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**Evaluation of Single-Sided Wall Assemblies Under Racking Load
Sheathed with 5/16" National Gypsum Wall Board**

Attached with:
"P 5100" Adhesive

Manufactured By:
Alpha Systems

Prepared For:

**Alpha Systems
5120 Beck Drive
Elhart, IN 46516**

Test Report: NTA990014B

Issued: March 25, 1999

Prepared By:

**John Kirkwood
NTA, Inc.**

Approved by:

**Kevin M. Finn, P. E.
Managing Engineer**



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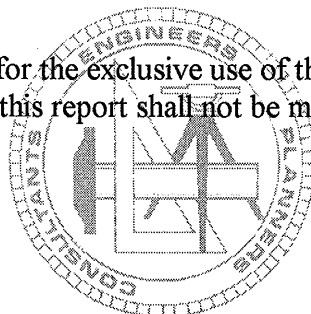


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1.0 INTRODUCTION

NTA, Inc. conducted racking load tests on wall assemblies at the NTA test facility in Nappanee, Indiana. The wall assemblies were tested in conformance to ASTM E 72-80; Standard Methods of Conducting Strength Tests of Panels for Building Construction, Section 14, Racking Load -- Evaluation of Sheathing Materials on a Standard Wood Frame.

The Purpose of this evaluation is to determine what the allowable design shear load is for wall assemblies constructed as described in this report, using 5/16" National Gypsum wall board attached with "P 5100" adhesive as manufactured by Alpha Systems when used in shear walls for manufactured housing.

2.0 TEST SPECIMEN DESCRIPTION

A. Materials

1. Studs: 2x3, Stud Grade SPF at 16" o.c.
2. Top Plate: Single 1x3, Un-Grade SPF.
3. Bottom Plate: Single 1x3, Un-Graded SPF.
4. Sheathing: 48" x 96", 5/16" National Gypsum wall board.
5. Adhesive: "P 5100", Alpha Systems.

B. Fastening

- Top plate fastened to studs with Two (2) - 7/16" x 1-3/4" x 15 Ga. staples per stud.
- Bottom plate fastened to studs with Two (2) - 7/16" x 1-3/4" x 15 Ga. staples per stud.
- Sheathing attached to 2x3 studs with Two (2) - 1/16" - 1/8" (average) beads of "P 5100" adhesive.
- Sheathing attached to center 2x3 stud at seam with Two (2) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing attached to 1x3 top plate with One (1) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing attached to 1x3 bottom plate with One (1) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing fastened to framing with 3/16" x 3/4" x 19 Ga. staples at 6" o.c. around perimeter of sheathing, and none in the field for the interior studs.

C. Construction Steps

- "P 5100" applied to the assembled wall with a caulking gun.
- The sheathing was placed on one side of the wall framing immediately after the adhesive was applied and then promptly fastened along all panel edges and framing members as described.

D. Cure Time

After construction, each of the wall assemblies were cured a minimum of seven (7) days before testing.

3.0 TEST SETUP AND PROCEDURE

The wall top plate was fastened to a steel load bar using four(4) - #10 wood screws into each stud bay adjacent to a panel edge for load application. The bottom plate was securely fastened to a structural tee with four (4) - #10 wood screws into each stud bay. The structural tee was then attached to the I-beam in order to secure the sample to the test rack.

Load was applied horizontally to the load bar attached to the top plate of the wall. Dial indicators were placed on the top plate (Indicator #1), and on the bottom plate (Indicator #2) opposite the loaded end of the wall. An additional dial indicator was placed on the load end of the wall at the base of the rack at the first stud location (Indicator #3). See Figure #2 for details.

Load was applied in 400 pound increments, up to 2400 pounds, at a rate of approximately 400 pounds per minute. When each load increment was reached, deflection readings were taken while maintaining the load. The load was then reduced back to zero at an approximate rate of 400 pounds per minute. Zero load readings were taken after each load increment up to 2400 pounds. Finally, load was applied at the same approximate rate until failure occurred.

