RAMTECH LABORATORIES, INC.

LAB. NO. 10480-95/1399

RACKING SHEAR TEST
ACCORDING TO ASTM E-72

ON

7/16-INCH THICK PLYCEM PANEL
ON METAL STUDS SPACED AT 16" O.C.
FASTENED WITH #8 X 1-1/4" ITW ROCK-ON SELF DRILLING
SCREWS SPACED 8-INCH CENTERS AT PERIMETER AND FIELD

PREPARED FOR

RICALIT, S. A.
EL RADIO, PARAISO
CARTAGO 7050, COSTA RICA

TESTED BY

RAMTECH LABORATORIES, INC.
14104 ORANGE AVENUE
PARAMOUNT, CA 90723

ISSUED; MAY 8, 1996

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TESTED BY: _____
STEVE BERGGREM, SENIOR TECHNICIAN

DATE: 5-8-96

REGISTERED PROFESSIONAL ENGINEER
RONALD I. OGAWA
No. 16286
Exp. 6-30-97
CIVIL
STATE OF CALIFORNIA
5/8/96

REPORT PREPARED BY: _____
RONALD I. OGAWA, P. E., PROJECT CONSULTANT

DATE: 5/8/96

REPORT REVIEWED BY: _____
DAVID R. MACEY, LABORATORY MANAGER

DATE: 5/10/96

REPORT APPROVED BY: _____
RONALD A. MACEY, P. E.,
LABORATORY DIRECTOR

DATE: MAY 10, 1996

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1.0 INTRODUCTION

At the request of Ricalit, S. A., Inc., Ramtech Laboratories performed racking shear tests on Ricalit's 7/16-inch thick Plycem Panels (Plycem). The tests were performed generally in accordance with the ASTM E-72-80 "Standard Method of Conducting Strength Tests of Panels for Building Construction".

2.0 OBJECTIVE

The objective of this test program was to determine the racking shear value of the 7/16-inch thick Plycem, when installed on 20 gauge metal 'C' studs spaced 16 inches on center and fastened with #8 x 1-1/4" ITW Rock-On™ self drilling screws. The screws were spaced at 8-inch centers around the perimeter and in the field. In all cases, the nails were spaced equally around the perimeter and at the intermediate studs except the first fastener from each corner of the Plycem panel was located a minimum of 2 inches from the corner.

3.0 MATERIAL DESCRIPTION

The 7/16-inch thick Plycem is a cellulose reinforced fiber-cement sheet. The exterior face of the board maybe either smooth or textured and the interior face is dimpled. For installation, the dimpled face was placed against the face of the stud. The dimension of the tested sheets measured 4 feet by 8 feet. Ronald A. Macey, P.E., of Ramtech Laboratories, selected the tested samples during the audit of August 28, 1995.

3.0 MATERIAL DESCRIPTION (continued)

Metal Stud:	Metal stud and plate conform to ICBO ES Report No. 4943. Studs conform to 358IC20 and plates conform to 400ST20. Report number stamped on studs.
Screw:	#8 x 1/2" self drilling screw: Top and bottom plates to studs,double top plate and double end studs.
Screws:	#8 x 1-1/4" S-12 Rock-On™ ITW self drilling screw. Part Number 2156500, Plycem Panel to studs and plates.

4.0 TEST WALL FABRICATION

Three wall test frame assemblies were constructed based on the standard frame configuration shown in Figure 6 of ASTM E-72-80. The 7/16-inch thick Plycem sheets were fastened to the steel studs with the #8 x 1-1/4" S-12 ITW fasteners spaced at 8 inches on center at all points. The first fastener from each corner was located a minimum of 2 inches from the corner. The head of the fastener was set flush with the panel surface.

