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TESTING ENGINEERS, INC.

December 4, 2006

TEI Project No. U173-A 02.15.2007
Test #2006704, 705, 718, 719

Mr. Steve Pryor
Manager of Building System Research and Development
Simpson Strong-Tie Co., Inc.
5956 W. Las Positas Blvd.
Pleasanton, California, 94588

Subject: 2D Substructure Test - 4ft Standard Wall

Dear Mr. Pryor,

As requested, Testing Engineers, Inc. (TEI) witnessed testing for the subject specimen on October 31, 2006 and November 10, 2006. The list of the test is shown in Table A. The test sample summary information is presented in Table B. The test measurement devices setup is located in Table C. The test results are summarized in Table D and attached graphs. Figures 1 through 10B depict the test set-up and typical failure modes.

The testing was conducted in the Tyrell Gilb Research and Development Laboratory, Inc. located at 1255 Performance Drive, Stockton, California.
Testing was performed according to TEI SOP 20.160 and ASTM 564 as guideline.

If you have any questions regarding this report, or if we may be of further service to you, please contact the undersigned.

TESTING ENGINEERS, INC.

Fernando Hong
Staff Engineer

Reviewed by:
Terry England PE
C.E. No. 34132, Exp. 06-30-07

REGISTERED PROFESSIONAL ENGINEER
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Revised on: 03/19/2007
Test specimen name update

I. Test Description

The tests were conducted on a two-story cyclic static rig located at Simpson Strong-Tie's Tyrell Gilb Research Laboratory. Two 4ft stand-alone walls with one 3/8" OSB sheathing panel at the center, and PHD5 holddowns at corner were tested via a connection between the double top plate and loading brackets at 2ft o.c. on the load beam. The individual loading brackets provide minimal stiffness to rotation of the double top plate about the axis perpendicular to the wall specimen. Additionally, two 4ft stand-alone walls with one 3/8" OSB sheathing panel at the center, but no holddowns at corner were also tested. The specimens were pulled monotonically to failure at a constant rate of 1 inch/min from north to south.

II. Test Assembly

Test specimens were assembled by Simpson Strong-Tie. Co. Inc. lab personnel at the Tyrell Gilb Research Laboratory in Stockton, California. Table A shows the test matrix The materials used to build the wall specimens are listed in Table B. MDF board was placed under the wall assemblies to ensure that the wall sheathing did not come in contact with the test bed during testing. Test construction plans are shown in Figure 1 and 2. The test assembly are shown in Figure 3 – 4.

The test specimens were designed to meet the general requirement of braced wall.

- 2X4 DF framing at 16 inch interval.
- 1/2" A36 anchor bolts with standard nut and 3/16" x 2" x 2" plated washer. All anchor bolts were installed snug tight plus one-quarter turn of the nut with a wrench.
- Center shear panel was 3/8" thick 4'X8' APA Rated Exposure I OSB with 8d common nails @ 6:12" o.c and 3/8" sill nail distance.

Table A - Test Matrix

Test Number	Configuration	Test Date
2006704	Double 2 x 4 corner studs PhD5 holddown	10/31/2006
2006705		10/31/2006
2006718	Single 2 x 4 corner stud, no holddown	11/10/2006
2006719		11/10/2006

Table B - Test Sample Data Summary.

Members

Member	Specimens, Size and Grade	Measured Moisture Content	Measured by:	How material was obtained
Sheathing Post	2X4 DF No. 2	704(9.6%) 705(10.4%) 718(10.3) 719(12%)	TEI	Purchased by Simpson Strong-Tie at local supplier.
Sill Plate	2X4 DF No. 2	704(8.3%), 705(8.7%), 718(12%), 719(11%)		
Top Plate	2X4 DF No. 2	704(8.2%), 705(8.4%), 718(14%), 719(14%)		
Wall Sheathing	3/8X4X8 APA rated Expo 1 24/0	N/A	N/A	Ainsworth Lumber Co. Ltd

Moisture Content measured with: Lognomat-Model: Mini Ligno Dx/C

Fastener

Location	Quantity and Type	Measured Diameter	Measured by	How material was obtained
Wall Sheathing	8d common @ 6:12" o.c.	0.131"	TEI	Purchased by Simpson Strong-Tie from White Cap Construction Supply.
Build-up Corner Studs	(1)10d common@ 24" o.c.	0.147"		
Sill/top Plate to Studs	2-16d common	0.162"		
Double Top Plates	(2) 10d common @ 24" o.c.	0.147"		
Intermediate Anchor Bolts	1/2" Ø. A36 steel threaded rod	N/A	Not Sampled by TEI	Randomly picked by Simpson Strong-Tie at the lab warehouse, Stockton, CA.
	3/16"x2"x2" square plate washer	N/A		
	1/2" Ø standard nut	N/A		
Corner Anchor	PHD5	N/A	Not Sampled by TEI	
	5/8" Ø. A36 steel threaded rod	N/A		
	(14) SDS1/4x3 Screws	N/A		