To determine the horizontal deflection of the panel, subtract the deflection readings from Indicators #2 and #3 from Indicator #1. Indicator #3, which is attached to the stud, will measure any rotation of the panel. Indicator #2 measures any slippage of the panel in the test rack. Indicator #1 measures the total of displacement of Indicators #2 and #3, as well as the deformation of the panel.

4.0 TEST RESULTS

A total of three (3) test samples were tested. Each sample had sheathing attached to one side using "P 5100" adhesive. The ultimate loads achieved and the types of failures that occurred are described below.

<u>SAMPLE</u>	<u>ULTIMATE LOAD</u>	<u>FAILURE MODE</u>
#1	6102 pounds	Gypsum shear.
#2	6386 pounds	Gypsum shear.
#3	4888 pounds	Gypsum shear.

Average Ultimate Load = 5792 pounds

Allowable Design Load = (Average Ultimate Load) / [(Wall Length)*(Safety Factor)]

(5792 pounds) / [(8 feet)*(2.5)] = 289.6 PLF

5.0 CONCLUSION

Based on the results of the tests conducted, the maximum allowable design load for a 96" tall shear wall built of 2x3 Stud Grade SPF studs at 16" o/c, 1x3, un-graded SPF top plates with 1x3 un-graded SPF bottom plates with sheathing attached to one side as described in this report is:

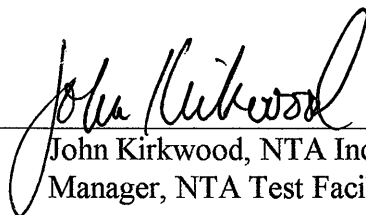
**For 5/16" National Gypsum Wall Board
Attached to One Side with
Alpha Systems
"P 5100" Adhesive = 289.6 PLF**

This design value is only applicable for Manufactured Housing built under the Manufactured Home Construction and Safety Standards and is not intended for use with other model building codes.


5.1 FOLLOW-UP TESTING

Follow-up testing will be in accordance with the NTA, Inc. follow-up testing procedures.

TEST REPORT BY:


John Kirkwood, NTA Inc.
Manager, NTA Test Facility

REPORT REVIEWED BY:


Kevin M. Finn, P.E.
Managing Engineer

NTA, Inc.

WALL RACKING TEST

Test Procedure: ASTM E 72-80

Adhesive Manufacturer: Alpha Systems
 Type of Adhesive: P 5100

Type of Gypsum: 5/16" National Gypsum
 Gypsum Lot Number: _____

FASTENERS: 3/16" x 3/4" x 19 Ga Senco Staples
 Field Spacing: None
 Top Plate Spacing: 6" o.c.
 Bottom Plate Spacing: 6" o.c.
 Vertical Edge Spacing: 6" o.c.
 Adhesive Bead Size: 1/16" - 1/8"
 Average Beads Per Stud _____

SAMPLE 1

Test Number: 990014B
 Test Date: 4/14/99
 Temperature: 68 F
 Relative Humidity: 35%

AVERAGE MOISTURE CONTENT

Plates: 11.00% 1 x 3 SPF Ungraded

Studs: 12.00% 2 x 3 SPF Stud Grade

LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)	
	READING	DEF.	READING	DEF.	READING	DEF.
0	0.145		0.224		0.288	
400	0.382	0.237	0.227	0.003	0.278	0.010
0	0.175	0.030	0.225	0.001	0.288	0.000
800	0.538	0.393	0.235	0.011	0.266	0.022
0	0.184	0.039	0.225	0.001	0.286	0.002
1200	0.661	0.516	0.238	0.014	0.263	0.025
0	0.186	0.041	0.226	0.002	0.285	0.003
1600	0.773	0.628	0.240	0.016	0.245	0.043
0	0.187	0.042	0.226	0.002	0.283	0.005
2000	0.871	0.726	0.241	0.017	0.231	0.057
0	0.190	0.045	0.227	0.003	0.281	0.007
2400	0.941	0.796	0.242	0.018	0.219	0.069
0	0.196	0.051	0.228	0.004	0.280	0.008