5.0 TEST EQUIPMENT

1. Racking Shear Fixture
2. Enerpac 12 ton (Holl-O-Ram) hydraulic cylinder #108407.
3. Dial indicators: Serial numbers A401, A717 and A402. All reading to 0.001".
4. Hand pump (Owatonna Tool Co., ID#Y21-1, Model C).
5. 20,000 Dillion Load Cell (S/N C3943)
6. Digital Readout (S/N A4787470034)

6.0 TEST PROCEDURE

Load was applied to each of the test specimens with a 12 ton hydraulic jack through a steel plate mounted to the wood top plate. A digital readout and load cell was attached to the system to record the load. Dial indicators were provided to measure the displacement of the test specimen during the test. See sketch on data sheet for location. The dial indicator at the lower right corner (3) measured the amount of lift (rotation), the dial at the lower left corner (2) measured the slippage of the test sample, and the dial at the upper left corner (1) measured the total deformation of the wall (including the slip and lift). The net deflection of the test sample for each loading was the reading of the dial at the upper right (1) minus the readings of the other two dials (2 & 3). Hold-down rods were provided on one end of the panel to prevent overturning of the panel as racking load increased. Steel plates, with three 1" diameter steel rollers, were provided between the test wall assembly and hold-down plate so that the top of the test specimen could deflect horizontally with respect to the bottom without unnecessary interference from the hold-down. To minimize any effect on the results of the test from the tension of the hold-downs, the hold-down rods were tightened to a 5 ft-lb torque at the beginning of each test. The test panel was screwed to a 4 x 4 wood plate, which was bolted to the racking shear test frame, in such a manner to allow for panel ends to rotate without bearing on it's edge during the test.

The test loads were applied manually through the hydraulic jack, with the Enerpac hand pump, in 400 lb.. increments and released to zero after 800 lbs., 1600 lbs., and 2400 lbs. respectively. The rate of loading was from 10 to 15 seconds for each 400 lb. increment of loading. The rate of loading for each load increment was approximately the same, however, not completely uniform due to the method of loading. Deflection reading were recorded up to a minimum load of 4800 pounds where possible.

7.0 RESULTS

Results of the tests are summarized in Table I. The deformation vs. the load application is shown graphically in Figure I. Raw test data for the racking shear tests are included in Appendix A.

Observation: Plycem panels performs very well during the initial stages of loading. With the fastener spaced a minimum of 2 inches from the corner, corner crack occured at a applied load of approximately 3000 pounds. In all cases, the failure was due to fastener head pulling through the Plycem surface. The failure was located along the center stud.

