Measuring the Bending Yield Strength of Timber Frame Pegs

Final Report presented to

Timber Frame Engineering Council

by

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Problem Statement

The design of traditional timber frame connections relies heavily on the use of wood pegs to resist shear forces. Wood pegs differ from the metal fasteners traditionally used in the *National Design Specification for Wood Construction* (NDS) by having lower strength and stiffness properties and including a fifth yield mode in the design equations (TFEC 2010, AWC 2015). An interesting advantage of the lower strength of pegs is the ability to reduce the spacing requirements used for steel fasteners. One of the key properties in the design of wood peg connections is the dowel bending yield strength, F_{yb}. This term is present in both Mode III and IV yield limit equations in the NDS.

Appendix I of the NDS discusses the dowel bending yield strength. The following quote is found in Appendix I, "Fastener bending yield strength (F_{yb}) shall by determined by the 5% diameter (0.05D) offset method of analyzing load-displacement curves developed from fastener bending tests" (AWC 2015). This method of fastener evaluation is detailed in ASTM F 1575 *Standard Test Method for Determining Bending Yield Moment of Nails* (ASTM 2015a) and ASTM D 5764 *Standard Test Method for Evaluating Dowel-Bearing Strength of Wood and Wood-Based Products* (ASTM 2015b) for fastener evaluation.

ASTM F 1575 defines the testing methodology for the bending yield moment of nails (ASTM 2015a). A center point load is applied with a span based upon the diameter of the nail. A short explanation of the 5% offset diameter load is provided, which is expanded upon in ASTM D 5764 (ASTM 2015b).

A previous study by Schmidt and MacKay (1997) examined various mechanical properties of timber frame pegs including the bending yield strength, shear strength and dowel bearing strength. Results for bending yield strength considered different peg species (red oak, white oak, locust, ash, maple, birch, and white oak with an octagonal shape), diameter of peg (3/4", 1", 1-1/4") and orientation of grain in peg (radial and tangential). While these tests covered a wide variety of pegs used in timber frames, the maximum specimen size for the factor combinations was ten, which does not provide an adequate number of samples to develop design values.

Schmidt and MacKay (1997) found a coefficient of variation of 26% from the red oak pegs tested. According to ASTM D 2915 *Standard Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products*, to have an estimate of precision (α) of 0.05 and a confidence interval (*CI*) of 75% with a coefficient of variation (COV) of 26%, a total of 37 samples per combination are required (ASTM 2015c).

Examining the commentary in the *TFEC 1-2010 Standard for Design of Timber Frame Structures and Commentary*, in Section 3.4.5, the bending yield strength of pegs is discussed. A comment is made that the bending yield strength of the pegs cannot simply be taken as the modulus of rupture (MOR) value from the *Wood Handbook* (USDA FPL 2010) tables because,

> "The higher flexural strength of the wood peg [versus the *Wood Handbook* values] can be attributed to the form factor associated with round pegs, the smaller size of the peg compared to the ASTM D 143 (Reference 10) standard test specimen, inadequate

population sampling for the peg tests, and possibly lower moisture content in the pegs." (TFEC 2010)

The TFEC commentary seems to be indicating that accurate assessment of the bending yield strength of pegs cannot be determined from the *Wood Handbook* (USDA FPL 2010), but that current sources of peg bending yield strength (Schmidt and MacKay(1997)) need to include further study of pegs to remain relevant.

Current tools for estimation of the F_{yb} value associated with pegs rely upon the Schmidt and MacKay (1997) or the *Wood Handbook* values for clear wood samples. MOR values of clear hardwood samples were regressed as a power function in Table 5-11b of the *Wood Handbook* (USDA FPL 2010), with MOR (psi) = $24{,}850*G^{1.13}$. Further characterization of the F_{yb} value associated with pegs can help improve the prediction of timber frame joint strength.

Current dowel embedment values in the NDS for wood members with a steel dowel use a two-factor power equation based on both the specific gravity and diameter of the fastener AWC 2015). This equation format was used to develop a generalized equation for F_{yb} in a common form which designers and engineers are used to.

