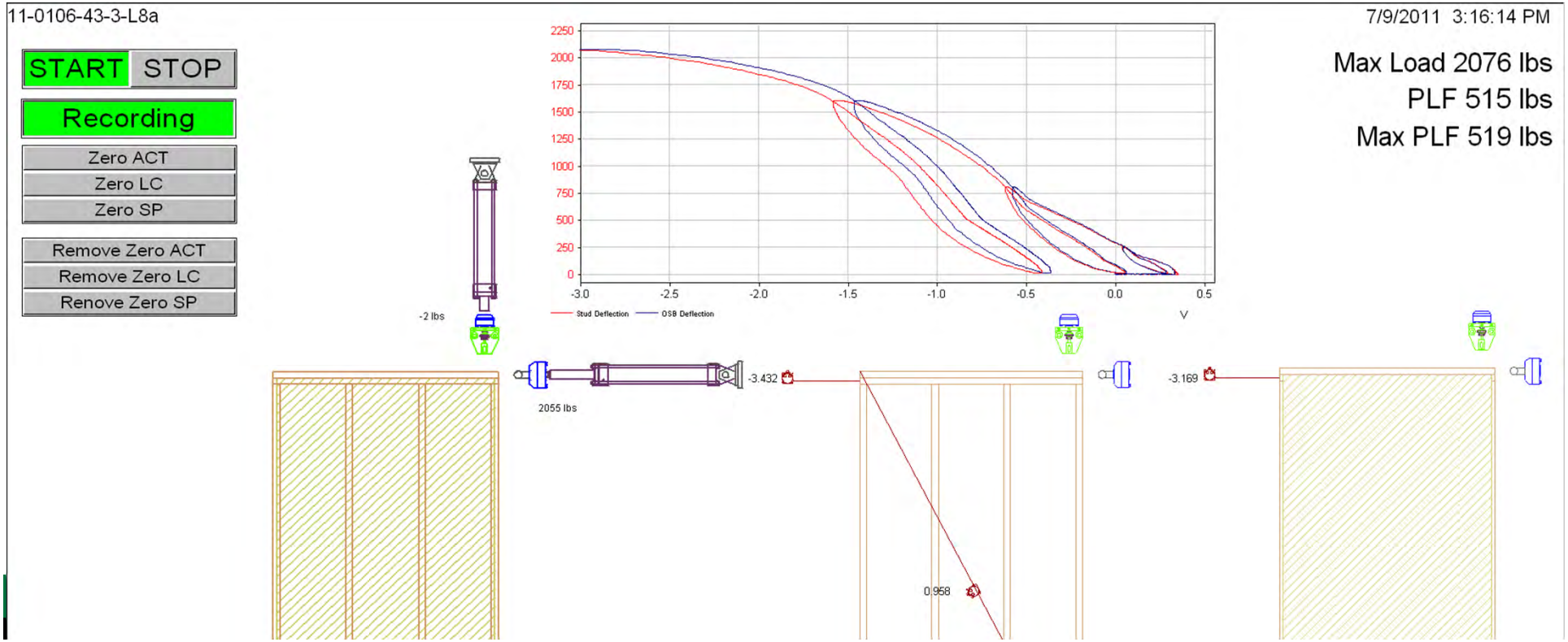
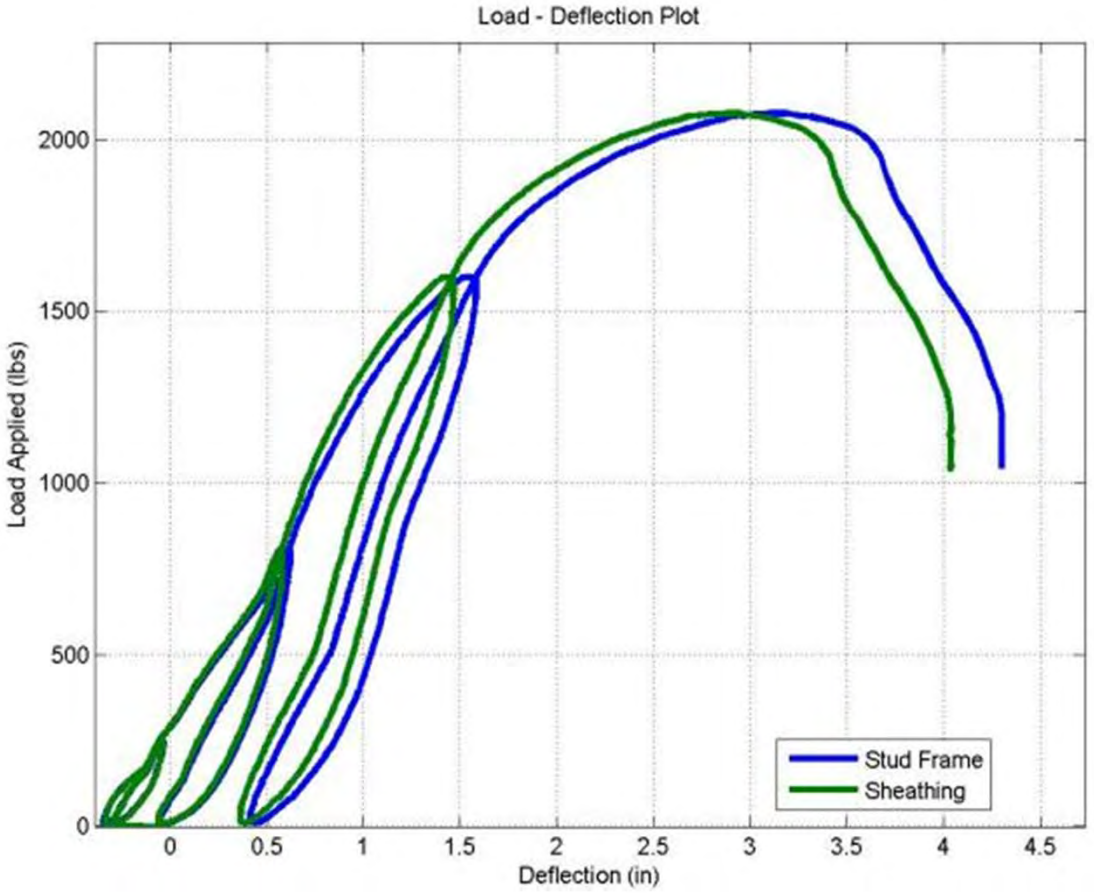
Test #1 – $^{3}/_{8}$" WSP & 3,935 lb. ¼" Quick Tie (QTG) Hold-Down Connector – 519 PLF