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TABLE I

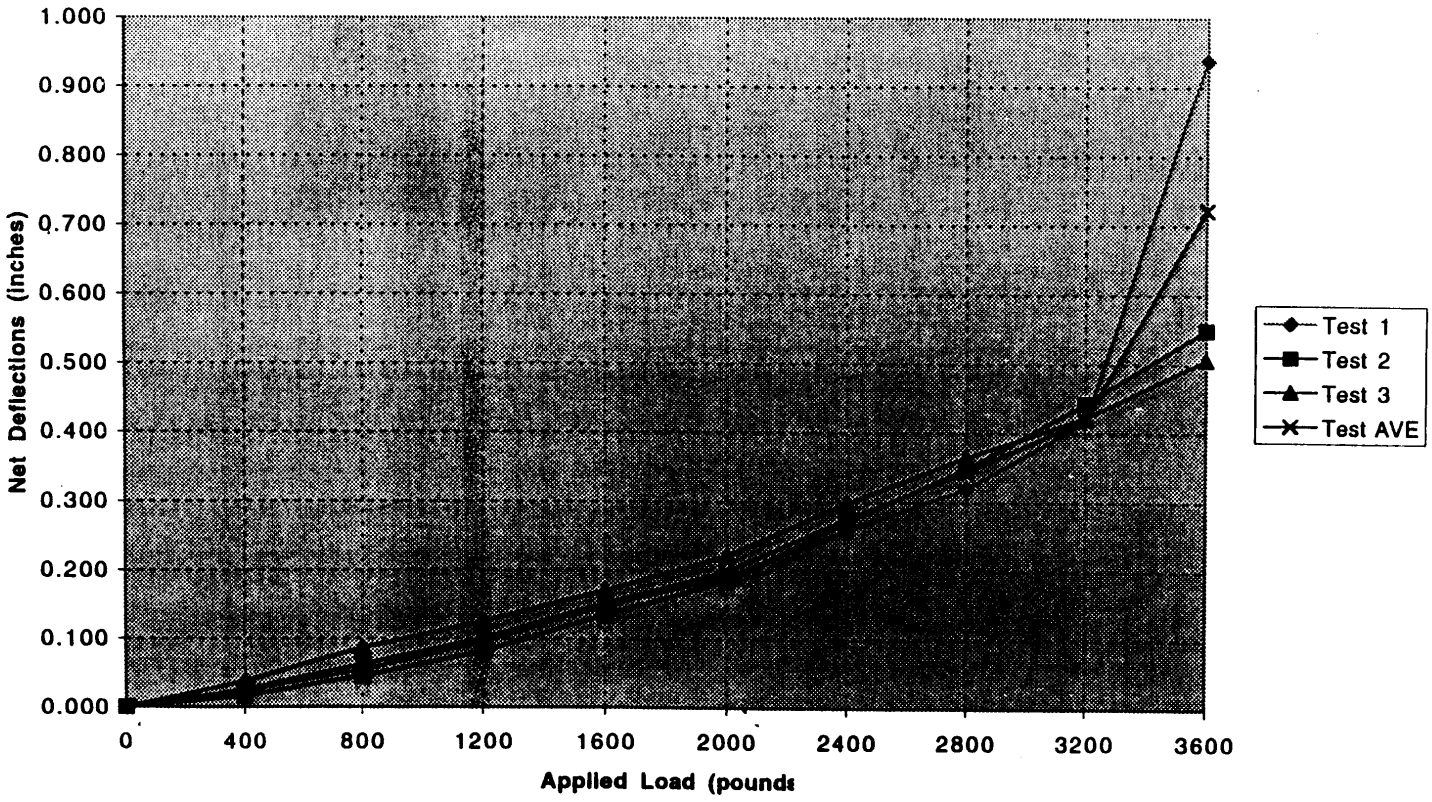
DRY RACKING TEST RESULTS. RACKING LOADS VERSUS DEFORMATIONS AND SETS AND FAILURE LOADS FOR 7/16" THICK PLYCEM PANELS W/#8 X 1-1/4" S-12 ROCK ON SELF DRILLING FASTENERS AT 8" O.C.

APPLIED RACKING	RACKING DEFORMATION (IN) PANEL NUMBER				SET AFTER LOAD REMOVAL (IN) PANEL NUMBER			
LOAD (LBS)	Test 1	Test 2	Test 3	AVE	Test 1	Test 2	Test 3	AVE
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
400	0.022	0.016	0.038	0.025				
800	0.055	0.045	0.086	0.062	0.053	0.044	0.023	0.040
1200	0.095	0.081	0.124	0.100				
1600	0.148	0.134	0.170	0.151	0.054	0.052	0.057	0.054
2000	0.191	0.184	0.221	0.199				
2400	0.258	0.271	0.298	0.276	0.114	0.125	0.122	0.079
2800	0.320	0.348	0.365	0.344				
3200	0.416	0.443	0.422	0.419				
3600	0.938	0.549	0.506	0.722				
4000								
4400								
4800								

TEST NO PNL NO	RACKING LOAD TO CAUSE PANEL FAILURE (LBS)	FAILURE TYPE
1	3800	Typical failure: Screw head pulling through panel surface. The predominate failures were along the center stud where the panel butted together. Also, the corners, where the corners were loaded in tension, cracked.
2	3900	
3	4060	
AVERAGE	3920	

AVERAGE LOAD AT 1/8" DEFLECTION = 1398 POUNDS = 175 POUNDS PER FEET
AVERAGE LOAD AT 1/4" DEFLECTION = 2267 POUNDS = 283 POUNDS PER FEET
AVERAGE ULTIMATE LOAD = 3920 POUNDS = 490 POUNDS PER FE