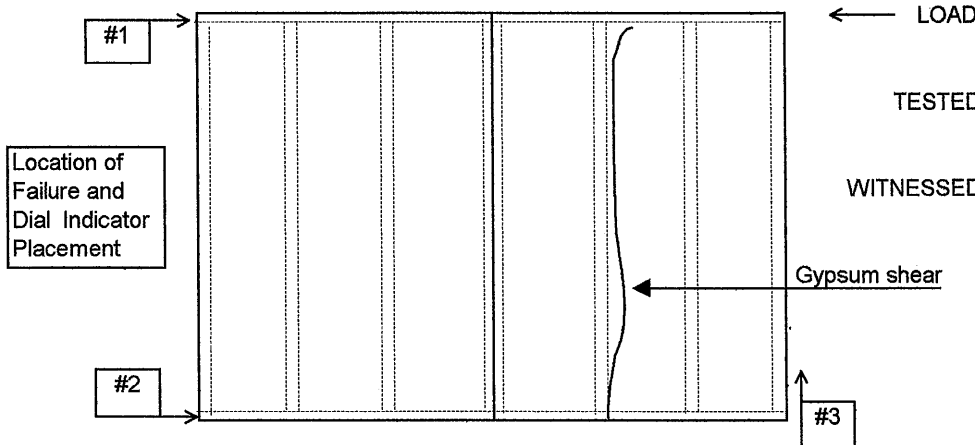
RESULTANT DEFLECTION (#1 - #2 - #3)
0.224
0.029
0.360
0.036
0.477
0.036
0.569
0.035
0.652
0.035
0.709
0.039

LOAD AT FAILURE: 6102 LBS.

DATE FABRICATED: 4/7/99

MODE OF FAILURE: Gypsum shear.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.



TESTED BY: Joe Merryman

WITNESSED BY: Shawn Weldy

NTA, Inc.

WALL RACKING TEST

Test Procedure: ASTM E 72-80

Adhesive Manufacturer: Alpha Systems
 Type of Adhesive: P 5100

Type of Gypsum: 5/16" National Gypsum
 Gypsum Lot Number: _____

FASTENERS: 3/16" x 3/4" x 19 Ga Senco Staples
 Field Spacing: None
 Top Plate Spacing: 6" o.c.
 Bottom Plate Spacing: 6" o.c.
 Vertical Edge Spacing: 6" o.c.
 Adhesive Bead Size: 1/16" - 1/8"
 Average Beads Per Stud _____

SAMPLE 2

Test Number: 990014B
 Test Date: 4/14/99
 Temperature: 68 F
 Relative Humidity: 35%

AVERAGE MOISTURE CONTENT

Plates: 11.00% 1 x 3 SPF Ungraded

Studs: 12.00% 2 x 3 SPF Stud Grade

LOAD (pounds)	INDICATOR #1 (In.)		INDICATOR #2 (In.)		INDICATOR #3 (In.)	
	READING	DEF.	READING	DEF.	READING	DEF.
0	0.146		0.249		0.179	
400	0.428	0.282	0.253	0.004	0.180	0.001
0	0.160	0.014	0.250	0.001	0.176	0.003
800	0.556	0.410	0.260	0.011	0.168	0.011
0	0.170	0.024	0.251	0.002	0.176	0.003
1200	0.747	0.601	0.266	0.017	0.145	0.034
0	0.162	0.016	0.251	0.002	0.177	0.002
1600	0.858	0.712	0.268	0.019	0.136	0.043
0	0.166	0.020	0.253	0.004	0.177	0.002
2000	0.934	0.788	0.270	0.021	0.131	0.048
0	0.171	0.025	0.254	0.005	0.178	0.001
2400	1.003	0.857	0.272	0.023	0.125	0.054
0	0.176	0.030	0.256	0.007	0.180	0.001