Test #1 – $^{3}/_{8}$" WSP & 3,935 lb. ¼" Quick Tie (QTG) Hold-Down Connector – 519 PLF Load Deformation Curve



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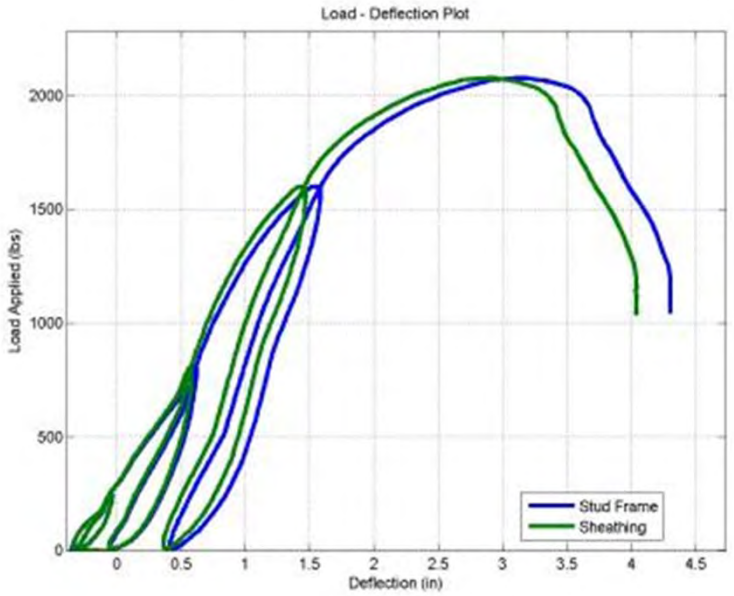
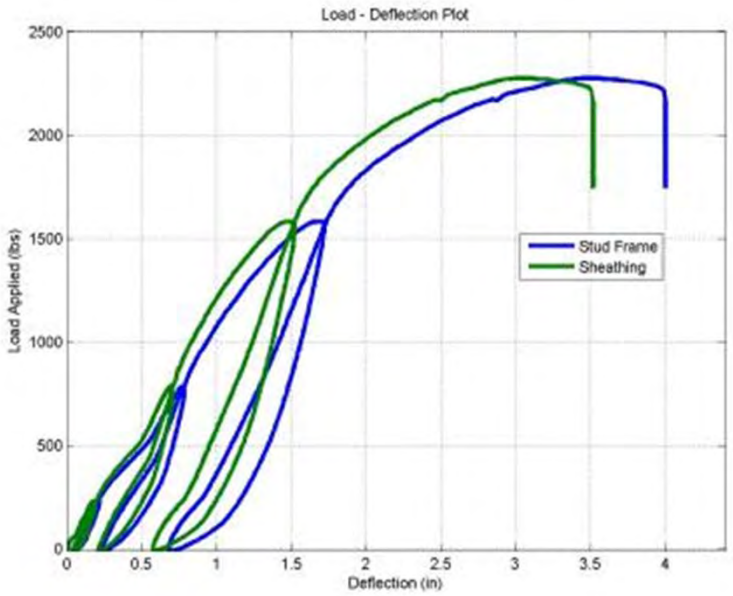
Quick Tie & HDU8 Comparison

¼" Quick Tie (QTG) Load Deformation Graph



HDU8 Load Deformation Graph



The only difference is QTG has residual capacity and is a soft failure as opposed to the HDU8 break.

Quick Tie Test Observations

- The shear wall PLF capacities are nearly identical.
- The failure modes are nearly identical.
- The load deformation curves are nearly identical.
- The only major difference between the two is:
  - The QTG has 2,280 lbs of residual tension in the load cell it is attached to providing residual hold down capacity.
- A key safety question – is it valuable to an engineer to have residual hold down capacity or not?

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As another shear wall panel performance point of view from ASTM E72/E564 Testing