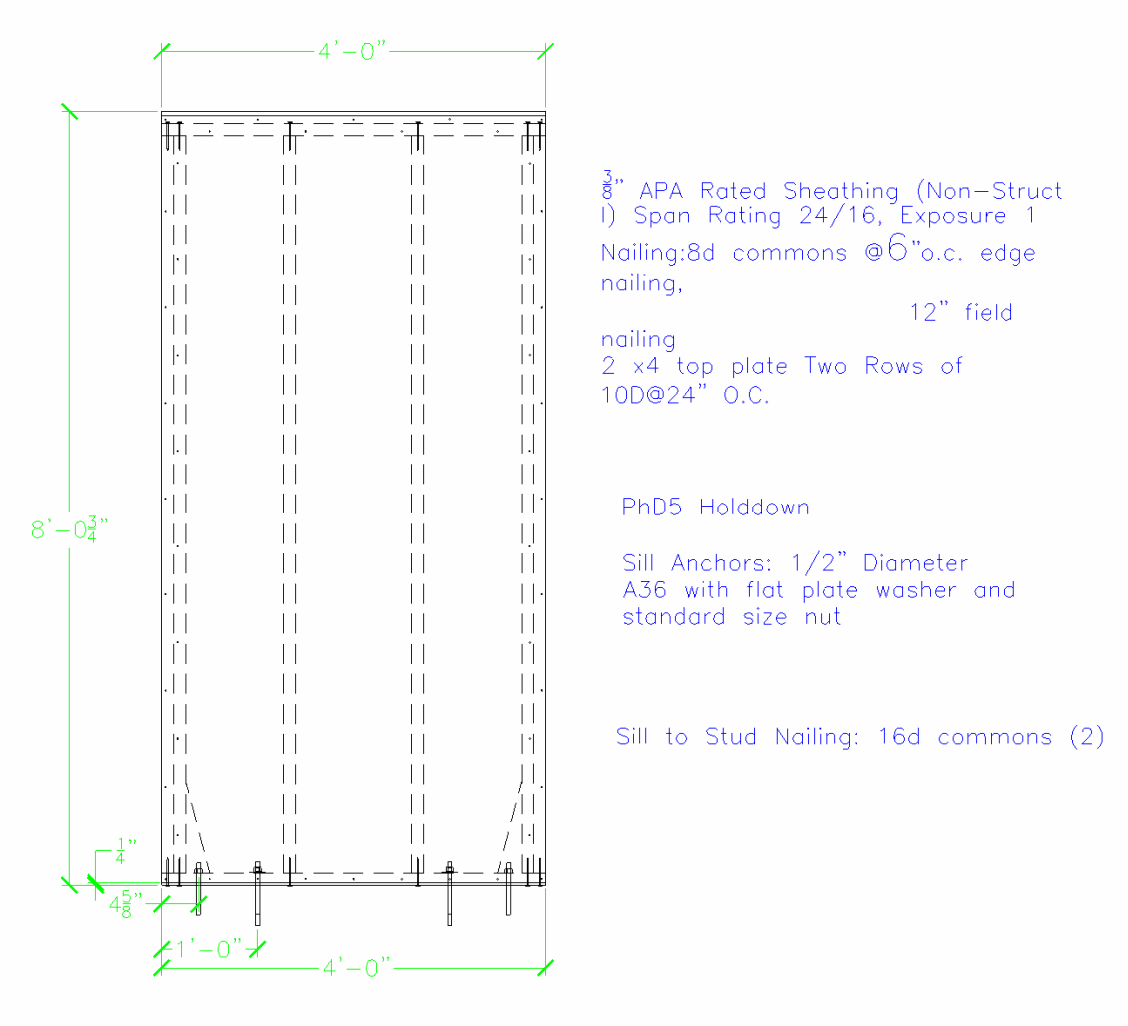

Figure 1 - Framing Details.
<With PhD5 and double corner studs>

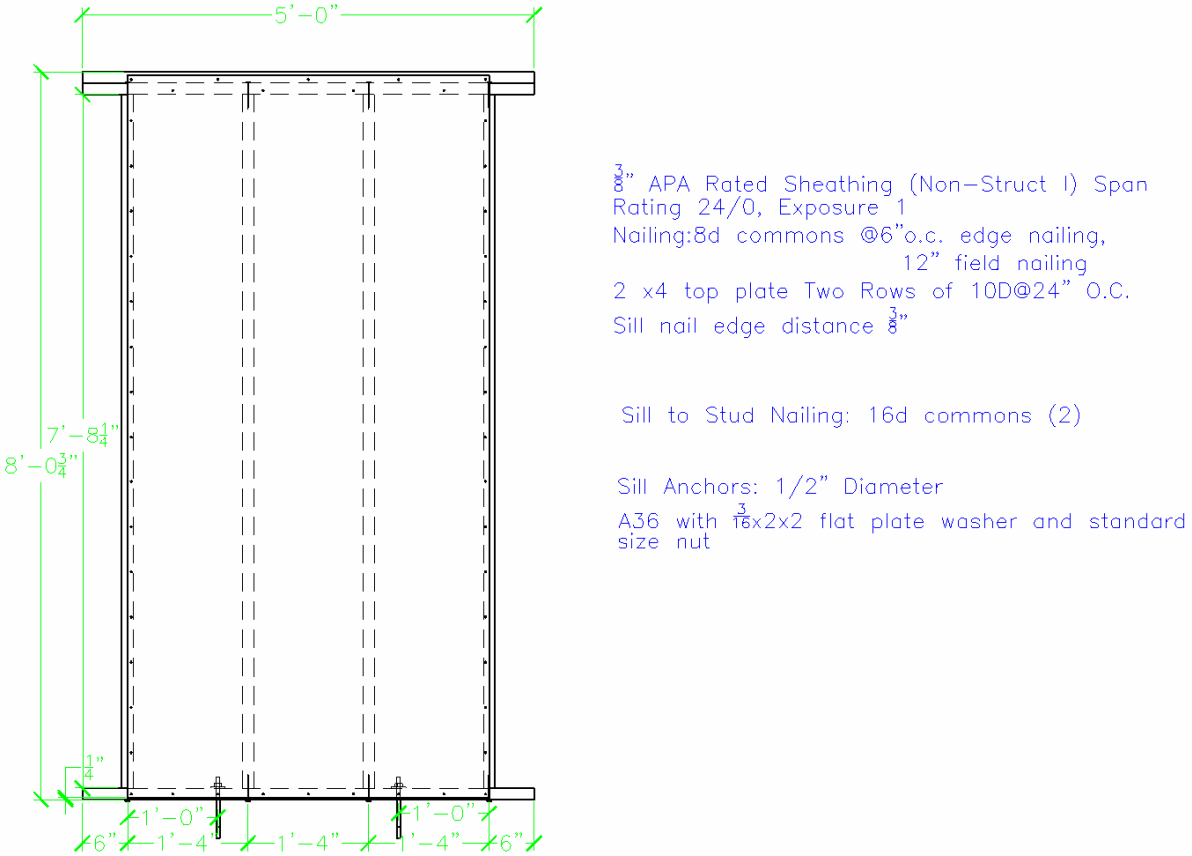

Figure 2 - Framing Details.
<Single corner stud and no holddown>

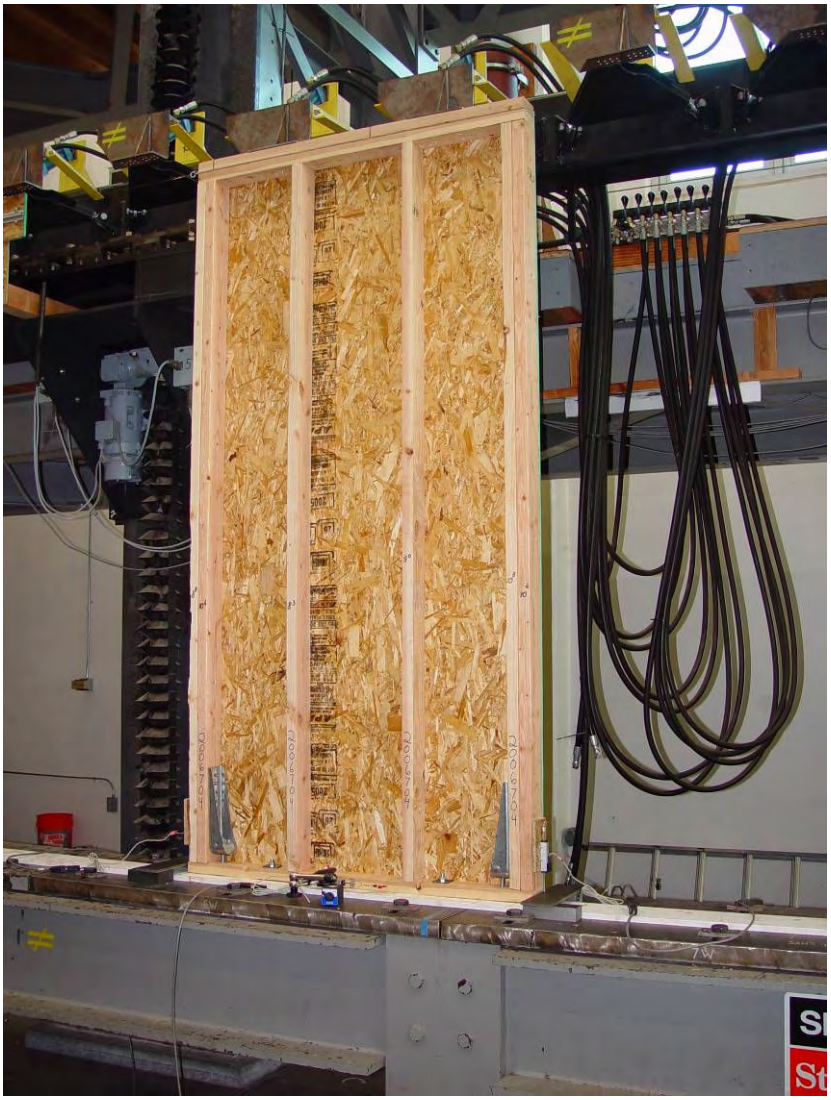

Figure 3 - Test Set-Up.
<Double Corner Studs and PhD5 Holddown.>

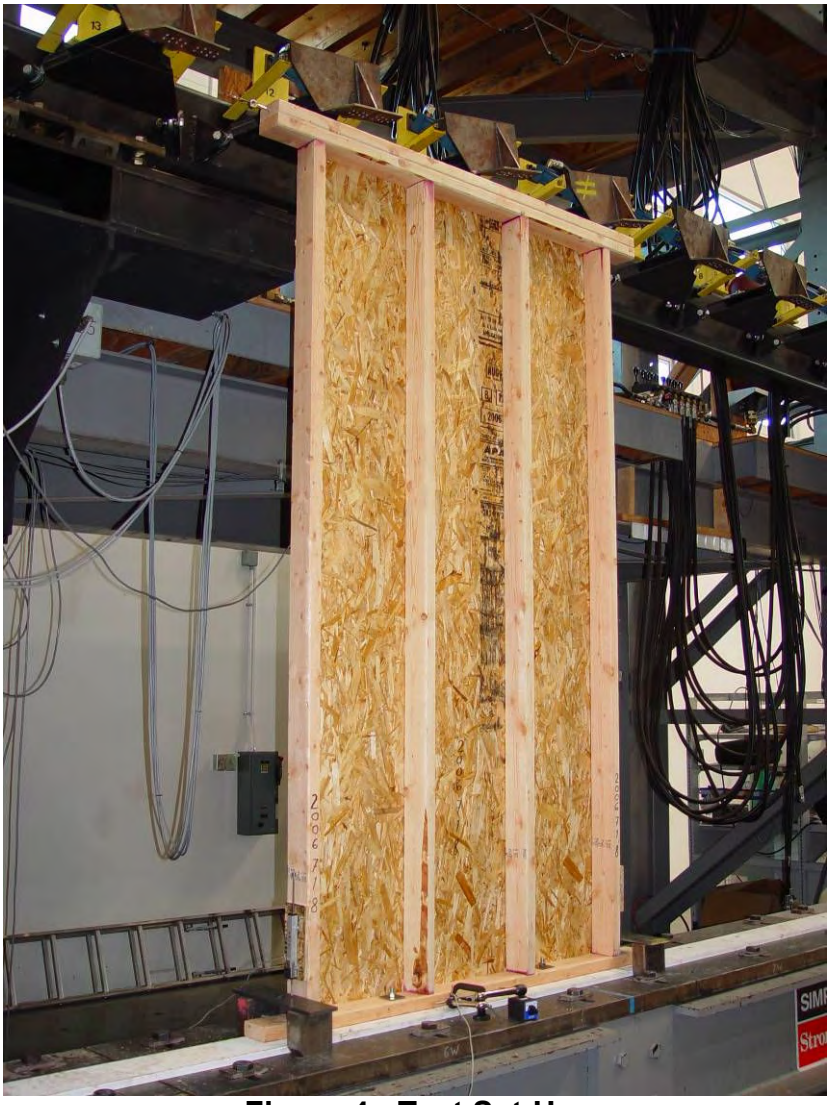

Figure 4 - Test Set-Up.
<Single Corner Stud and no Holddown>

III Instrumentation

Devices were used to monitor applied load at the top of the wall, actuator displacement, top of wall displacement, post uplift, and slip of the wall relative to the rigid foundation.

Table C is a summary of all devices used in the test including serial number and calibration due date. Figures 5 show detailed location of instruments.

Table C – Test Measurement Setup

Test Procedure:		Monotonic Test	
Test Machine:		Two Story Cyclic Static Rig	
Load Rate:		1inch/min	
No.	**Measuring Devices:**	**Serial #**	**Cal. Due Date**
1	Actuator Load	MTS # 1471282	3/3/2007
2	Actuator Disp	MTS # 10155645	3/3/2007
3	Top of Wall Disp	Temposonic # 10123028	2/1/2007
4	NPost Uplift	TR50 #03 – 20286 <Test 2006704,2006705 only>	7/20/2007
		TR100 #03 - 21118 <Test 2006718,2006719 only>	7/20/2007
5	SPost Uplift	TR50 #03 - 20298	7/20/2007
6	Sill Slip	TR50 #03 - 20292	7/20/2007