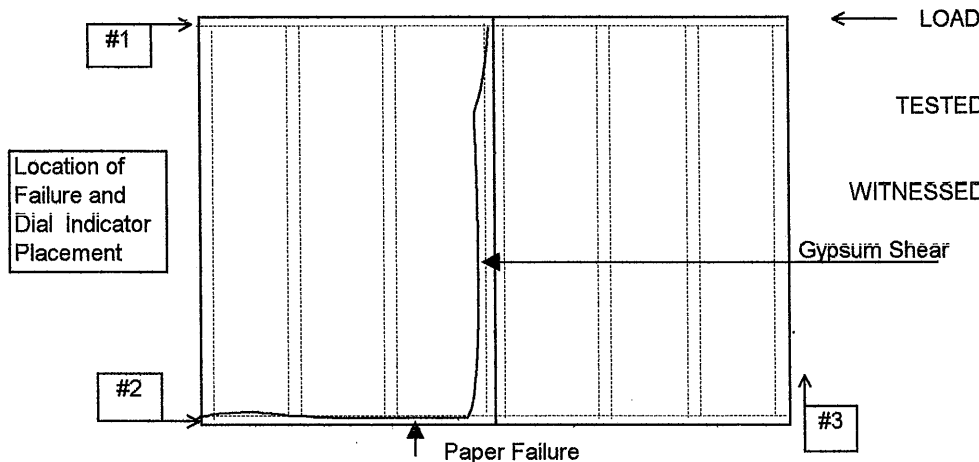
RESULTANT DEFLECTION (#1 - #2 - #3)
0.277
0.010
0.388
0.019
0.550
0.012
0.650
0.014
0.719
0.019
0.780
0.022

LOAD AT FAILURE: 6386 LBS.

DATE FABRICATED: 4/7/99

MODE OF FAILURE: Gypsum shear, paper failure.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.



TESTED BY: Joe Merryman

WITNESSED BY: Shawn Weldy

NTA, Inc.

WALL RACKING TEST

Test Procedure: ASTM E 72-80

Adhesive Manufacturer: Alpha Systems
 Type of Adhesive: P 5100

Type of Gypsum: 5/16" National Gypsum
 Gypsum Lot Number: _____

FASTENERS: 3/16" x 3/4" x 19 Ga Senco Staples
 Field Spacing: None
 Top Plate Spacing: 6" o.c.
 Bottom Plate Spacing: 6" o.c.
 Vertical Edge Spacing: 6" o.c.
 Adhesive Bead Size: 1/16" - 1/8"
 Average Beads Per Stud _____

SAMPLE 3

Test Number: 990014B
 Test Date: 4/14/99
 Temperature: 68 F
 Relative Humidity: 35%

AVERAGE MOISTURE CONTENT

Plates: 11.00% 1 x 3 SPF Ungraded

Studs: 12.00% 2 x 3 SPF Stud Grade

LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)	
	READING	DEF.	READING	DEF.	READING	DEF.
0	0.052		0.072		0.284	
400	0.107	0.055	0.074	0.002	0.269	0.015
0	0.156	0.104	0.072	0.000	0.281	0.003
800	0.232	0.180	0.081	0.009	0.256	0.028
0	0.160	0.108	0.072	0.000	0.277	0.007
1200	0.395	0.343	0.083	0.011	0.240	0.044
0	0.165	0.113	0.074	0.002	0.275	0.009
1600	0.564	0.512	0.081	0.009	0.216	0.068
0	0.178	0.126	0.072	0.000	0.272	0.012
2000	0.673	0.621	0.081	0.009	0.201	0.083
0	0.184	0.132	0.073	0.001	0.267	0.017
2400	0.761	0.709	0.081	0.009	0.186	0.098
0	0.187	0.135	0.072	0.000	0.264	0.020