1) $^{15}/_{32}$" WSP & Anchor Bolt Only Hold-Down – 162 PLF – Pictures

&

2) $^{15}/_{32}$" WSP & 3,300-lb Applied Vertical Load – 615 PLF – Pictures

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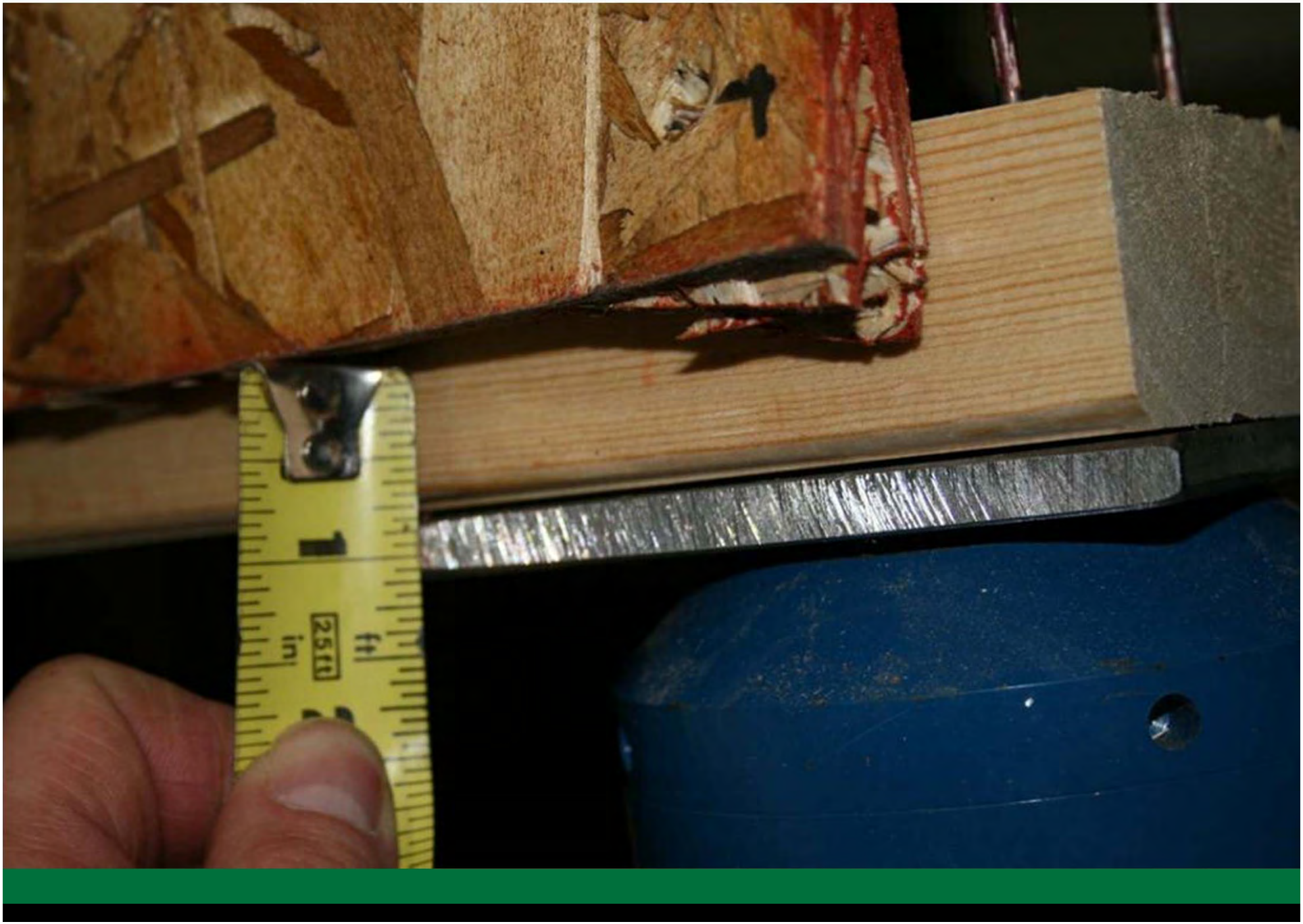
ASTM E72/E564 Testing – $^{15}/_{32}$" WSP & Anchor Bolt Hold-Down – 162 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud at the anchor bolt due to applied lateral load rotating the BWP.

