KING-POST TESTS FOR
CRYSTAL PARK LUMBER CO.
D. H. Percival - April 16, 1959
DESIGN AND FULL-SCALE TEST
OF NAIL-GLUED WOOD TRUSSES FOR

THE CRYSTAL PARK LUMBER COMPANY
1900 MAHONING ROAD, N. E.,
CANTON, OHIO

by

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April 16, 1959
FULL SCALE TESTS ON NAIL-GLUED ROOF-TRUSSES FOR
CRYSTAL PARK LUMBER COMPANY, CANTON, OHIO

The nail-glued connection is rigid, and when used to fabricate
wood trusses, stress analysis through accepted stress diagrams are
unrealistic. Secondary bending is not considered. Full scale testing
is the only practical method of investigating the various designs.

DESIGN:

Two king-post wood truss designs were investigated for deflection
under design load, and for strength under maximum loads. These tests
were supervised by D. H. Percival, wood Technologist, Small Homes
Council, Champaign, Illinois for Mr. Robert Weintraub, Crystal Park
Lumber Company, 1900 Mahoning Road, N. E., Canton, Ohio. This report
includes test results of 3/12 and 5/12 slope, 24'-0" span, king-post
design suggested by Robert Weintraub, Plate 1 and 2.

MATERIALS:

Materials for both the 3/12 and 5/12 designs included:

1) 2x6 chords and posts — 1500f stress grade Southern yellow
   pine (No. 2 K.D.)

2) 3/8" C-D grade, Interior type UFPA, grade-marked plywood,
   (Any increase in grade or type will be a bonus.)

3) Casein Glue (National Casein Company, NYOP) Federal
   Specifications MM-A-125 Type II.

4) Spotnail Staples, 1-1/8" long, spaced approximately 4" apart.

5) Plywood gussets were nail-glued to both sides of the truss.
Plate 1

Diagram of 2 x 6 king-post design 3/12 slope

24' - 0"

Gusset plates applied to both sides
1500' Southern yellow pine
3/8" DPFA plywood, 1-1/8" staples.
SUBJECT PLATES APPLIED TO BOTH SIDES
1000# southern yellow pine
3/8" DEPA plywood, 1-1/8" staples.
METHOD OF TESTS:

The trusses were set-up in pairs, with two-foot spacing, Fig. 1.

Fig. 1. Two-foot spacing

They were sheathed with plywood, Fig. 2.

Fig. 2. Plywood sheathing
Concrete blocks, averaging 43.5 pounds are used as the loading element. (Shingle bundles or similar elements are often used for convenience.)

The load is calculated on a horizontal projection. The deflection is observed by reading 0.001 in. AMES dials clamped to the lower chords, Fig. 3.

Fig. 3, AMES Dial for deflection reading

One dial is clamped to the center of the chord, and another, secured to the quarter point of the chord. After preliminary flexural loads had been applied and removed, the dials were set at zero and the tests were begun. The blocks were placed on the sheathing and dial readings were observed at loads up to 45 pounds per square foot.
Fig. 4. King-post trusses, 3/12 slope, 24'-0" span, 45 psf load

Fig. 5. King-post trusses, 5/12 slope, 24'-0" span, 45 psf load
The deflection results for the 3/12 slope tests are recorded in Table 1; the results for the 5/12 slope tests in Table 2. After the deflection readings were recorded, the dials were removed and loads great enough to cause failure were applied. Failing loads are recorded in Table 1 and Table 2.

**TABLE 1: TEST INFORMATION**

24'-0" span, 3/12 slope
king-post design

<table>
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<tr>
<th>TOTAL LOAD</th>
<th>LOAD (pounds)</th>
<th>DEFLECTION (in.)</th>
<th>Residual Deflection (in.)</th>
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<tr>
<td></td>
<td></td>
<td>Quarter points</td>
<td>Mid-span</td>
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<td>435</td>
<td>4.5</td>
<td>.047, .012</td>
<td>0</td>
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<td>870</td>
<td>9.1</td>
<td>.095, .026</td>
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<td>18.1</td>
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<tr>
<td>4326</td>
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</table>

Total Load at Failure = 129 psf.

**TABLE 2: Test Data, 5/12 slope**

<table>
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<th>TOTAL LOAD</th>
<th>LOAD (pounds)</th>
<th>DEFLECTION (in.)</th>
<th>Residual Deflection (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Quarter points</td>
<td>Mid-span</td>
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<tr>
<td>4326</td>
<td>45.0</td>
<td>.455, .191</td>
<td>.012</td>
</tr>
</tbody>
</table>

Total Load at Failure = 148 psf.
Fig. 6. 3/12 slope, 24'-0" span, 100 psf.

Fig. 7. 3/12 slope, 24'-0" span, 125 psf.
Fig. 8. 5/12 slope, 24'-0" span, 100 psf.

Fig. 9. 5/12 slope, 24'-0" span, 120 psf.
CONCLUSIONS:

1) The deflection, at a design load of 45 psf, in each case, was within the \( \frac{L}{360} \) deflection criteria; 0.455 in. for 5/12 slope and 0.540 in. for 3/12 slope.

Criteria: \( \frac{L}{360} \leq \frac{2L}{3} \times \frac{12}{360} = 0.30 \) inches

The stiffness exceeds the criterion of \( \frac{L}{360} \).

2) Since the trusses were loaded in excess of 100 psf, they were shown to be more than strong enough to carry a design load of 45 psf.

3) The major change in design from the Small Homes Council instruction sheets was the reduction in length of the heel gusset plates. This reduction did not seriously affect the strength characteristics of the 2x4 king-post design, however, some increase in the deflection performance was noticed. As stated in number 1, the deflection did not exceed the criteria of \( \frac{L}{360} \).