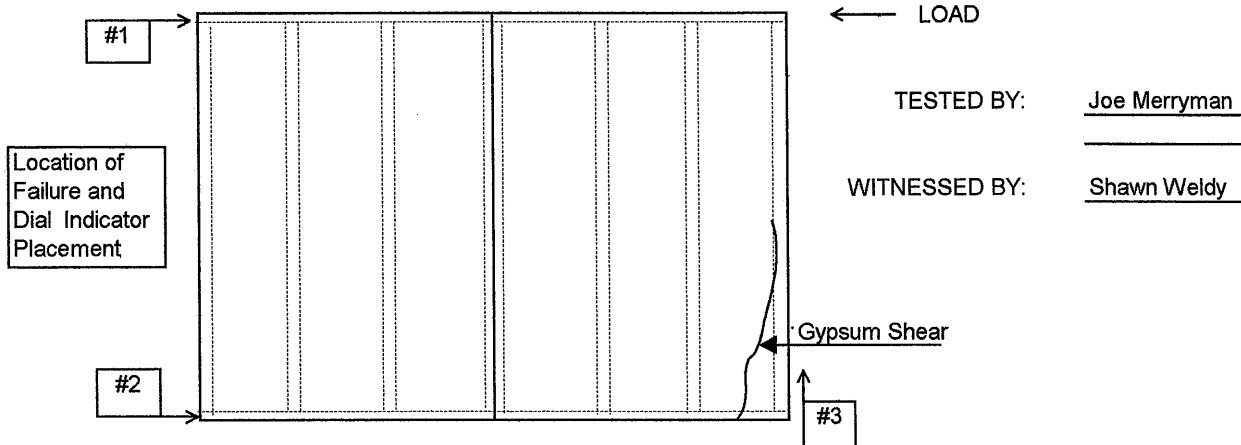
RESULTANT DEFLECTION (#1 - #2 - #3)
0.038
0.101
0.143
0.101
0.288
0.102
0.435
0.114
0.529
0.114
0.602
0.115

LOAD AT FAILURE: 4888 LBS.

