ALPHA SYSTEMS

Full Scale Cathedral Ceiling
Diaphragm Test 15'-6" x 48'-0"
Using ALPHASEAL 5200

7/7/98

This test report contains twenty-seven (27) pages, including the cover sheet. Any additions to, alterations of, or unauthorized use of excerpts from this report are expressly forbidden.

98-1032
1. TITLE

Full scale (simple span) cathedral ceiling diaphragm test.

2. OBJECTIVE

The objective of this test was to determine the horizontal diaphragm strength of a simple span cathedral ceiling diaphragm constructed per the enclosed details using Alpha Systems ALPHASEAL 5200 two-part polyurethane adhesive as a fastener of the ceiling board to roof trusses.

3. TESTED FOR

Alpha Systems
5120 Beck Drive
Elkhart, IN 46516

4. TESTING ORGANIZATION

Progressive Engineering, Inc.
58640 State Road 15
Goshen, IN 46528

5. TESTING PERSONNEL

Test Engineer  -  Evor F. Johns, P.E.
Director of Testing - Greg A. Weeden
Technician  -  Chad Brower
Technician  -  Shawn Kaufman
Technician  -  Jason Holdeman

6. TEST CRITERIA

The tests were conducted in accordance with Progressive Engineering, Inc. Standard No. 89-1 Simple Span Ceiling or Roof Diaphragm Shear Resistance Test Procedure for Manufactured Homes.
7. **TEST SPECIMEN MATERIALS**

Ceiling Material: 48" x 186" x 5/16" SHEETROCK® MH Gypsum ceiling panels supplied by U.S. Gypsum Co.

Roof Trusses: Third Party certified trusses rated for:
- Roof Live Load of 20 PSF
- Roof Dead Load of 10 PSF
- Truss Spacing 24" o.c.

Adhesive: Alpha Systems ALPHASEAL 5200 two-part polyurethane adhesive.

Adhesive Bead Size: See the attached drawing B4 for minimums, maximums and averages of bead size on the trusses and gypsum.

Edge Rails: 1 x 3 SPF (ungraded) lumber with 14" long 1 x 3 SPF splice blocks.

Shear Wall Top Plate: 1 x 4 SPF (ungraded) lumber.

Exterior Wall Top Plate: 1 x 4 SPF (ungraded) lumber with 14" long 1 x 4 SPF splice blocks.

Exterior Wall Plate Wedge: 1½" wide wedge fastened to 1 x 4 with 1" c. x 1" lg. x 16 Ga. staples at 16" o.c.

Ridge Rail: 1 x 3 SPF (ungraded) lumber.

Staples: Edge rail to truss -
- 7/16" c. x 2½" lg. x 15 Ga.
- Edge rail splice blocks -
  - 1" c. x 1½" lg. x 16 Ga.
- Ridge rail to truss -
  - 7/16" c. x 2" lg. x 16 Ga.
- Top plate splice blocks -
  - 1" c. x 1½" lg. x 16 Ga.
- Gypsum to side wall top plates -
  - 1" c. x 1½" lg. x 16 Ga.

Screws: End truss -
- #8 x 4" washer head wood screws

Adhesive: PVA adhesive for splice blocks, Sun Adhesives -
- Product No. 59-10.

Nails: Truss ends to side wall top plates -
- .131" Dia. x 3½" lg. nails
8. TEST SPECIMEN CONSTRUCTION

Three (3) test samples were constructed, 15'-6" x 48'-0" by Progressive Engineering, Inc. and Alpha Systems. The application of adhesive was applied by David Holdread of Alpha Systems according to the process described in it's use and application procedure.

A. Twelve (12) gypsum panels were laid out on a wood fixture built to match the cathedral trusses. The gypsum panels were scored at their center line on the back side before being laid on the fixture.

B. 3/4" wide masking tape was applied to all gypsum seams.

C. Roof trusses were placed on the gypsum at 24" o.c. A maximum gap of 1/2" between truss bottom chord and the gypsum was noted due to trusses and floor flatness.