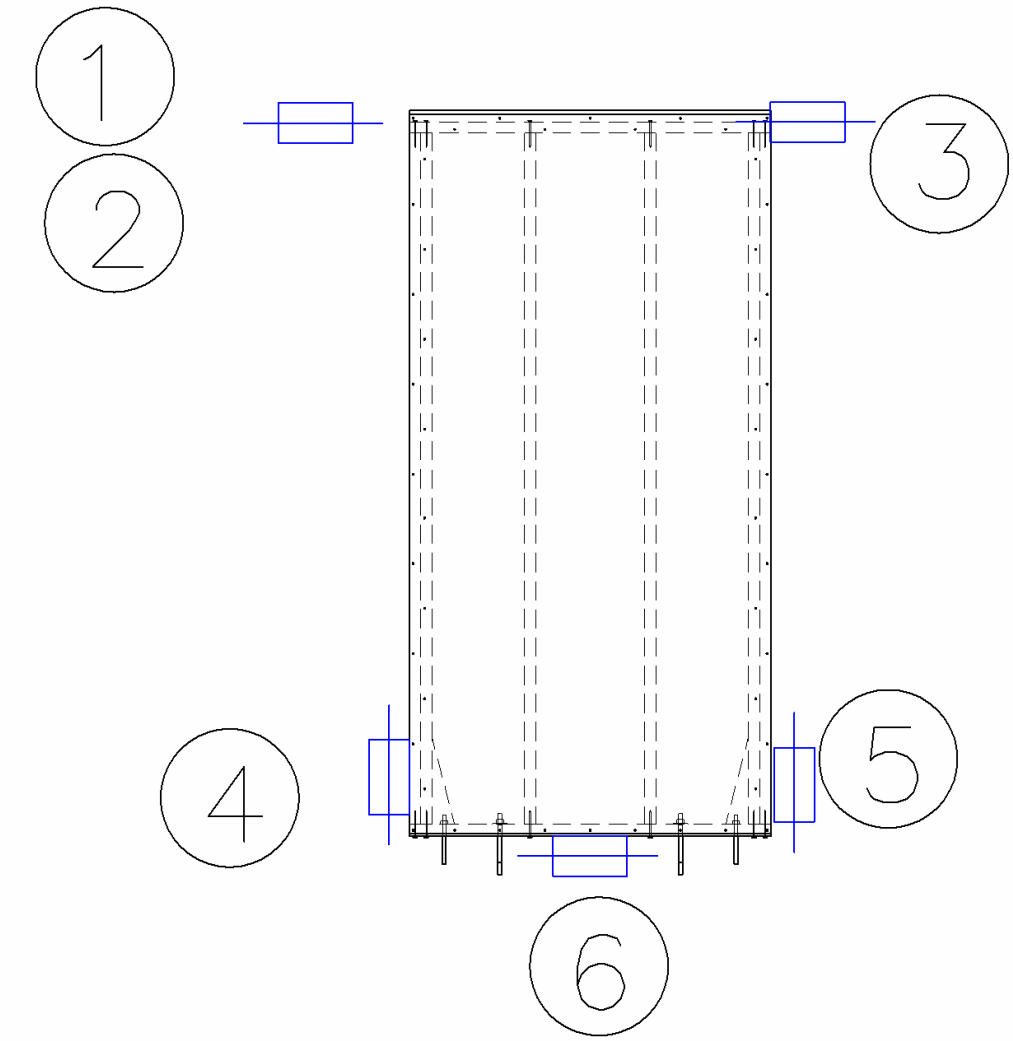

Figure 5- Instrument Details.

IV Results

Table D shows load and top of wall deflection results at drifts of 0.24", 0.48" and at peak load. Figure 6 – 10A/B show the typical deformed specimen states and failure mechanisms after testing.

Failure modes:

- **2005-704**: Sheathing nails tore out at sill plate and north corner stud; shearwall north frame member uplifted from the sill; sill plate bending distortion.
- **2005-705:** Sheathing nails tore out at sill plate and north corner stud; shear wall north frame member uplifted from the sill; sill plate bending distortion.
- **2005-718:** Sheathing nails tore out at sill plate; shearwall north boundary member detached from the sill; sill plate bending distortion.
- **2005-719:** Sheathing nails tore out at sill plate; shearwall north boundary member detached from the sill; sill plate bending distortion.

Figure 11 shows the overall performance of wall under monotonic loading. Figures 12A-12D show the uplift of each specimen under loading.

Table D –Loads at Various Drift Levels and Ultimate Load Information.

Test Number #	Disp.	Load	Disp.	Load	Ultimate	
	(in.)	(lb)	(in.)	(lb)	Load	Disp.
2006704	0.24	818	0.48	1385	2385	2.66
2006705	0.24	802	0.48	1314	2390	2.44
2006718	0.24	340	0.48	534	672	0.81
2006719	0.24	365	0.48	510	769	1.24