The purpose of this project was to evaluate the bending yield strength of various sizes and wood species of pegs used in timber frame joints. The F_{yb} results determined from the individual results were regressed to create a two-factor power equation. Results of this research can lead to improvements in the F_{yb} values currently used in timber frame design.

Materials and Methods

Materials

The matrix of test properties is provided in Table 1 including the peg species, peg diameter and number of specimens per group. Four wood species will be evaluated – white oak (*Quercus alba*), red oak (*Quercus rubra*), black locust (*Robinia psuedoacacia*) and hard maple (*Acer saccharum* and *Acer nigrum*). These species represent the common peg wood species and the range of specific gravity values for pegs (TFEC 2010). All of the black locus pegs were cut into octagon shapes, while all other pegs were round.

Pegs were supplied by Northcott Turning and Cabin Creek Timber Frames. Cabin Creek Timber Frames provided one set of the black locust octagonal pegs, while Northcott Turning provided all other materials. Nominal peg diameters are given in Table 1 for identification. Actual diameters were used for stress calculations. Tapered pegs had a constant change in diameter over the length of the peg. The change in diameter to length ratio for the 0.75" pegs was 1:280, (for every inch of length, the diameter changed 1/280 or 0.0036 inches) for the 0.875" pegs was 1:265, and for the 1.0" pegs was 1:174.

A sample size per combination of 30 pegs was used for testing. This number of pegs produces a 75% confidence interval at COV values of 23.3% or less. This number of pegs was chosen based on the variation of peg bending yield strength COV observed from Schmidt and MacKay (1997).

Table 1. Characteristics and Number of Samples of Pegs Tested

Peg Species	Nominal Peg Diameter	Taper?	Number of Samples
Black Locust	1.0”	No	30
Octagonal	1.0”	No	30[1]
Hard Maple	0.75”	No	30
	1.0”	No	30
	1.25”	No	30
Red Oak	0.75”	No	30
	1.0”	No	30
	1.25”	No	30
	0.75”	Yes	30
	0.875”	Yes	30
	1.0”	Yes	30
White Oak	0.875”	No	30
		TOTAL	360

[1] Obtained from Cabin Creek Timber Frames. All other pegs were obtained from Northcott Turning.

The TFEC commentary speculated that the lower moisture content present in pegs may increase the bending yield strength (TFEC 2010). While the correlation between lower moisture content and higher bending strength is well-known, the placement of pegged structures cannot be guaranteed for indoor only applications. Many uses of timber frame joints are in exterior, covered applications where the moisture content may be greater than indoor conditions. Therefore, all pegs in this study were conditioned to 12% moisture content for testing.

Schmidt and MacKay (1997) evaluated pegs loaded in both the radial and tangential directions, and found that the radial direction bending strength was stronger. Sandberg et al. (2000) tested connections with pegs oriented in the radial, tangential and 45 degrees to the radial and found no difference in properties. Specific placement of the pegs, however, cannot be guaranteed in structural applications, so no specific orientation of the pegs was used.

Methods

The bending tests were conducted according to the procedures used in Schmidt and MacKay (1997). The single load point from ASTM F 1575 (ASTM 2015a) was changed to two equally spaced loads to better represent the double shear action of a peg in a mortise and tenon joint. Figure 1 is a diagram of the test setup. Load was applied by two points 3.13 inches from each end to a 9 inch long span. The diameter of the peg was measured at two positions (90 degrees around the peg) at both support locations. The displacement rate of testing was 0.05 inches per minute. Specimens were loaded until failure. Displacement was measured by an LVDT touching the bottom face of the peg at midspan. Figure 2 is a photograph of a specimen during testing, showing the loading, supports and LVDT placement.