D. The 1 x 3 edge rails were spliced with 1 x 3 x 14" splice blocks to create a 48 foot long rail. The splice blocks were attached with FVA adhesive and six (6) 1" c. x 1½" lg. x 16 Ga. staples on each side of joint.

E. Previously constructed edge rails were stapled to the truss heels with two (2) 7/16" c. x 2½" lg. x 15 Ga. staples at each truss heel.

F. The ridge rail was then stapled to the trusses with two (2) 7/16" c. x 2" lg. x 16 Ga. staples per truss.

G. The entire framework was squared-up with the gypsum.

H. The adhesive was then applied to the assembly. The ALPHASEAL 5200 is a two-part polyurethane adhesive manufactured by Alpha Systems. It is composed of A-ISO and B-Resin components listed by Progressive Engineering, Inc. The components were preheated and pumped at a ratio of 1 to 1 in accordance with the manufacturer's instructions. The adhesive was applied to both sides of the bottom chord of the trusses at all gypsum seams and to one side of the bottom chord of field trusses. The intersection of the ceiling board and edge rail and the end trusses were not foamed. The foam was held 3" short of the edge rail on both ends of all trusses. The end trusses were not foamed.

I. The 1 x 4 side wall top plates were spliced with 1 x 4 x 14" splice blocks to create 48 foot long plates. The splice blocks were attached with FVA adhesive and six (6) 1" c. x 1½" lg. x 16 Ga. staples on each side of joint. A 1½" wide wedge was stapled at 16" o.c. to the top plates to match the ceiling angle.

J. Exactly two (2) minutes after applying the final adhesive bead, the sample was lifted up and the shearwall and exterior wall top plates were placed under the ceiling.
K. The two (2) end trusses were screwed 3" o.c. into the top plates with #8 x 4" lg. washer head wood screws.

L. One (1) 3½" lg. x .131" Dia. nail was toe-nailed in the heel of each truss end. See drawings for details.

9. TEST INFORMATION

The test sample was supported by appliance rollers at 4'-0" o.c. around perimeter of sample on a concrete floor. A bearing support was placed at both ends of the test sample. Three (3) loading cylinders were located on the opposite side of the test sample. The load was applied from the cylinders through steel I-beams, to nine (9) 18" bearing blocks to uniformly apply the load to the ceiling. Five (5) dial indicators were placed along the bearing side of the test sample to measure deflections. The splice block adhesive and ALPHASEAL 5200 was allowed to cure for a minimum of 24 hours before any loads were applied. See attached drawings for details.

10. TEST EQUIPMENT

A. Three (3) Enerpac Model P-39 hydraulic hand pumps.
B. Three (3) Enerpac Model RC-1010 hydraulic cylinders.
C. Five dial indicators.
   2" movement - .001 increments.
D. Three (3) Omega digital meters.
E. Three (3) Omega pressure transducers.
F. Three (3) 9 ft. I-beams.
G. Six (6) 6 ft. I-beams.
H. Five (5) rigid bearings bolted to floor.

11. PROCEDURE

A. The loads were generated using three (3) 1½" diameter x 10" stroke hydraulic cylinders, one at each load point. The applied forces were measured with three (3) digital meters and pressure transducers. A permanent record of the applied forces was made on the attached data sheets.

B. The loads were generated by applying hydraulic pressure to create mechanical force until the required load was indicated on the digital meters.

C. The entire ceiling assembly was loaded in increments of 1/4 L.L. Each load was held for 10 minutes before the deflection readings were taken. After the 1½ L.L. deflection reading was taken, the assembly was then loaded, at a rate of approximately 1800 pounds per minute, until a failure occurred.
12. ANALYSIS OF RESULTS

Using a deflection limit of .500 inches and a factor of safety of 2.5, the following values were obtained.

Live Load > 3410 lbs./15.5 ft. = 235 PLF

Average ultimate Load = 9013.3 lbs./15.5 ft. = 581.5 PLF

Design Shear = 581.5/2.5 = 232.6 PLF * Controls

Since testing was conducted with a truss spacing of 24 inches on center, the same design value could be assigned to a system with trusses spaced at 16 inches on center. All fastening is to remain the same as the 24" o.c. assembly. Our construction accuracy on truss spacing was ± 1/2".