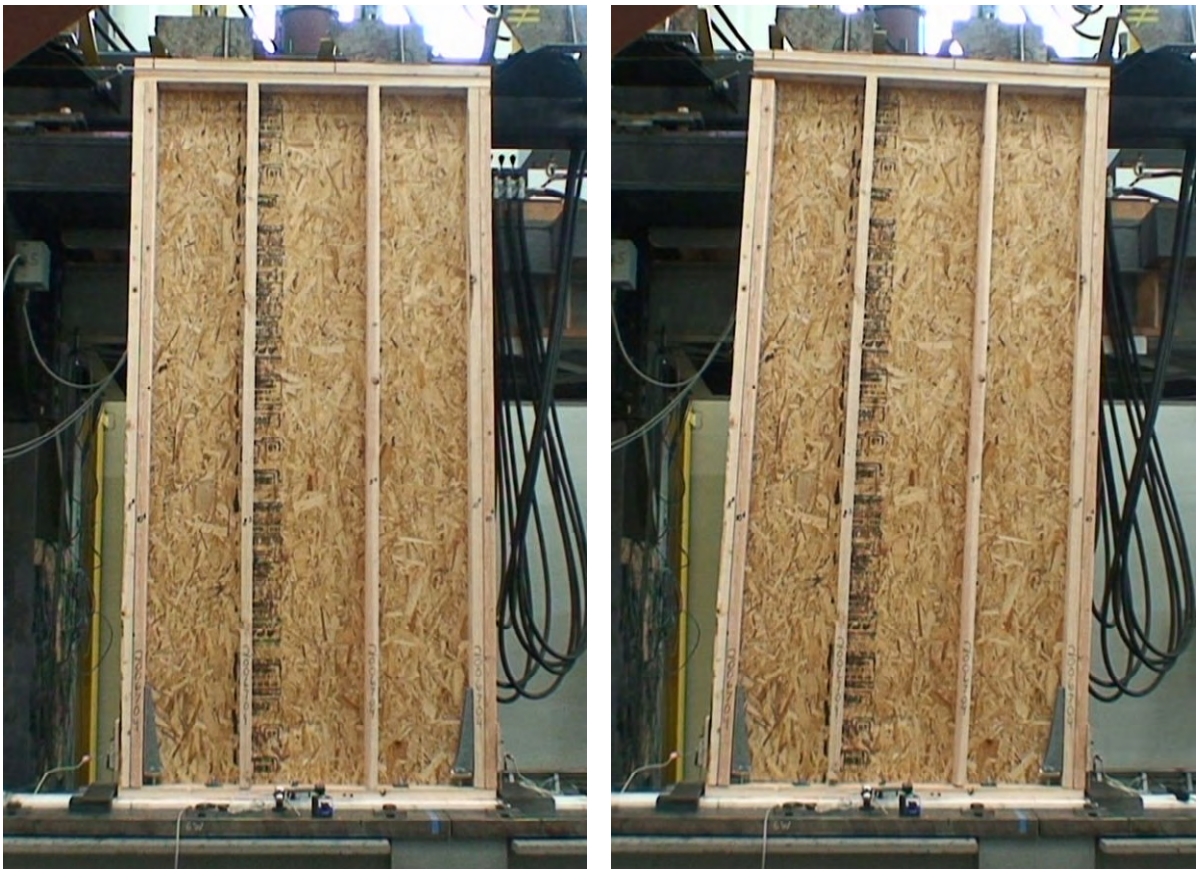

Figure 6 – View Before and After Test
<Double Corner Studs and PhD5 Holddown.>

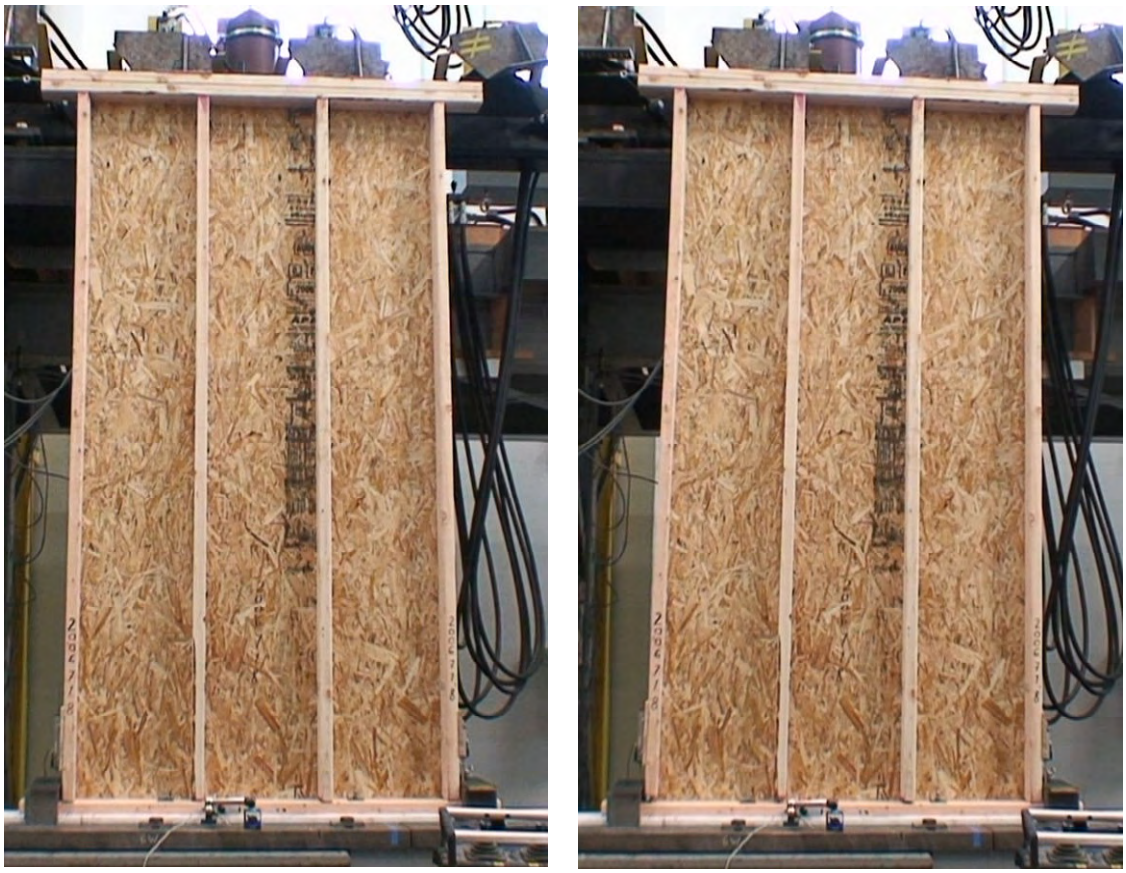

Figure 7 – View Before and After Test
<Single Corner Stud and No Holddown.>

Figure 8 - Typical Sheathing Nail Tear-Out.

Figure 9 – Typical Deformation after test.
<Double corner studs with PhD 5 holddown>