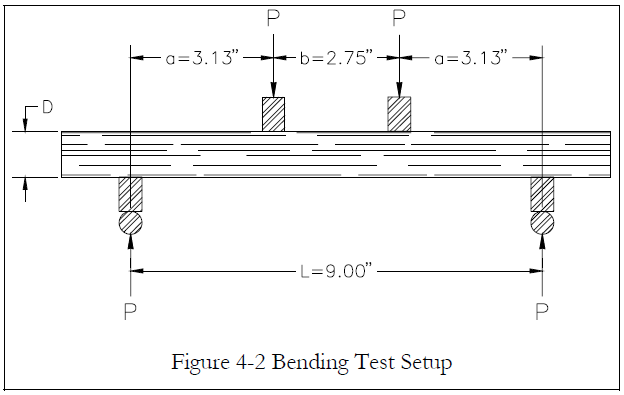

Figure 1. Bending Test Diagram from Schmidt and MacKay (1997)

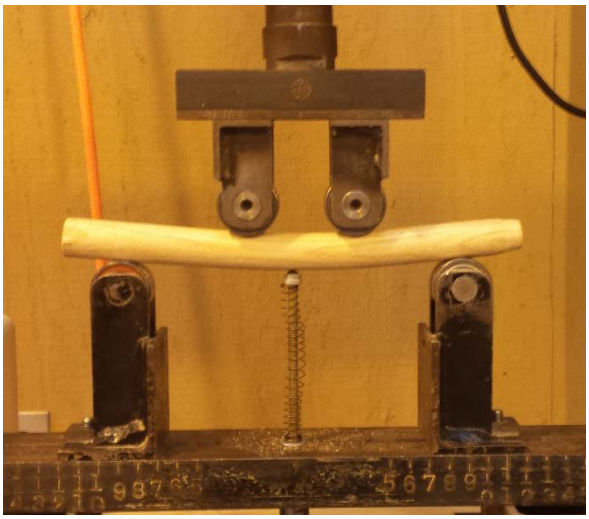

Figure 2. Photograph of Peg Testing

The load-deflection curve of each test was plotted and the yield load, 5% offset load (0.05*D*) and ultimate load were found. Figure 3 is a graph of the load-displacement curve of a red oak 1 inch diameter peg showing the yield load, 5% offset load and ultimate load. The two super-imposed lines represent the initial slope of the load-displacement curve and the initial slope with the 5% diameter offset. A comparison of the super-imposed lines with the load-deflection curve was used to find the yield and 5% offset loads.

After testing was completed, the peg failure was noted. Undamaged portions of the pegs were cut for moisture content and specific gravity measurements according to ASTM D 4442 (ASTM 2015d) and ASTM D 2395 (ASTM 2015e), respectively. Moisture content used the oven-dry method and specific gravity was based on the oven dry volume using the water displacement method.