Based on the performance of the test assemblies and observations of the failed area, good performance can be expected with an average bead height of 3/8" and 7/8" average bead width.

Application of the ALPHASEAL 5200 varied due to the gap variation between the ceiling board and the bottom truss chord, which ranged from 0" to 1/2".

13. CONCLUSIONS

Based on the data obtained from this investigation; a design shear of 232.6 PLF can be achieved from a ceiling diaphragm constructed as follows:

A. 5/16" SHEETROCK® MH gypsum ceiling panels from U.S. Gypsum Company.
B. Certified roof trusses spaced at 24" o.c.
C. 1 x 4 top plate with splices glued and stapled. See attached drawing.
D. 1 x 4 shear wall top plate with screws through truss into shear wall top plate.
E. 1 x 3 edge rails fastened with two (2) staples per truss.
F. The 5/16" gypsum fastened to the trusses with ALPHASEAL 5200 two-part polyurethane adhesive. See attached drawings for amounts.
G. Gypsum fastened to side wall top plates with staples at 4" o.c.
H. Thicker gypsum of equal grade used on the ceiling would be expected to provide comparable shear resistance due to the mode of failure.
Ceiling Width: 186"  
Design Load: 235 P.L.F.

**TEST No.1**

**CEILING TEST LOADS**

<table>
<thead>
<tr>
<th>Loading Increments</th>
<th>Total Ceiling Load (lbs.)</th>
<th>Load No.1 (lbs.)</th>
<th>Load No.2 (lbs.)</th>
<th>Load No.3 (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Load</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/4 L.L.</td>
<td>1821</td>
<td>607</td>
<td>607</td>
<td>607</td>
</tr>
<tr>
<td>1/2 L.L.</td>
<td>3643</td>
<td>1214</td>
<td>1214</td>
<td>1214</td>
</tr>
<tr>
<td>3/4 L.L.</td>
<td>5464</td>
<td>1821</td>
<td>1821</td>
<td>1821</td>
</tr>
<tr>
<td>Live Load</td>
<td>7285</td>
<td>2428</td>
<td>2428</td>
<td>2428</td>
</tr>
<tr>
<td>1-1/4 L.L.</td>
<td>9106</td>
<td>3035</td>
<td>3035</td>
<td>3035</td>
</tr>
<tr>
<td>1-1/2 L.L.</td>
<td>10928</td>
<td>3643</td>
<td>3643</td>
<td>3643</td>
</tr>
<tr>
<td>1-3/4 L.L.</td>
<td>12749</td>
<td>4250</td>
<td>4250</td>
<td>4250</td>
</tr>
<tr>
<td>2.0 L.L.</td>
<td>14570</td>
<td>4857</td>
<td>4857</td>
<td>4857</td>
</tr>
<tr>
<td>2-1/4 L.L.</td>
<td>16,391</td>
<td>5464</td>
<td>5464</td>
<td>5464</td>
</tr>
<tr>
<td>2-1/2 L.L.</td>
<td>18,213</td>
<td>6071</td>
<td>6071</td>
<td>6071</td>
</tr>
</tbody>
</table>

Ultimate Load 20452  

Design Load 263.9 P.L.F.
Test No. 1  
Date: 7/2/98  
Temp. & Humidity During Construction: 80 deg. F / 69%  
Temp. & Humidity During Test: 82 deg. F / 78%

| Time | Load Load/Reading | Increment | Load (lbs.) | Clear Span | Indicator #2 | Indicator #3 | Indicator #4 |
|------|-------------------|-----------|-------------|------------|--------------|--------------|--------------|-------------|
|      |                   |           |             |            | Reading | Deflection | Reading | Deflection | Reading | Deflection |
| 8:50 | No Load           |           | 0 lbs.      |            | .143    | ----        | .262    | ----        | .378    | ----        |
| 8:51/9:01 | 1/4 Live Load |           | 1821 lbs.   |            | .218    | .075        | .361    | .099        | .472    | .094        |
| 9:02/9:12 | 1/2 Live Load  |           | 3643 lbs.   |            | .300    | .157        | .458    | .196        | .554    | .176        |