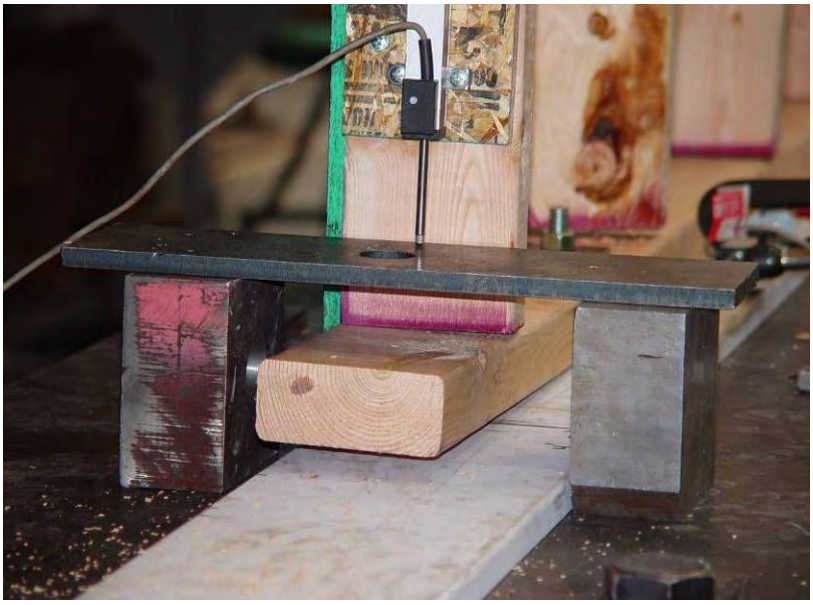

Figure 10 A- Typical Deformation near failure.
<Single corner stud NO Holddown >

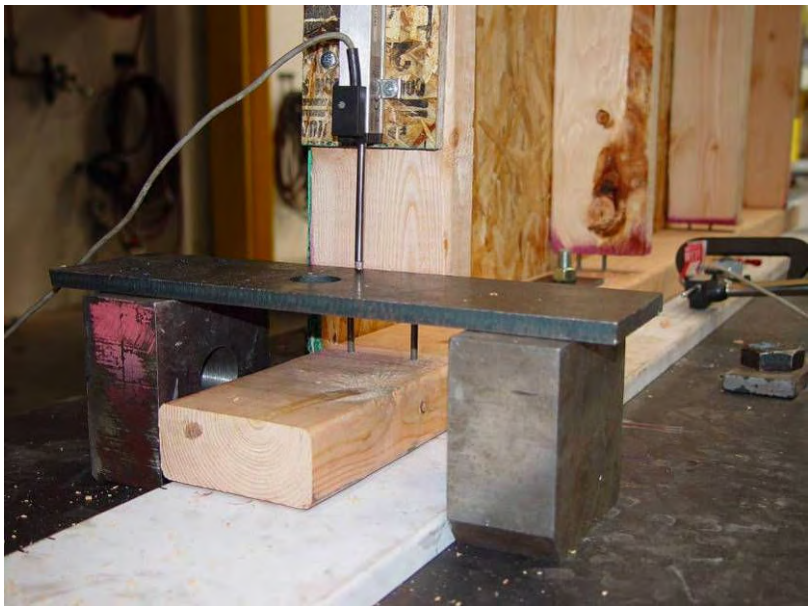

Figure 10 B -Typical Deformation after test.
<Single corner stud NO Holddown >

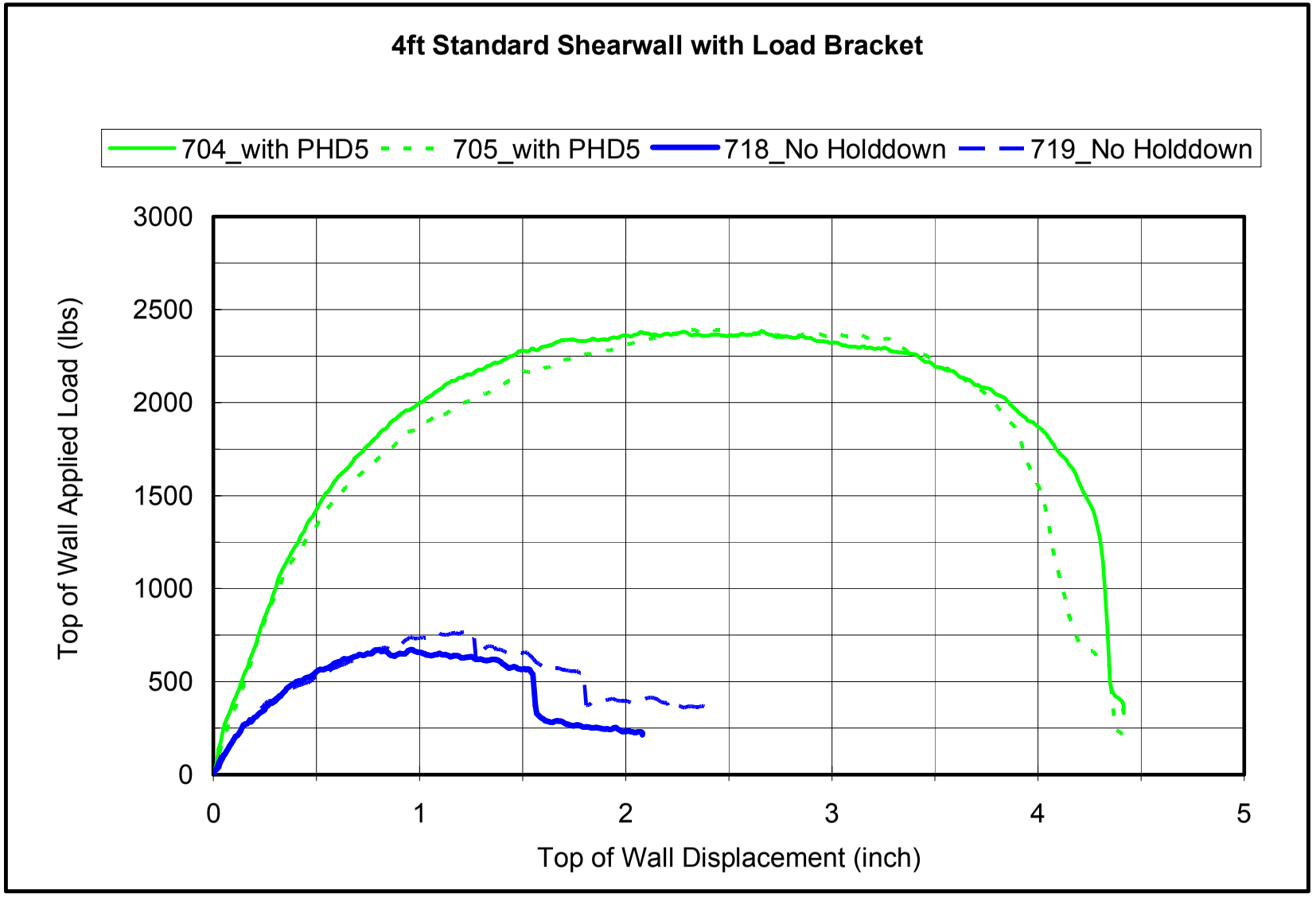

Figure 11 - Top of Wall Applied Load vs. Displacement.