Load v. Deflection (7/16" Plycem Panel on 20 gauge me Studs Spaced at 16" Centers)



8.0 CONCLUSION

The results of this test program indicate that the ultimate average racking shear load for the 7/16-inch thick Plycem with #8 x 1-1/4" S-12 Rock On™ fasteners at 8-inch centers is 3920 pounds and the ultimate racking shear value per linear foot is 490 pounds. The average load at 1/8-inch deflection is 1398 pounds (175 pounds per linear foot). The Plycem Panel is fastened to minimum 20 gauge metal studs spaced at 16 inches on center with #8 x 1-1/4" ITW S-12 Rock On fasteners spaced at 8 inch at all edges and intermediate framing. Fastener are to be spaced a minimum of 2 inches from the corner of the panel.

When used for structural considerations, the allowable shear value should be determined based on the applicable safety factor and acceptance criteria of each Code Agency having jurisdiction.

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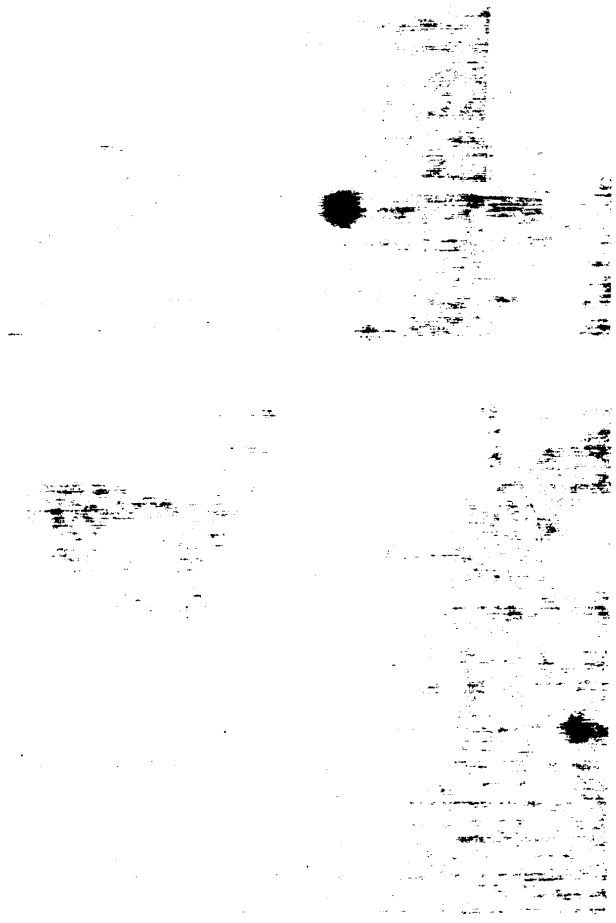
APPENDIX A

- FRAME CONSTRUCTION AND INSTALLATION OF PLYCEM PANEL-FIGURE I I
- TEST DATA SHEETS FOR TEST 1,2 AND 3 FOR 8-INCH NAIL SPACING ASSEMBLIES