Mode of Failure: 1/2 Foam pulled from gypsum 1/2 foam pulled from wood on seam #1 on end #2

RESULTANT DEFLECTION

.068
.151
.245
.369
.485
# Test No. 1
Date: 7/2/98

## CEILING DIAPHRAGM TEST

<table>
<thead>
<tr>
<th>Time Load/Reading</th>
<th>Load Increment</th>
<th>Load (lbs.)</th>
<th>Indicator #1 Reading</th>
<th>Indicator #1 Deflection</th>
<th>Indicator #5 Reading</th>
<th>Indicator #5 Deflection</th>
<th>AVERAGE BEARING DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:50</td>
<td>No Load</td>
<td>0 lbs.</td>
<td>.104</td>
<td>----</td>
<td>.186</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>8:51/9:01</td>
<td>1/4 Live Load</td>
<td>1821 lbs.</td>
<td>.131</td>
<td>.027</td>
<td>.221</td>
<td>.035</td>
<td>.031</td>
</tr>
<tr>
<td>9:02/9:12</td>
<td>1/2 Live Load</td>
<td>3643 lbs.</td>
<td>.146</td>
<td>.042</td>
<td>.235</td>
<td>.049</td>
<td>.046</td>
</tr>
<tr>
<td>9:13/9:23</td>
<td>3/4 Live Load</td>
<td>5464 lbs.</td>
<td>.162</td>
<td>.058</td>
<td>.244</td>
<td>.058</td>
<td>.058</td>
</tr>
<tr>
<td>9:24/9:34</td>
<td>Live Load</td>
<td>7285 lbs.</td>
<td>.180</td>
<td>.076</td>
<td>.249</td>
<td>.063</td>
<td>.070</td>
</tr>
<tr>
<td>9:35/9:45</td>
<td>1-1/4 Live Load</td>
<td>9106 lbs.</td>
<td>.190</td>
<td>.086</td>
<td>.255</td>
<td>.069</td>
<td>.078</td>
</tr>
</tbody>
</table>

Alpha Systems
Ceiling Width: 186"
Design Load: 235 P.L.F.

TEST No.2

<table>
<thead>
<tr>
<th>Loading Increments</th>
<th>Total Ceiling Load (lbs.)</th>
<th>Load No.1 (lbs.)</th>
<th>Load No.2 (lbs.)</th>
<th>Load No.3 (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Load</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/4 L.L.</td>
<td>1821</td>
<td>607</td>
<td>607</td>
<td>607</td>
</tr>
<tr>
<td>1/2 L.L.</td>
<td>3643</td>
<td>1214</td>
<td>1214</td>
<td>1214</td>
</tr>
<tr>
<td>3/4 L.L.</td>
<td>5464</td>
<td>1821</td>
<td>1821</td>
<td>1821</td>
</tr>
<tr>
<td>Live Load</td>
<td>7285</td>
<td>2428</td>
<td>2428</td>
<td>2428</td>
</tr>
<tr>
<td>1-1/4 L.L.</td>
<td>9106</td>
<td>3035</td>
<td>3035</td>
<td>3035</td>
</tr>
<tr>
<td>1-1/2 L.L.</td>
<td>10928</td>
<td>3643</td>
<td>3643</td>
<td>3643</td>
</tr>
<tr>
<td>1-3/4 L.L.</td>
<td>12749</td>
<td>4250</td>
<td>4250</td>
<td>4250</td>
</tr>
<tr>
<td>2.0 L.L.</td>
<td>14570</td>
<td>4857</td>
<td>4857</td>
<td>4857</td>
</tr>
<tr>
<td>2-1/4 L.L.</td>
<td>16,391</td>
<td>5464</td>
<td>5464</td>
<td>5464</td>
</tr>
<tr>
<td>2-1/2 L.L.</td>
<td>18,213</td>
<td>6071</td>
<td>6071</td>
<td>6071</td>
</tr>
</tbody>
</table>