EN
15
LP



STANLEY
25ft
ft
in
1
2
3

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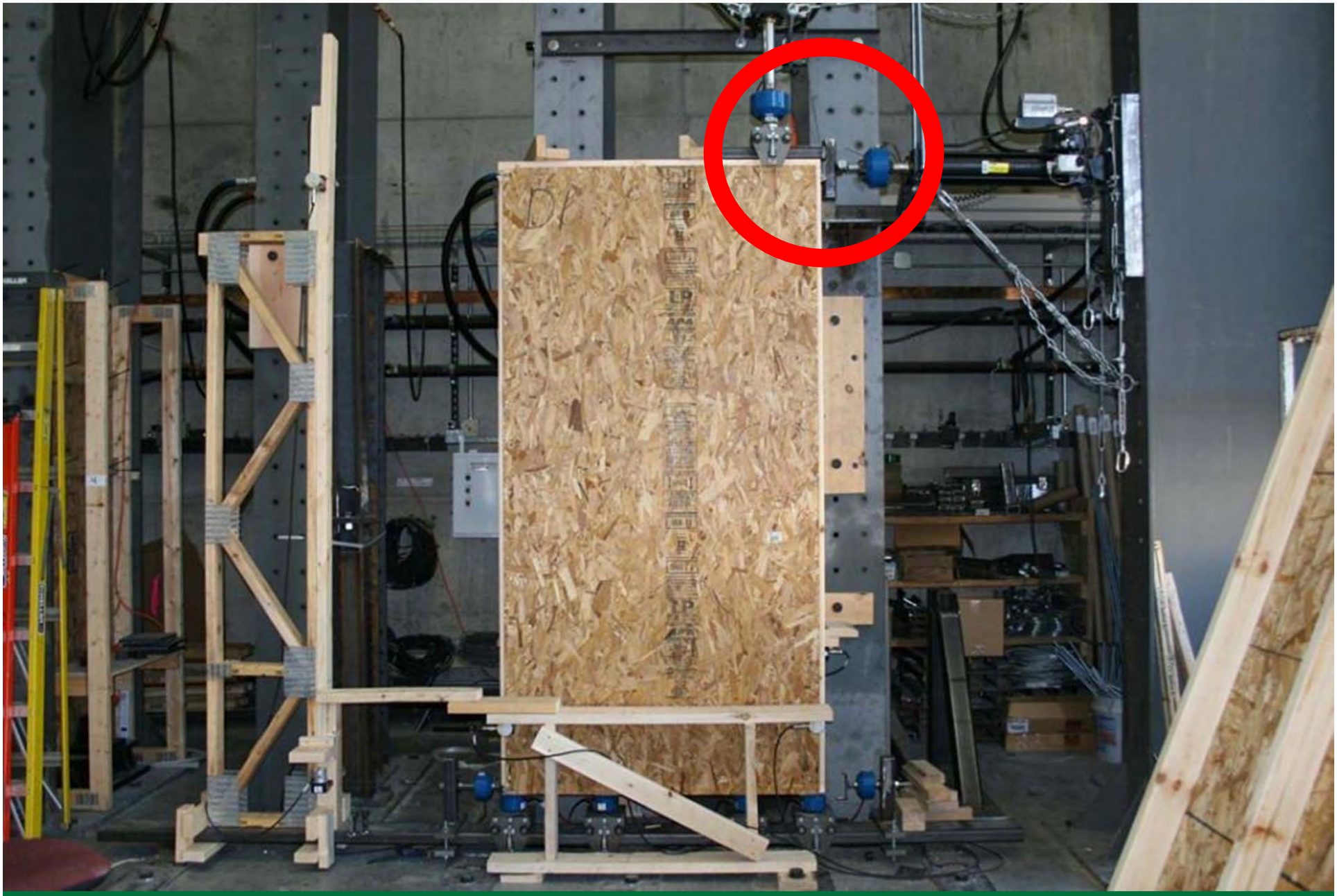
ASTM E72/E564 – $^{15}/_{32}$" WSP – 3,300-lb Applied Vertical Load Testing – 615 PLF

Demonstrating:

- Sheathing/nail capacity along the bottom plate and diagonally into the panel due to vertically applied load increasing nail capacity.
- "Pull through" with respect to nail/sheathing interface at bottom plate with the lead stud.
  - Sheathing pull through capacity.
- Uplift of the stud with 3,300-lb vertical load with applied lateral load rotating the BWP.
- Gravity load holding the BWP lead stud down and increasing lateral load carrying capacity accordingly.