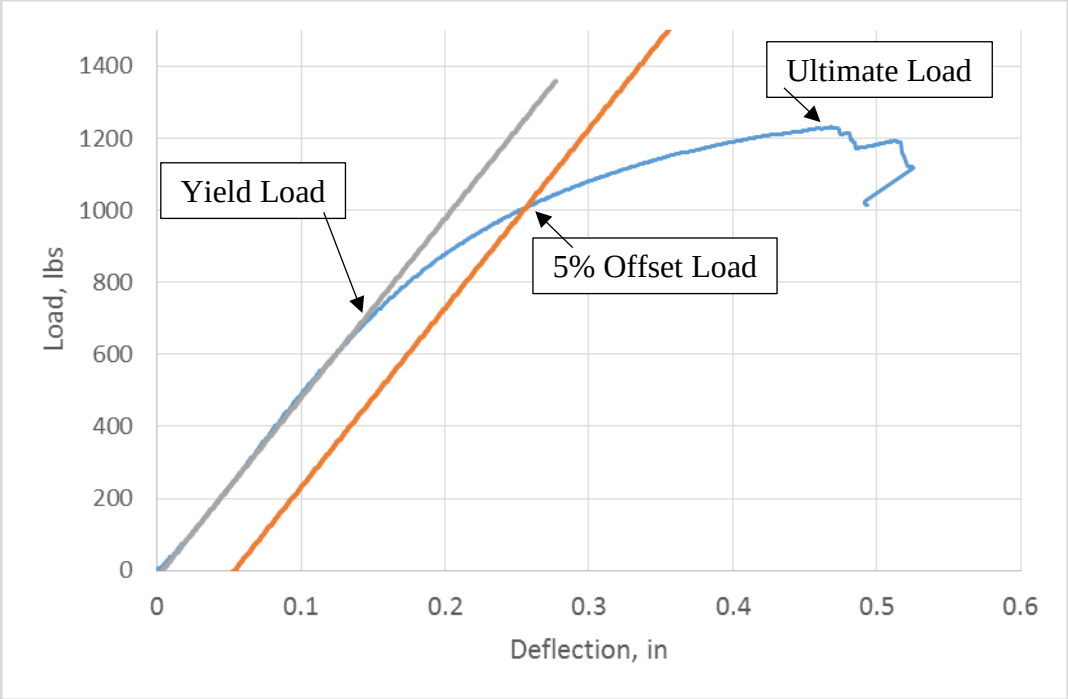

Figure 3. Load-Deflection Curve Of Red Oak 1" Peg Showing Yield Load, 5% Offset Load, and Ultimate Load

The stiffness (modulus of elasticity) and yield strength, 5% offset strength, and ultimate strength (MOR) were calculated based on the load-deflection curve and the dimensions of the peg. The stress and modulus of elasticity equations used to calculate the values for the non-tapered and tapered pegs are shown in Appendix 1. All values were then converted to an equivalent strength/stiffness at a 12% moisture content using procedures in ASTM D 1990 (ASTM 2015f).

After conversion to the 12% moisture content equivalent, a two-factor power equation based on diameter and specific gravity of the peg was developed. Appendix 2 explains this procedure.

Results and Discussion

The moisture content, specific gravity and stiffness of the pegs are shown in Table 2. Moisture content values ranged from 9.66% to 15.0%. Average specific gravity values were all greater than 0.57, the minimum specific gravity allowed for pegs (TFEC 2010), while the black locust octagonal 1.0 inch diameter Group 2 pegs had a greater specific gravity than 0.73, the maximum specific gravity allowed for pegs. Stiffness values were greatest for the black locust (average of 3.13×10^6 psi), followed by the red oak (average of 2.54×10^6 psi), the hard maple (average of 2.51×10^6 psi) and the white oak (2.39×10^6 psi).

Table 2. Moisture Content, Specific Gravity and Stiffness Values of Pegs Tested

Name	Moisture Content, % (COV)	Specific Gravity, (COV)	Stiffness Adjusted for 12% MC, psi (COV)
Black Locust Octagonal 1.0", Group 1	13.8% (3.05%)	0.702 (7.25%)	3.11×10^6 (13.8%)
Black Locust Octagonal 1.0", Group 2	9.90% (17.1%)	0.785 (5.31%)	3.15×10^6 (14.1%)
Hard Maple 0.75"	14.0% (5.65%)	0.614 (11.8%)	2.85×10^6 (24.4%)
Hard Maple 1.00"	15.0% (1.68%)	0.675 (6.33%)	2.64×10^6 (17.0%)
Hard Maple 1.25"	13.6% (2.27%)	0.689 (6.06%)	2.03×10^6 (12.6%)
Red Oak 0.75"	11.2% (11.4%)	0.664 (10.7%)	3.30×10^6 (15.5%)
Red Oak 1.00"	13.1% (1.24%)	0.639 (8.25%)	2.35×10^6 (17.9%)
Red Oak 1.25"	9.66% (3.71%)	0.648 (8.62%)	1.76×10^6 (12.9%)
Red Oak 0.75" Taper	13.9% (2.31%)	0.629 (9.69%)	2.91×10^6 (18.6%)
Red Oak 0.875" Taper	14.0% (2.98%)	0.654 (7.26%)	2.63×10^6 (12.6%)
Red Oak 1.00" Taper	13.5% (3.23%)	0.634 (7.19%)	2.34×10^6 (17.9%)
White Oak 0.875"	14.6% (3.61%)	0.650 (7.56%)	2.39×10^6 (12.8%)

The yield load, 5% offset load and ultimate strength values calculated from the peg bending are shown in Table 3. The values that are of most interest to this project are the 5% offset strength. The black locust values had the greatest strength, followed by the hard maple, then the red oak and the white oak. The average strength values of the entire population of black locust octagonal pegs are presented in Table 3. Comparison of the Group 1 and Group 2 values by t-test found that only the yield strength was significantly different ($p=0.0001$) between the two groups.