Ultimate Load 18456

Design Load 238.1 P.L.F.
## CEILING DIAPHRAGM TEST

**Test No. 2**  
**Date:** 7/2/98  
**Temp. & Humidity During Construction:** 80 deg. F / 69%  
**Temp. & Humidity During Test:** 82deg. F / 54%

<table>
<thead>
<tr>
<th>Time Load/Reading</th>
<th>Load Increment</th>
<th>Load (lbs.)</th>
<th>Indicator #2 Reading</th>
<th>Indicator #2 Deflection</th>
<th>Indicator #3 Reading</th>
<th>Indicator #3 Deflection</th>
<th>Indicator #4 Reading</th>
<th>Indicator #4 Deflection</th>
<th>RESULTANT DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:25</td>
<td>No Load</td>
<td>0 lbs.</td>
<td>.202</td>
<td>---</td>
<td>.187</td>
<td>---</td>
<td>.186</td>
<td>---</td>
<td>.051</td>
</tr>
<tr>
<td>18:26/1:36</td>
<td>1/4 Live Load</td>
<td>1821 lbs.</td>
<td>.300</td>
<td>.098</td>
<td>.290</td>
<td>.103</td>
<td>.274</td>
<td>.088</td>
<td>.138</td>
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<tr>
<td>1:37/1:47</td>
<td>1/2 Live Load</td>
<td>3643 lbs.</td>
<td>.423</td>
<td>.221</td>
<td>.424</td>
<td>.237</td>
<td>.384</td>
<td>.198</td>
<td>.249</td>
</tr>
<tr>
<td>1:48/1:58</td>
<td>3/4 Live Load</td>
<td>5464 lbs.</td>
<td>.534</td>
<td>.332</td>
<td>.562</td>
<td>.375</td>
<td>.510</td>
<td>.324</td>
<td>.376</td>
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<tr>
<td>1:59/2:09</td>
<td>Live Load</td>
<td>7285 lbs.</td>
<td>.656</td>
<td>.454</td>
<td>.714</td>
<td>.527</td>
<td>.653</td>
<td>.467</td>
<td>.492</td>
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<tr>
<td>2:10/2:20</td>
<td>1-1/4 Live Load</td>
<td>9106 lbs.</td>
<td>.765</td>
<td>.563</td>
<td>.854</td>
<td>.667</td>
<td>.782</td>
<td>.596</td>
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</tr>
</tbody>
</table>

**Mode of Failure:** Gypsum shear from seam #1 to seam #2 on end #2

*Alpha Systems*
## CEILING DIAPHRAGM TEST

**Test No. 2**  
**Date:** 7/2/98

<table>
<thead>
<tr>
<th>Time Load/Reading</th>
<th>Load Increment</th>
<th>Load (lbs.)</th>
<th>Indicator #1 Reading</th>
<th>Indicator #1 Deflection</th>
<th>Indicator #5 Reading</th>
<th>Indicator #5 Deflection</th>
<th>AVERAGE BEARING DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:25</td>
<td>No Load</td>
<td>0 lbs.</td>
<td>.204</td>
<td>----</td>
<td>.209</td>
<td>----</td>
<td>.052</td>
</tr>
<tr>
<td>18:26/1:36</td>
<td>1/4 Live Load</td>
<td>1821 lbs.</td>
<td>.264</td>
<td>.060</td>
<td>.253</td>
<td>.044</td>
<td>.099</td>
</tr>
<tr>
<td>1:37/1:47</td>
<td>1/2 Live Load</td>
<td>3643 lbs.</td>
<td>.325</td>
<td>.121</td>
<td>.286</td>
<td>.077</td>
<td>.126</td>
</tr>
<tr>
<td>1:48/1:58</td>
<td>3/4 Live Load</td>
<td>5464 lbs.</td>
<td>.343</td>
<td>.139</td>
<td>.322</td>
<td>.113</td>
<td>.152</td>
</tr>
<tr>
<td>1:59/2:09</td>
<td>Live Load</td>
<td>7285 lbs.</td>
<td>.356</td>
<td>.152</td>
<td>.360</td>
<td>.151</td>
<td>.175</td>
</tr>
<tr>
<td>2:10/2:20</td>
<td>1-1/4 Live Load</td>
<td>9106 lbs.</td>
<td>.373</td>
<td>.169</td>
<td>.390</td>
<td>.181</td>
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</tr>
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</table>