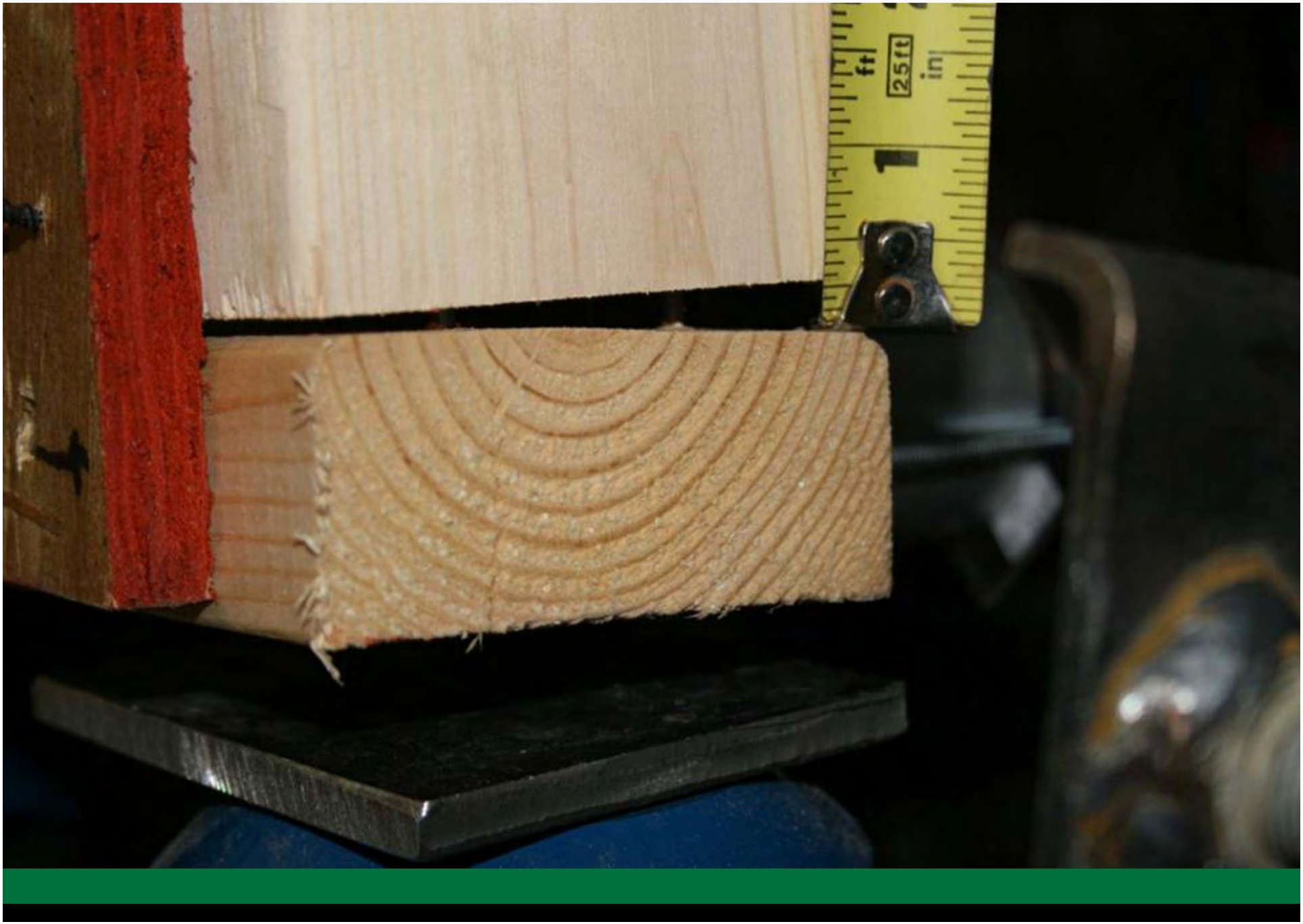


JAN
22
LP
APA
32/16

1
3
4
Life Guard

ft
1
2
STANLEY
3
Life Guard
4
5

STANLEY
25ft
ft
in
1
2
3


ft
25ft
in
1

LC-064

STANLEY
Life Guard
in
1
2
3
4

STANLEY
LC-064

Testing & Technical Substance Behind our Evaluation of Lateral Braced Wall Design?

- Qualtim/SBCRI testing uses the standardized testing procedure techniques of ASTM E2126, E564 and E72 as appropriate in our full building testing.
- A comprehensive set of non-proprietary data and BWP/BWL analysis provided courtesy of Qualtim is available at:
  - sbcri.info/bcters.php
  - sbcri.info/ibcirc.php

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