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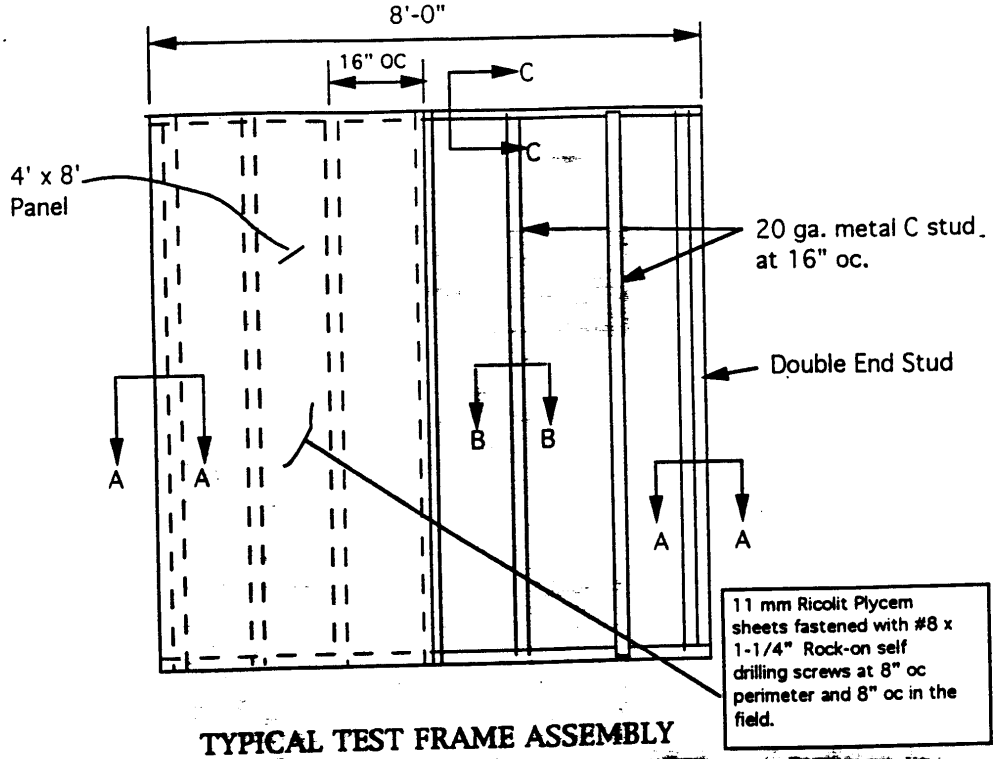
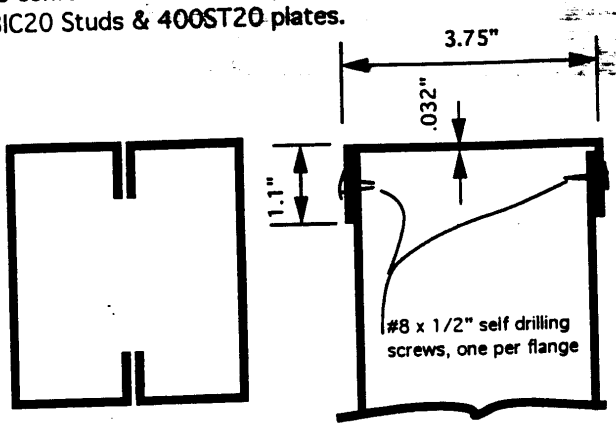


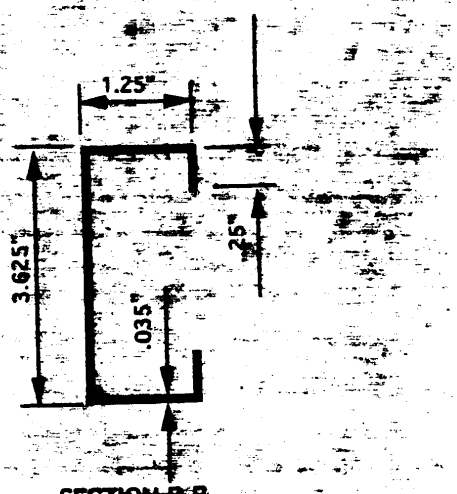
TYPICAL TEST FRAME ASSEMBLY

Studs conform to ICBO ES Report 4943
(358IC20 Studs & 400ST20 plates.