**Alpha Systems**
Ceiling Width: 186"
Design Load: 235 P.L.F.

TEST No.3

<table>
<thead>
<tr>
<th>Loading Increments</th>
<th>Total Ceiling Load (lbs.)</th>
<th>Load No. 1 (lbs.)</th>
<th>Load No. 2 (lbs.)</th>
<th>Load No. 3 (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Load</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/4 L.L.</td>
<td>1821</td>
<td>607</td>
<td>607</td>
<td>607</td>
</tr>
<tr>
<td>1/2 L.L.</td>
<td>3643</td>
<td>1214</td>
<td>1214</td>
<td>1214</td>
</tr>
<tr>
<td>3/4 L.L.</td>
<td>5464</td>
<td>1821</td>
<td>1821</td>
<td>1821</td>
</tr>
<tr>
<td>Live Load</td>
<td>7285</td>
<td>2428</td>
<td>2428</td>
<td>2428</td>
</tr>
<tr>
<td>1-1/4 L.L.</td>
<td>9106</td>
<td>3035</td>
<td>3035</td>
<td>3035</td>
</tr>
<tr>
<td>1-3/4 L.L.</td>
<td>10928</td>
<td>3643</td>
<td>3643</td>
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</tr>
<tr>
<td>1-3/4 L.L.</td>
<td>12749</td>
<td>4250</td>
<td>4250</td>
<td>4250</td>
</tr>
<tr>
<td>2.0 L.L.</td>
<td>14570</td>
<td>4857</td>
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</tr>
<tr>
<td>2-1/4 L.L.</td>
<td>16,391</td>
<td>5464</td>
<td>5464</td>
<td>5464</td>
</tr>
<tr>
<td>2-1/2 L.L.</td>
<td>18,213</td>
<td>6071</td>
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<td>6071</td>
</tr>
</tbody>
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Ultimate Load 15172  5019  5113  5040

Design Load 195.8 P.L.F.
Test No. 3  
Date: 7/7/98  
Temp. & Humidity During Construction: 80 deg. F / 69%  
Temp. & Humidity During Test: 79 deg. F / 92%  

<table>
<thead>
<tr>
<th>Time Load/Reading</th>
<th>Load Increment</th>
<th>Load (lbs.)</th>
<th>Indicator #2 Reading</th>
<th>Indicator #2 Deflection</th>
<th>Indicator #3 Reading</th>
<th>Indicator #3 Deflection</th>
<th>Indicator #4 Reading</th>
<th>Indicator #4 Deflection</th>
<th>RESULTANT DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:50</td>
<td>No Load</td>
<td>0 lbs.</td>
<td>.191</td>
<td>----</td>
<td>.195</td>
<td>----</td>
<td>.232</td>
<td>----</td>
<td>.064</td>
</tr>
<tr>
<td>1:51/2:01</td>
<td>1/4 Live Load</td>
<td>1821 lbs.</td>
<td>.264</td>
<td>.073</td>
<td>.278</td>
<td>.083</td>
<td>.305</td>
<td>.073</td>
<td>.156</td>
</tr>
<tr>
<td>2:02/2:12</td>
<td>1/2 Live Load</td>
<td>3643 lbs.</td>
<td>.348</td>
<td>.157</td>
<td>.386</td>
<td>.191</td>
<td>.395</td>
<td>.163</td>
<td>.295</td>
</tr>
<tr>
<td>2:24/2:34</td>
<td>Live Load</td>
<td>7285 lbs.</td>
<td>.656</td>
<td>.465</td>
<td>.743</td>
<td>.548</td>
<td>.693</td>
<td>.461</td>
<td>.674</td>
</tr>
<tr>
<td>⬆ 2:35/2:45</td>
<td>1-1/4 Live Load</td>
<td>9106 lbs.</td>
<td>.851</td>
<td>.660</td>
<td>.969</td>
<td>.774</td>
<td>.895</td>
<td>.663</td>
<td></td>
</tr>
</tbody>
</table>