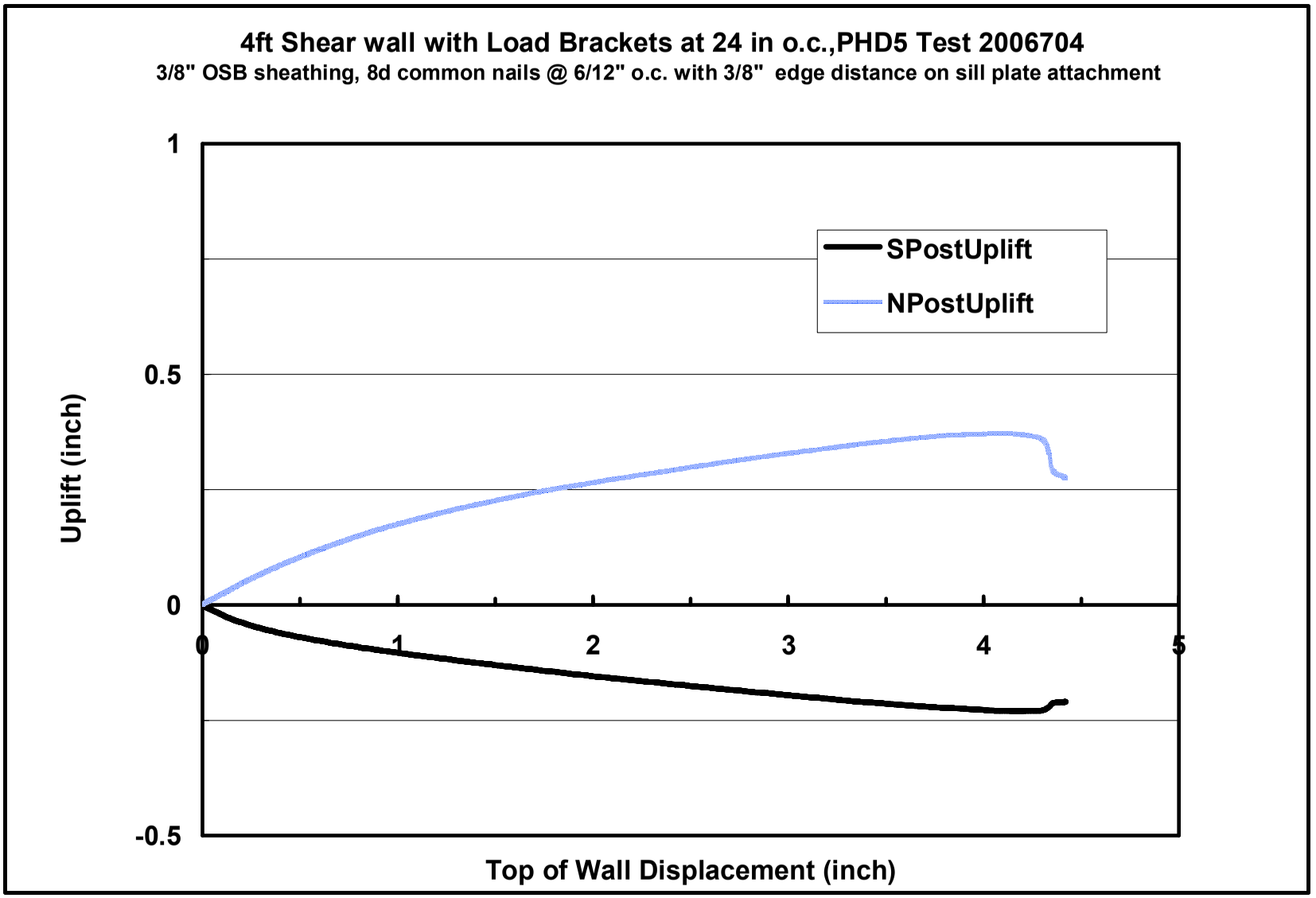

Figure 12A - Uplift vs. Wall Displacement. <Test 2006704>

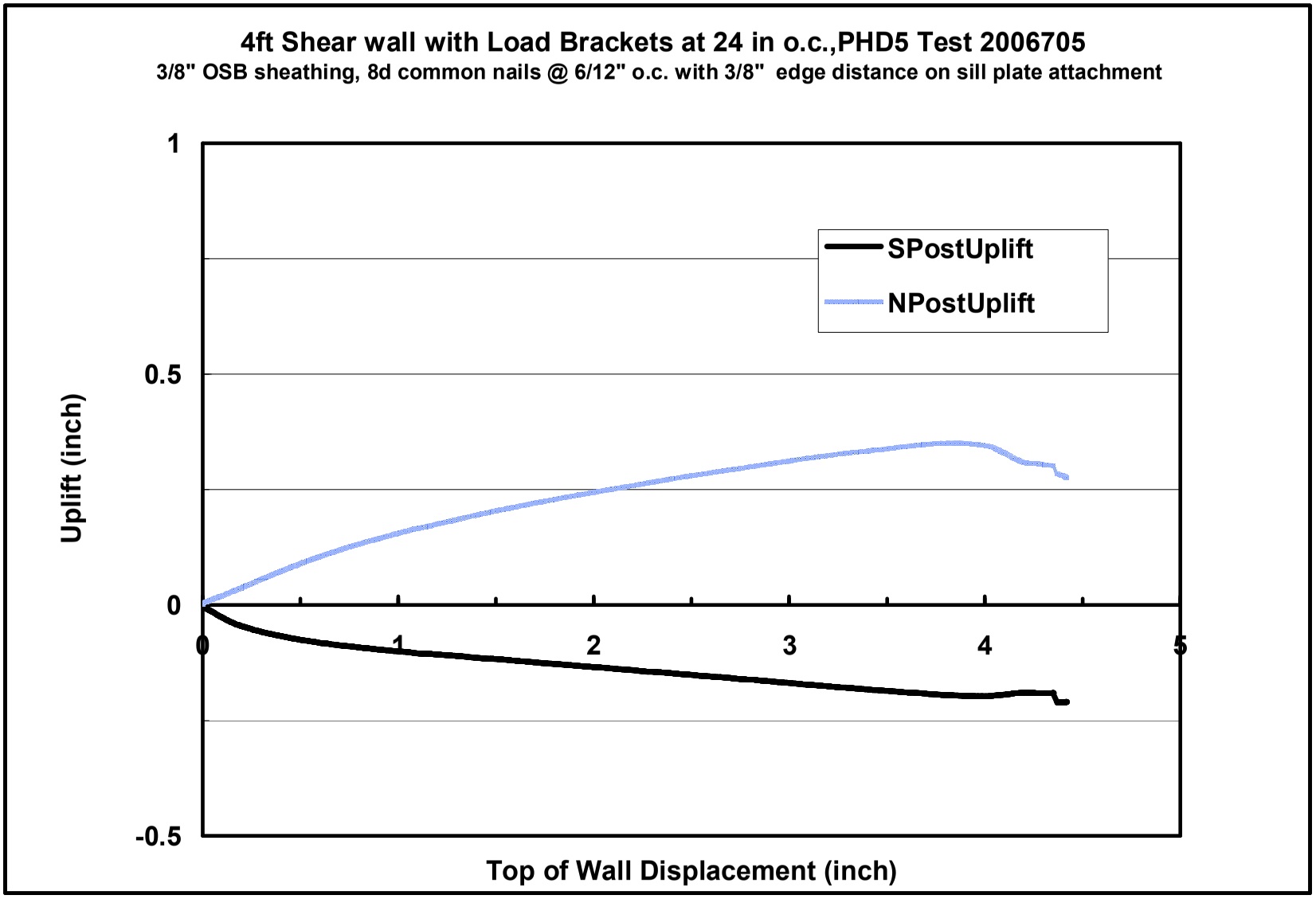

Figure 12B - Uplift vs. Wall Displacement. <Test 2006705>