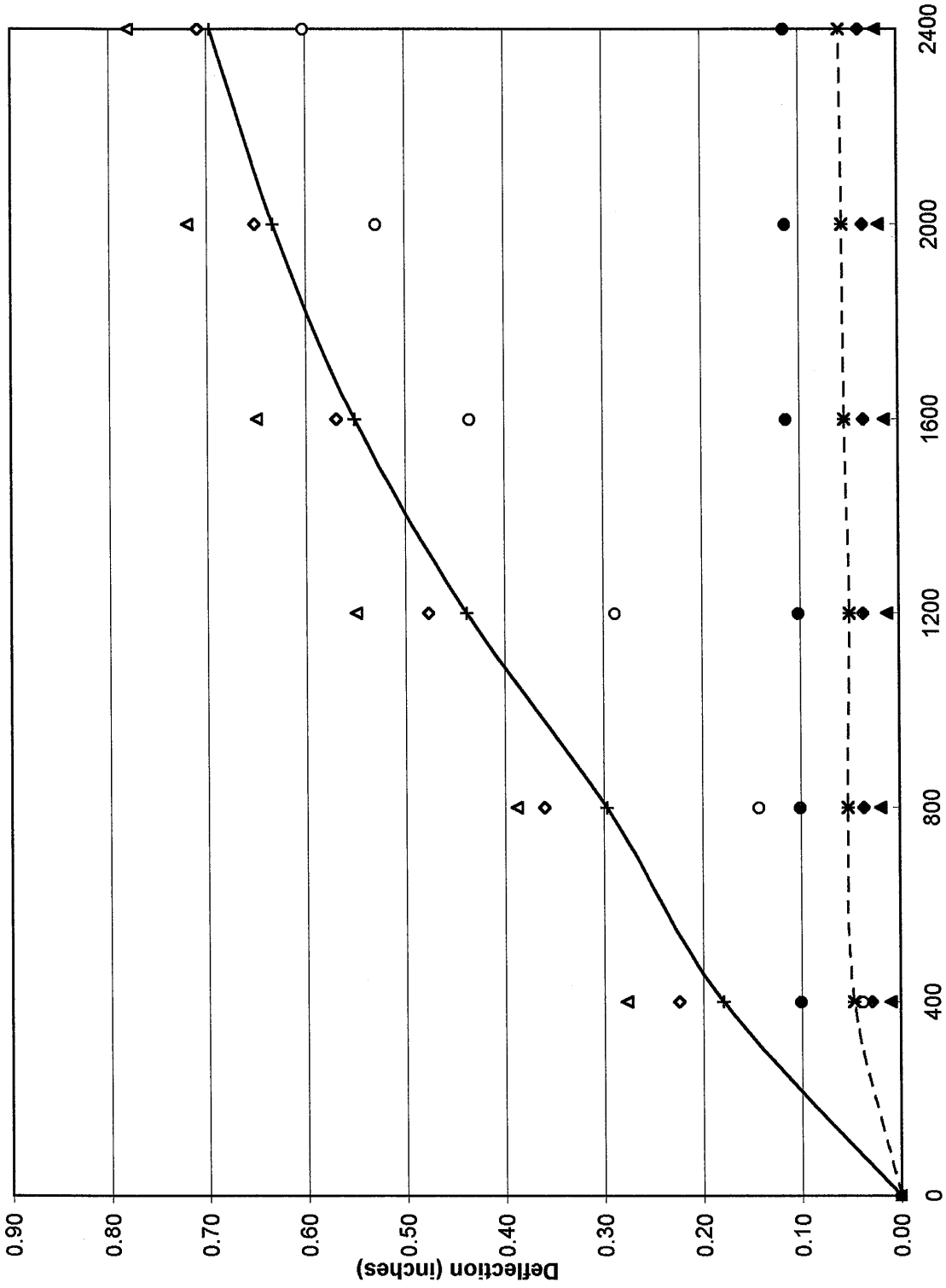
DATE FABRICATED: 4/7/99

MODE OF FAILURE: Gypsum shear lower right corner.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.