The primary failures of the pegs observed were splintering, cross-grain tension, simple tension, brash tension, and horizontal shear. Figures 4 through 8 illustrate the various failures observed. For several of the cross-grain tension specimens observed, especially in the maple, failure of the peg occurred at maximum load as cross-grain tension occurred in a brittle manner leading to catastrophic failure of the pegs.

Table 3. Yield Strength, 5% Offset Strength, and Ultimate Strength From Peg Testing

Name	Yield Strength, psi (COV)	5% Offset Strength, psi (COV)	Ultimate Strength, psi (COV)
Black Locust Octagonal 1.0", Group 1	10,200 (11.2%)	17,300 (12.2%)	21,100 (16.7%)
Black Locust Octagonal 1.0", Group 2	9,020 (13.3%)	17,100 (16.2%)	20,200 (20.1%)
Black Locust Octagonal Average	9,620* (13.6%)	17,200 (14.2%)	20,700 (18.4%)
Hard Maple 0.75"	9,800 (20.4%)	13,000 (22.1%)	16,700 (25.3%)
Hard Maple 1.00"	9,860 (15.8%)	15,700 (16.7%)	19,000 (18.5%)
Hard Maple 1.25"	10,500 (18.0%)	16,500 (12.4%)	18,200 (12.2%)
Red Oak 0.75"	10,300 (12.8%)	14,900 (13.1%)	19,200 (15.1%)
Red Oak 1.00"	9,250 (21.7%)	14,400 (14.7%)	17,200 (17.8%)
Red Oak 1.25"	10,600 (22.7%)	14,700 (15.5%)	15,900 (17.1%)
Red Oak 0.75" Taper	10,100 (25.3%)	13,900 (18.9%)	17,700 (18.9%)
Red Oak 0.875" Taper	8,900 (16.2%)	13,600 (13.1%)	17,500 (14.4%)
Red Oak 1.00" Taper	8,590 (11.2%)	14,000 (13.5%)	17,200 (14.5%)
White Oak 0.875"	7,700 (16.9%)	12,400 (12.7%)	17,000 (12.5%)

* A t-test found that the yield strength of the black locust groups was significantly different.

Figure 4. Splintering Failure in Black Locust Octagonal Peg. View is From the Bottom Surface of Peg.

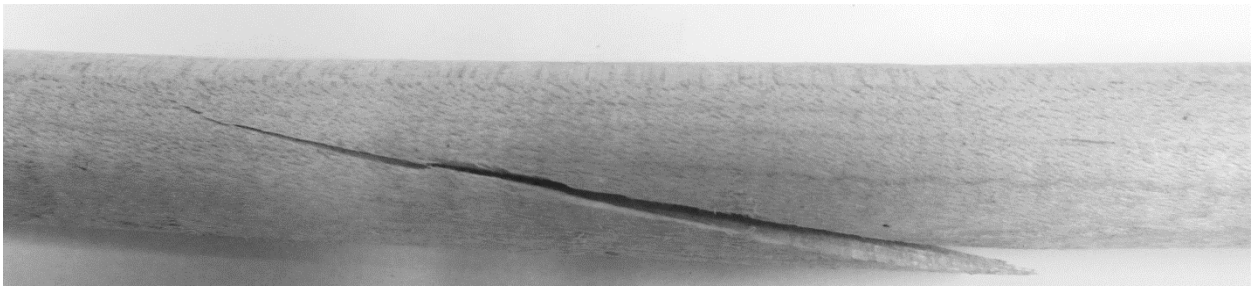

Figure 5. Cross Grain Failure in Maple Peg.