SECTION A-A

SECTION C-C



SECTION B-B

Note: thickness w/o galvanizing

APPENDIX A

RICALIT, S. A.
LAB. NO. 10480-95/1399

DATA SHEET
RACKING SHEAR TEST
(Test # 1)

LAB NO.: 10480-95

DATE: 4/1/96
CLIENT: RICALIT
TEST NO: 1
FRAMING: 2x4 @ 16" o.c. 20 GA METAL STUD

PANEL: 7/16" Plycem; sampled 8/28/95 by R.A.M @ Costa Rica Plant
TEST METHOD: ASTM E-72
FASTENER: #8 x 1-1/4" ITW Buildex Rock-On™, part # 2156500. Fastener spaced at 8 inches on center. Fastener spaced a minimum of 2 inches from Plycem corner.

LOADING	LOAD PRESSURE (PSI)	ACTUAL LOAD (LBS)	DEFLECTION READINGS DIAL 1	DIAL 2	DIAL 3	NET DEFL
0		0	0.000	0.000	0.000	0.000
400		400	0.031	0.000	0.009	0.022
800		800	0.080	0.002	0.025	0.053
0		0	0.021	0.002	0.005	0.014
800		800	0.082	0.002	0.025	0.055
1200		1200	0.140	0.002	0.043	0.095
1600		1600	0.206	0.002	0.065	0.139
0		0	0.072	0.002	0.016	0.054
1600		1600	0.217	0.002	0.067	0.148
2000		2000	0.282	0.002	0.089	0.191
2400		2400	0.356	0.002	0.110	0.244
0		0	0.148	0.002	0.032	0.114
2400		2400	0.372	0.002	0.112	0.258
2800		2800	0.483	0.002	0.161	0.320
3200		3200	0.625	0.002	0.207	0.416
3600		3600	1.360	0.002	0.420	0.938
4000		4000				
4400		4400				
4800		4800				

Ult. Load = 3800 (lbs)

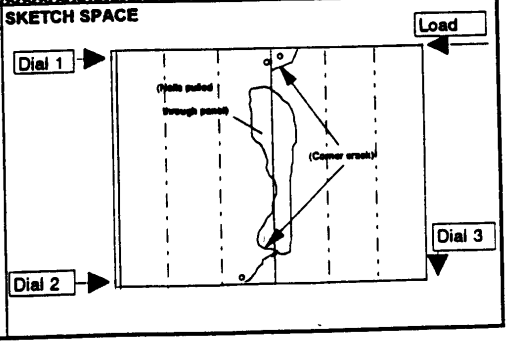
COMMENTS:

Vertical Holdowns rods torqued to 5 ft lbs.

Fastener rotation about steel stud flange leading to fastener head pull through Plycem surface. Corner also cracked.

1/8" DEFLECTION LOAD = 1426 (lbs)
1/4" DEFLECTION LOAD = 2352 (lbs)

SKETCH SPACE



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DATA SHEET
RACKING SHEAR TEST
(Test # 2)

LAB NO.: 10480-95

DATE: 4/2/96
CLIENT: RICALIT
TEST NO: 2
FRAMING: 2x4 @ 16" o.c. 20 GA METAL STUD

PANEL: 7/16" Plycem; sampled 8/28/95 by R.A.M @ Costa Rica Plant
TEST METHOD: ASTM E-72
FASTENER: #8 x 1-1/4" ITW Buildex Rock-On™, part # 2156500. Fastener spaced at 8 inches on center. Fastener spaced a minimum of 2 inches from Plycem corner.

LOADING	LOAD PRESSURE (PSI)	ACTUAL LOAD (LBS)	DEFLECTION READINGS DIAL 1	DIAL 2	DIAL 3	NET DEFL
0		0	0.000	0.000	0.000	0.000
400		400	0.025	0.000	0.009	0.016
800		800	0.066	0.000	0.022	0.044
0		0	0.018	0.002	0.004	0.012
800		800	0.068	0.000	0.023	0.045
1200		1200	0.121	0.000	0.040	0.081
1600		1600	0.189	0.000	0.061	0.128
0		0	0.070	0.000	0.018	0.052
1600		1600	0.196	0.000	0.062	0.134
2000		2000	0.273	0.000	0.089	0.184
2400		2400	0.381	0.000	0.126	0.255
0		0	0.166	0.000	0.041	0.125
2400		2400	0.401	0.000	0.130	0.271
2800		2800	0.519	0.000	0.171	0.348
3200		3200	0.658	0.000	0.215	0.443
3600		3600	0.800	0.000	0.251	0.549
4000		4000				
4400		4400				
4800		4800				