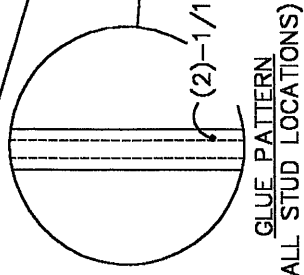


Load Deflection Curves



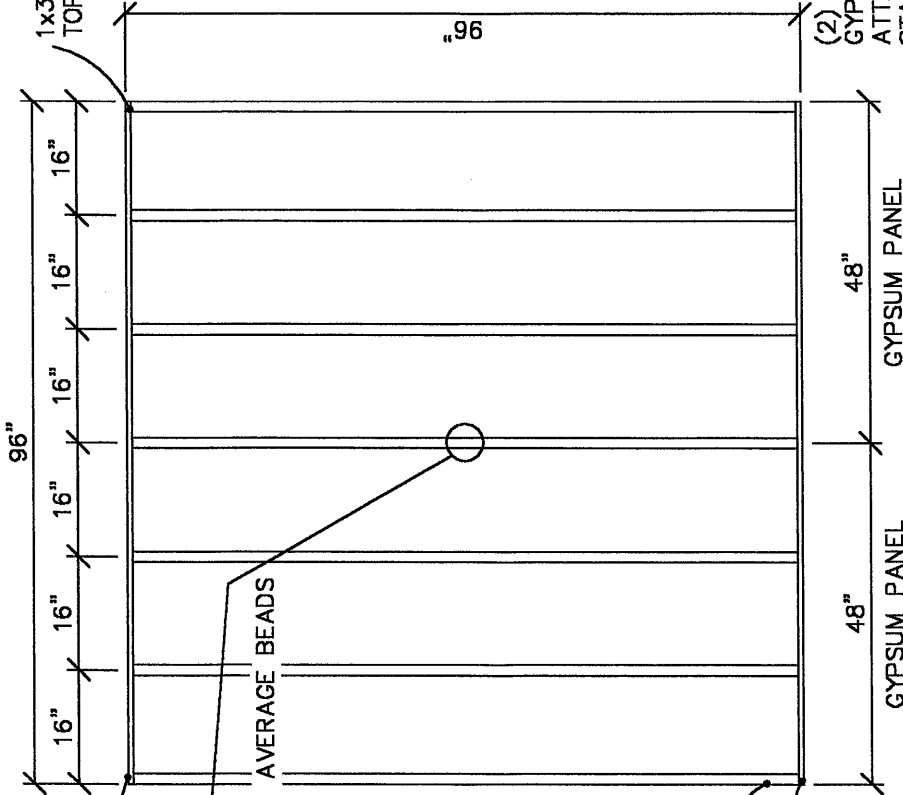
Load (lbs)
Alpha Systems
"P 5100" Adhesive
5/16" National Gypsum Wall Board
(Single-Sided)