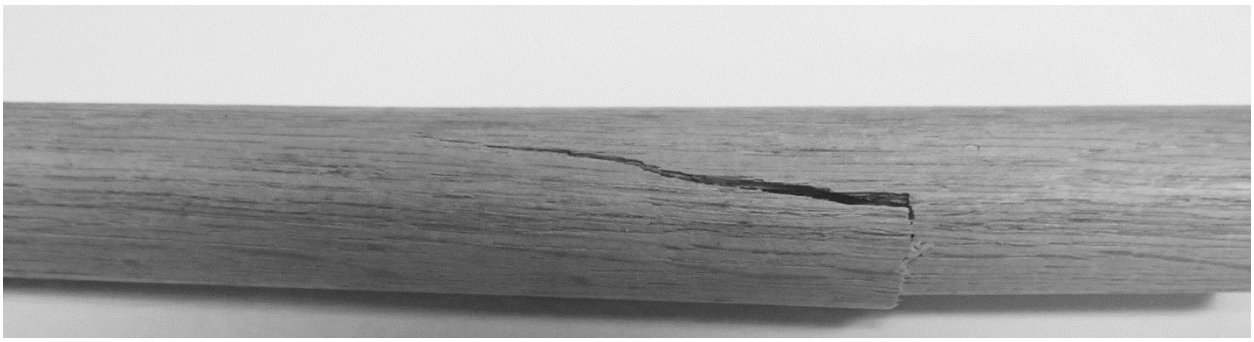

Figure 6. Simple Tension Failure in Peg

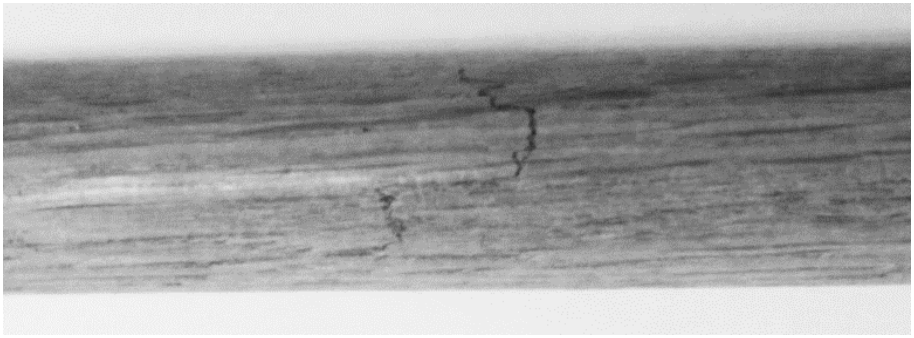

Figure 7. Brash Failure in Peg

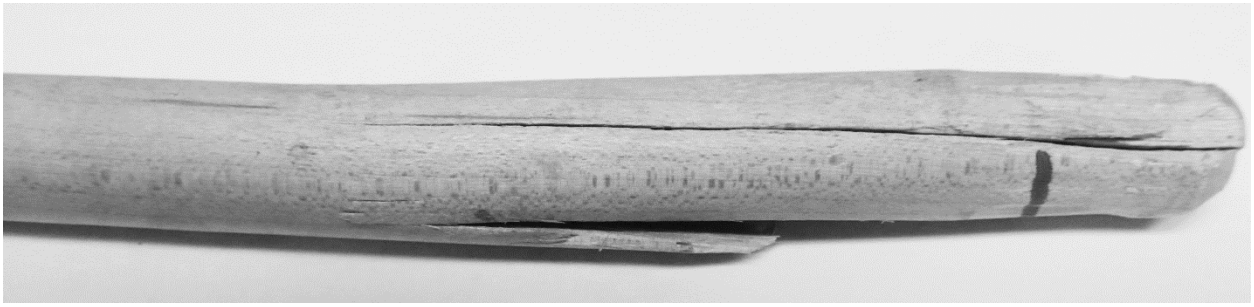

Figure 8. Horizontal Shear Failure in Peg. Note that the chamfered end of the peg is shown on the right side.

The number of peg failures for each of the groups tested is listed in Table 4. The majority of peg failures were splintering or cross-grain failure. Some simple tension, a few brash failures and one horizontal shear failure occurred. The number and diversity of failures seems consistent with clear wood products and no real trends were observed.