Mode of Failure: Gypsum shear on 1st bay on end #2.
**PROGRESSIVE ENGINEERING, Inc.**  
CEILING DIAPHRAGM TEST

Test No. 3  
Date: 7/7/96

<table>
<thead>
<tr>
<th>Time Load/Reading</th>
<th>Load Increment</th>
<th>Load (lbs.)</th>
<th>Bearing Points</th>
<th>Indicator #1 Reading</th>
<th>Indicator #1 Deflection</th>
<th>Indicator #5 Reading</th>
<th>Indicator #5 Deflection</th>
<th>Average Bearing Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:50</td>
<td>No Load</td>
<td>0 lbs.</td>
<td>Indicator #1</td>
<td>.180</td>
<td>-----</td>
<td>.206</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>1:51/2:01</td>
<td>1/4 Live Load</td>
<td>1821 lbs.</td>
<td>Indicator #1</td>
<td>.193</td>
<td>.013</td>
<td>.231</td>
<td>.025</td>
<td>.019</td>
</tr>
<tr>
<td>2:02/2:12</td>
<td>1/2 Live Load</td>
<td>3643 lbs.</td>
<td>Indicator #1</td>
<td>.201</td>
<td>.021</td>
<td>.256</td>
<td>.050</td>
<td>.036</td>
</tr>
<tr>
<td>2:13/2:23</td>
<td>3/4 Live Load</td>
<td>5464 lbs.</td>
<td>Indicator #1</td>
<td>.222</td>
<td>.042</td>
<td>.277</td>
<td>.071</td>
<td>.057</td>
</tr>
<tr>
<td>2:24/2:34</td>
<td>Live Load</td>
<td>7285 lbs.</td>
<td>Indicator #1</td>
<td>.248</td>
<td>.068</td>
<td>.295</td>
<td>.089</td>
<td>.079</td>
</tr>
<tr>
<td>2:35/2:45</td>
<td>1-1/4 Live Load</td>
<td>9106 lbs.</td>
<td>Indicator #1</td>
<td>.280</td>
<td>.100</td>
<td>.306</td>
<td>.100</td>
<td>.100</td>
</tr>
</tbody>
</table>

Alpha Systems
TOP PLATE SPLICE

EDGE RAIL SPLICE

END WALL FASTENING

TRUSS FASTENING TO SIDEWALLS

RIDGE RAIL FASTENING

THIS DRAWING IS A PART OF TEST REPORT NO. 98-1032

ALPHA SYSTEMS

DETAILS

PROGRESSIVE ENGINEERING, INC.
TESTING LABORATORY

58640 State Road 15
COSHEN, INDIANA 46526
Telephone (219) 532-0337

DRL. BY: D. LEHMANN
REVISED ON: 4/23/98

DATE: 7/14/98

SCALE: 1/2" = 1' 0"

JOB NO.: 98-1032

CLINT: ALPHA SYSTEMS

NOTE: This drawing and all information contained herein is the property of PROGRESSIVE ENGINEERING, INC., and is not to be reproduced without the expressed written permission of PROGRESSIVE ENGINEERING, INC. PROGRESSIVE ENGINEERING, INC. assumes no responsibility for unauthorized use of this drawing.
1x3 END RAIL

1x4 TOP PLATE

7/16" C. x 2" lg.
2x 16 ga. STAPLE
(2 PER STUD END)

5/16" Sheet Rock MIP Gypsum
ONE PIECE PER SIDE GLUED & STAPLED
WITH 1/4" C. x 1" LG. x .030" THK.
STAPLES @ 6" O.C. ALONG PLATES
AND ONE PER STUD

1x4 TOP AND BOTTOM PLATES

THIRD-PARTY CERTIFIED TRUSS

#8 x 3/4" LG. WASHER HEAD SCREWS
THRU CHORD INTO TOP PLATE @ 3° O.C.