(2) 7/16" x 1 3/4" x 15 ga. STAPLES AT EACH STUD END TOP PLATE.



1x3 UTILITY SPF TOP PLATE

3/16" x 3/4" x 19 ga. STAPLES - 6" O.C. AROUND GYPSUM PERIMETER AND NO FIELD FASTENERS



TYPICAL ADHESIVE PATTERN

2x3 STUD GRADE SPF STUDS

1x3 UTILITY SPF BOTTOM PLATE (2) 7/16" x 1 3/4" x 15 GA. STAPLES AT EACH END BOTTOM PLATE

(2) 48" x 96", 5/16" NATIONAL GYPSUM GYPSUM WALL BOARD ATTACHED TO ONE SIDE WITH STAPLES AND (2) 1/16"-1/8" AVG BEADS OF ADHESIVE ON ALL STUDS AND (1) BEAD ON THE TOP AND BOTTOM PLATES.

NOTE:
SEE THE ATTACHED TEST REPORT FOR EXACT CONSTRUCTION PROCEDURE.

ADHESIVE=P 5100 ADHESIVE AS MANUFACTURED BY ALPHA SYSTEMS
DESIGN SHEAR = 289.6 PLF

6.2 PAGE 10 OF 11

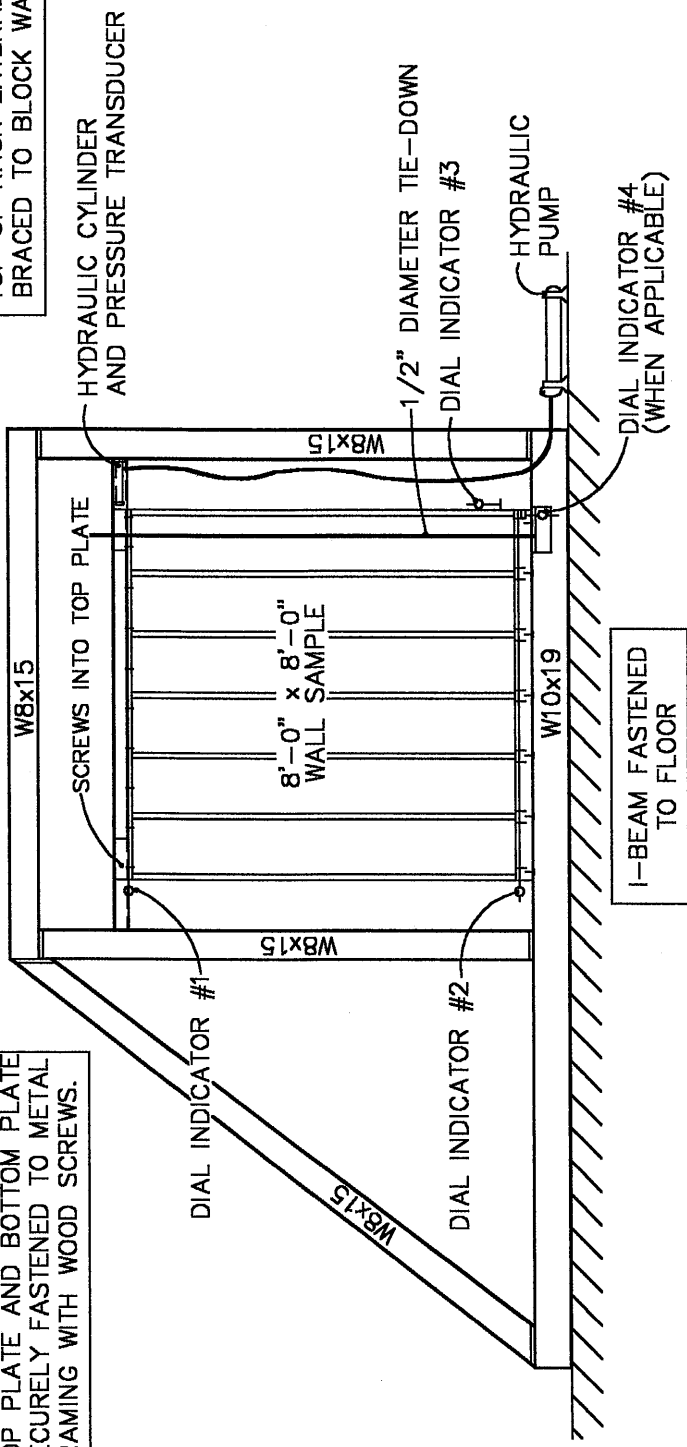
REVISIONS:	SCALE: N.T.S.	APPROVED BY:
	DATE: 04/14/99	PROJECT NO: NTA990014B
990014B	MODEL:	DRAWING NO: JCK
	TITLE: WALL PANEL	FIGURE #1

NTA, INC.

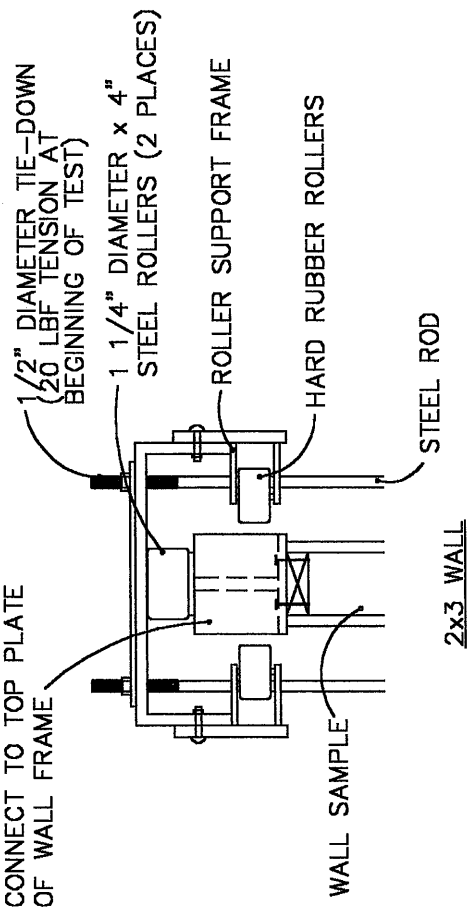
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TOP OF RACK LATERALLY BRACED TO BLOCK WALL

TOP PLATE AND BOTTOM PLATE SECURELY FASTENED TO METAL FRAMING WITH WOOD SCREWS.



METAL FRAMING USED TO CONNECT TO TOP PLATE OF WALL FRAME



2x3 WALL

2x4 WALL

REVISIONS:	SCALE: N.T.S.	APPROVED BY:
990014B	DATE:	N.T.S.
MODEL:	TITLE: RACKING TEST FIXTURE	PROJECT NO: NTA990014B
		DRAWING NO: FIGURE #2
		DRAWN BY: JCK

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