Table 4. Primary Failures of Pegs

Name	Splintering	Cross-Grain	Simple Tension	Brash	Horizontal Shear
Black Locust Octagonal 1.0", Group 1	16	10	4	--	--
Black Locust Octagonal 1.0", Group 2	23	6	1	--	--
Hard Maple 0.75"	6	21	2	--	1
Hard Maple 1.00"	7	14	8	1	--
Hard Maple 1.25"	--	26	4		--
Red Oak 0.75"	12	18	--	--	--
Red Oak 1.00"	5	21	2	2	--
Red Oak 1.25"	4	19	7	--	--
Red Oak 0.75" Taper	13	17	--	--	--
Read Oak 0.875" Taper	11	14	4	1	--
Red Oak 1.00" Taper	17	12	1	--	--
White Oak 0.875"	14	2	2	2	--

The 5% offset strength values from testing were regressed to form a set of one and two factor power equations based upon the diameter and specific gravity of the peg. The regression equations are shown in Table 5. Using only the current data, a two factor power equation produced an exponent for the diameter of 0.17 and for the specific gravity of 1.0. A single factor equation using only the specific gravity value had a specific gravity exponent of 1.06.

Table 5. Regression Equations Applied To Peg Data

Description	Regression Equation	Adjusted R^2 Value
2-Factor Power Equation Using Current Data	$F_{yb} = 22{,}150 * D^{0.17} * G^{1.0}$	0.335
1-Factor Power Equation Using Current Data	$F_{yb} = 22{,}530 * G^{1.06}$	0.335
Wood Handbook Equation	$F_{yb} = 24{,}850 * G^{1.13}$	0.225
2-Factor Power Equation Using Current Data and Schmidt and MacKay (1997)	$F_{yb} = 22{,}630 * D^{0.01} * G^{1.02}$	0.256
1-Factor Power Equation Using Current Data and Schmidt and MacKay (1997)	$F_{yb} = 22{,}640 * G^{1.02}$	0.257

The current data was combined with previous data from Schmidt and MacKay (1997) that was normalized to a 12% moisture content (ASTM D 1990 (ASTM 2015f)) to create a larger dataset. Seventy-four specimens with 5% offset strength from Schmidt MacKay (1997) were used. The total data set of four hundred and thirty-four specimens was used to generate the second set of two-factor and one-factor power regressions. For the two-factor equation, the power of the

diameter term decreased to 0.01 and the power of the specific gravity term was 1.02 for both the two-factor and single factor regressions.

Table 5 also shows the adjusted R-squared values. These R-squared values are normalized for multiple factors. The largest R-squared value were the single and two-factor regressions using the current data. The R-squared values fo the current data with the Schmidt and MacKay (1997) data included had a lower – but similar – R-squared value (0.256 for single factor, 0.257 for two-factor). The *Wood Handbook* equation had the lowest R-squared value of the regression equations applied.

The low value of the exponent for the diameter term and the similarity in the R-squared value of the single and two-factor regressions indicate that the diameter term has little power compared to the specific gravity value in the regression equations for the dowel bending strength. It should be noted that the calculation of bending strength used the diameter term, so that the stress values are normalized. To simplify the estimation of the dowel bending strength, the use of a single factor regression equation is advised.

Figure 9 is a graph of the current data and Schmidt and MacKay (1997) data along with the three single factor regression equations (*Wood Handbook*, current data, current data with Schmidt and MacKay (1997)). The Schmidt and MacKay (1997) data shows a greater variation of strength values compared to the current data. The *Wood Handbook* regression line is greater than the other two lines and does not seem to pass through the middle of the data, hence the lower R-squared value. The current data and the current data with Schmidt and MacKay (1997) regression lines are similar and roughly parallel over the range of specific gravity values.

For a conservative estimate of the dowel bending strength, the use of the current data equation is recommended ($F_{yb} = 22{,}530\ G^{1.06}$). However, the use of the *Wood Handbook* equation also produces satisfactory results.