Ult. Load = 3900 (lbs)

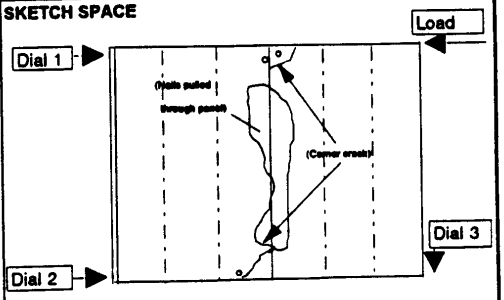
COMMENTS:

Vertical Holdowns rods torqued to 5 ft lbs.

Fastener rotation about steel stud flange leading to fastener head pull through Plycem surface. Corner also cracked.

1/8" DEFLECTION LOAD = 1532 (lbs)
1/4" DEFLECTION LOAD = 2303 (lbs)

SKETCH SPACE



Revised 6/26/95

DATA SHEET
RACKING SHEAR TEST
(Test # 3)

LAB NO.: 10480-95

DATE: 4/1/96
CLIENT: RICALIT
TEST NO: 3
FRAMING: 2x4 @ 16" o.c. 20 GA METAL STUD

PANEL: 7/16" Plycem; sampled 8/28/95 by R.A.M @ Costa Rica Plant
TEST METHOD: ASTM E-72
FASTENER: #8 x 1-1/4" ITW Buildex Rock-On™, part # 2156500. Fastener spaced at 8 inches on center. Fastener spaced a minimum of 2 inches from Plycem corner.

LOADING	LOAD PRESSURE (PSI)	ACTUAL LOAD (LBS)	DEFLECTION READINGS DIAL 1	DIAL 2	DIAL 3	NET DEFL
0		0	0.000	0.000	0.000	0.000
400		400	0.048	0.000	0.010	0.038
800		800	0.110	0.000	0.028	0.082
0		0	0.028	0.000	0.005	0.023
800		800	0.114	0.000	0.028	0.086
1200		1200	0.171	0.000	0.047	0.124
1600		1600	0.231	0.000	0.066	0.165
0		0	0.069	0.000	0.012	0.057
1600		1600	0.238	0.000	0.068	0.170
2000		2000	0.310	0.000	0.089	0.221
2400		2400	0.401	0.000	0.115	0.286
0		0	0.151	0.000	0.029	0.122
2400		2400	0.416	0.000	0.118	0.298
2800		2800	0.527	0.000	0.162	0.365
3200		3200	0.612	0.000	0.190	0.422
3600		3600	0.730	0.000	0.224	0.506
4000		4000	1.038	0.000	0.299	0.739
4400		4400				
4800		4800				

Ult. Load = 4060 (lbs)

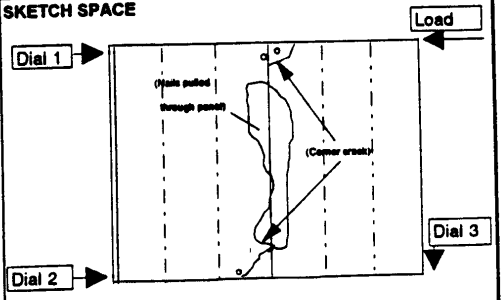
COMMENTS:

Vertical Holdowns rods torqued to 5 ft lbs.

Fastener rotation about steel stud flange leading to fastener head pull through Plycem surface. Corner also cracked.

1/8" DEFLECTION LOAD = 1209 (lbs)
1/4" DEFLECTION LOAD = 2151 (lbs)

SKETCH SPACE



Revised 6/28/95