2x3 STUD 24° O.C.

1 1/2" END WEDGE FASTENED TO 1x4
W/ 1" C. x 1" LG. X 16 GA. STAPLES 16° O.C.

1 1/2" END WEDGE FASTENED TO 1x4
W/ 1" C. x 1" LG. X 16 GA. STAPLES 16° O.C.

CEILING BOARD

(2) 7/16" C. x 2 1/2" lg. x 15 ga.
STAPLES AT EACH TRUSS HEEL

END WALL DETAILS

THIS DRAWING IS A PART OF TEST REPORT NO. 98-1032

DATE: 7/14/98

SCALE: 3/4" = 12"

JOB NO. 98-1032

DRAWN BY D. LEHMAN

REVISED ON

CLIENT: ALPHA SYSTEMS

TESTING LABORATORY

PROGRESSIVE ENGINEERING, INC.
50640 State Road 15
GOSHEN, INDIANA 46526
Telephone (219) 533-8537
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP CHORD</td>
<td>2 x 2 RIPPED FROM #2 GRADE S.P.F.</td>
<td>2</td>
</tr>
<tr>
<td>BOTT. CHORD</td>
<td>2 x 3 #2 GRADE S.P.F.</td>
<td>2</td>
</tr>
<tr>
<td>POSTS</td>
<td>2 x 2 RIPPED FROM #3 GRADE S.P.F.</td>
<td>2</td>
</tr>
<tr>
<td>HORIZ. MEMBER</td>
<td>2 x 3 STUD GRADE S.P.F.</td>
<td>1</td>
</tr>
<tr>
<td>DIAGONALS</td>
<td>2 x 2 RIPPED FROM #3 GRADE S.P.F.</td>
<td>2</td>
</tr>
<tr>
<td>KING POST</td>
<td>2 x 3 STUD GRADE S.P.F.</td>
<td>1</td>
</tr>
<tr>
<td>GUSSETS</td>
<td>3/8&quot; A.P.A. PLYWOOD (BOTH SIDES)</td>
<td>16</td>
</tr>
</tbody>
</table>

Note: Grades noted are minimums.

--- DESIGN LOADS ---

- TOP CHORD LIVE LOAD: 30 P.S.F.
- TOP CHORD DEAD LOAD: 9 P.S.F.
- BTM. CHORD DEAD LOAD: 6 P.S.F.
- TRUSS SPACING 16" O.C.: TOTAL 45 P.S.F.
- CLEAR SPAN 184-1/2"

--- ALTERNATE LOADS ---

- TOP CHORD LIVE LOAD: 20 P.S.F.
- TOP CHORD DEAD LOAD: 6 P.S.F.
- BTM. CHORD DEAD LOAD: 4 P.S.F.
- TRUSS SPACING 24" O.C.: TOTAL 30 P.S.F.

NOTES:

1) TRUSS TESTED PER SECTION 280.402(d) OF THE FEDERAL STANDARD
2) STAPLES- 7/16" C. x 1-3/8"LG. X 16 GA. (QUANTITIES SHOWN IN CIRCLES ABOVE)
3) GLUE TYPE- P.V.A.-34, ELIXER, W-17
4) GLUE AMOUNT- 80% min. COVERAGE ON ALL GUSSETS
5) GUSSETS MAY BE 1/8" SMALLER max. THAN SIZE NOTED
6) GRAIN ON HEEL GUSSETS TO BE IN VERTICAL POSITION

R.J. COLE, INC.
21790 Beck Dr. Elkhart, Indiana

Progressive Engineering Inc.

TRUS NUMBER: C16-1
DRAWING NUMBER: 92-1714
Test #1 During Loading

Test #1 After Failure
Test #3 During Loading

Test #3 After Failure