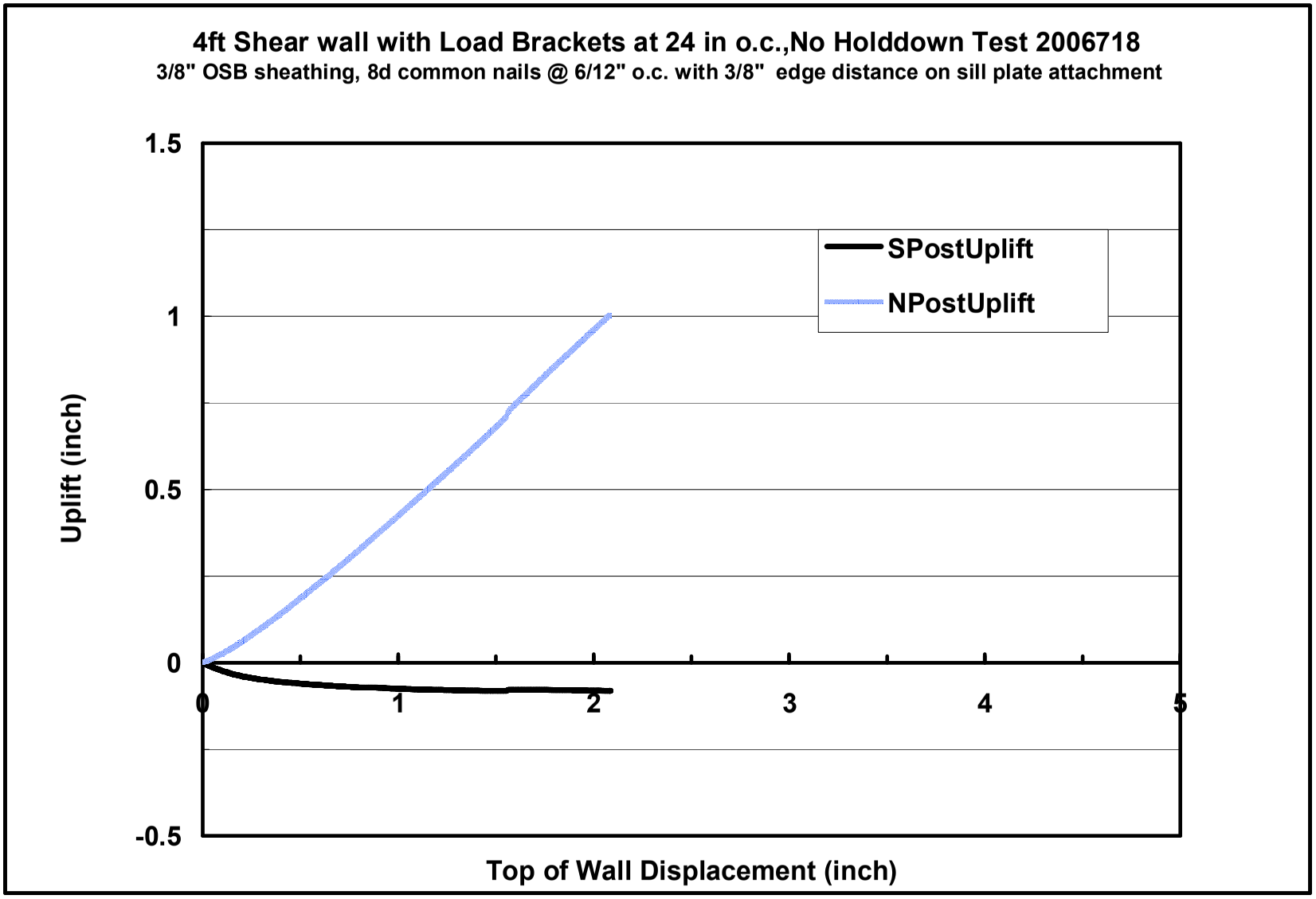

Figure 12C - Uplift vs. Wall Displacement. <Test 2006718>

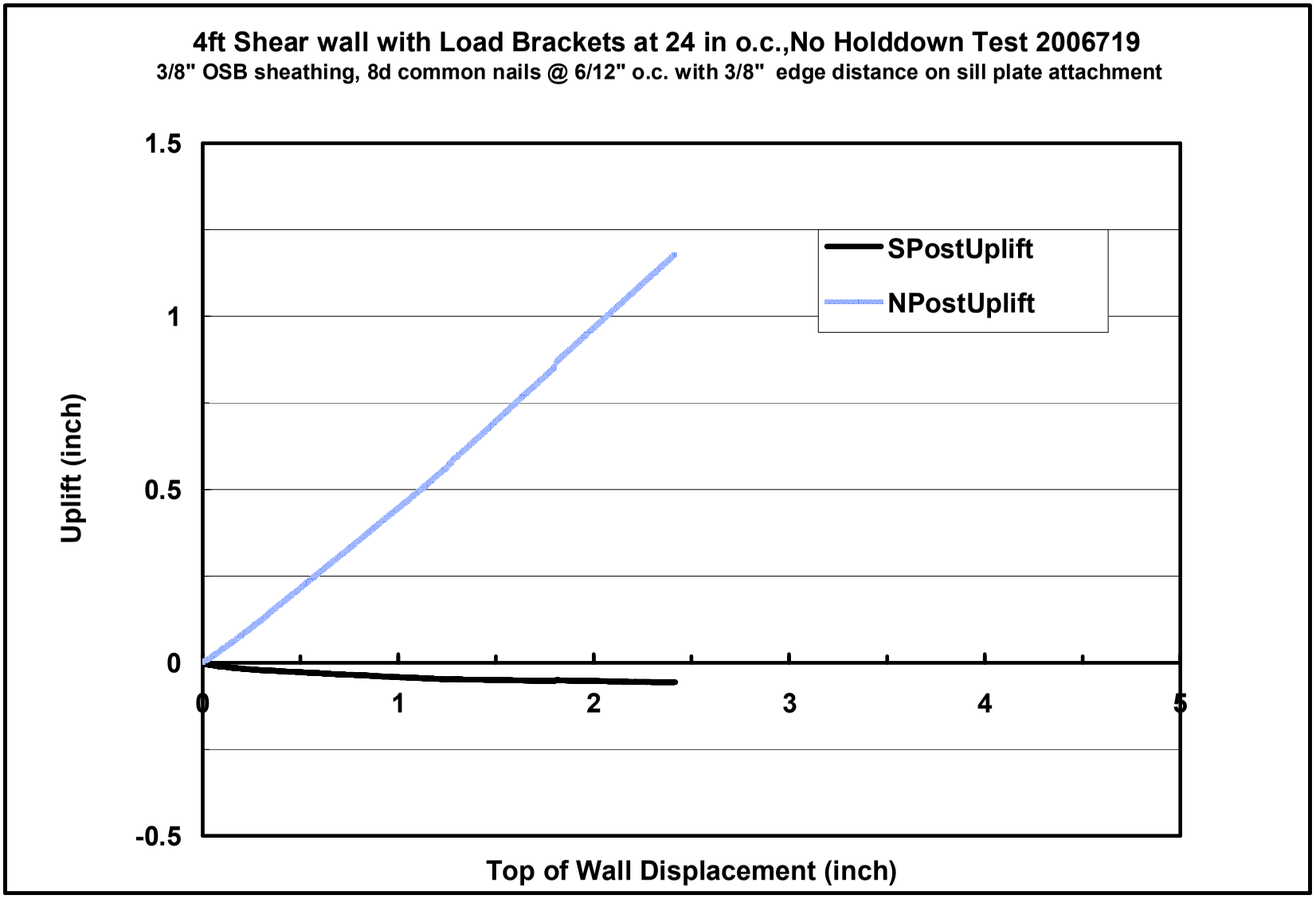

Figure 12D - Uplift vs. Wall Displacement. <Test 2006719>