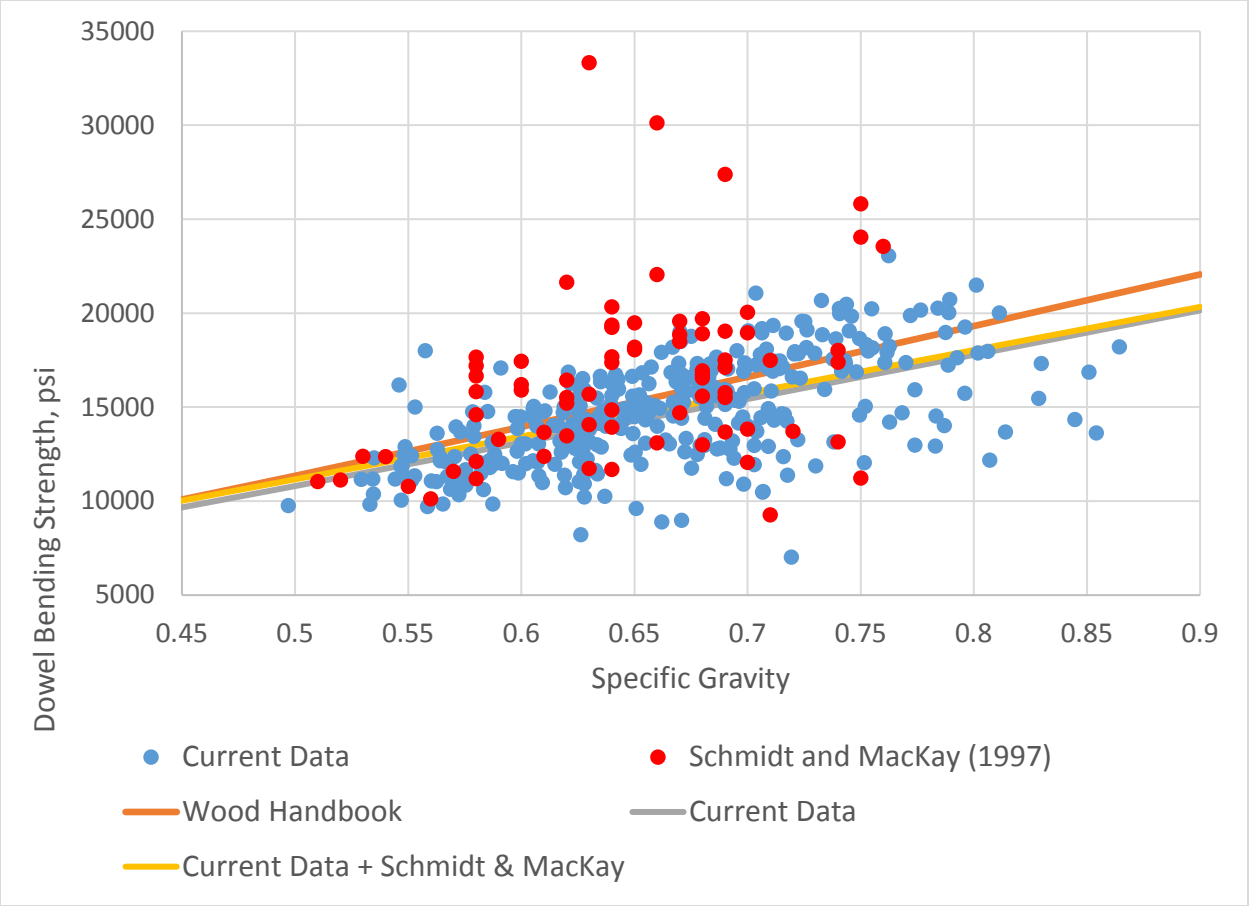

Figure 9. Comparison of Single Factor (Specific Gravity) Regression Curves Vs. Data

Conclusions

This project measured the 5% offset strength of a variety of timber frame pegs over several peg diameters. Three hundred and sixty pegs of different species (red oak, white oak, black locust, hard maple), diameter (¾", ¾"tapered, 7/8", 7/8" tapered, 1", 1" tapered, 1" octagonal, 1-1/4") were tested. The regression of the 5% offset strength values used both a two-factor and one-factor power equations. A regression of the 5% offset strength values was also performed including previous data from Schmidt and MacKay (1997). The exponent found for the diameter term was low, and very low (0.01) for the combined data set. Both single-factor and two-factor equations were presented to help member of TFEC choose an appropriate design relationship. The use of a single-factor regression equation based on specific gravity only is recommended.

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Appendix 1. Calculation of Bending Strength (MOR) of Pegs

The bending strength (MOR) equation is:

$$MOR = \frac{M}{S}$$

Where *M* is the applied moment and *S* is the section modulus. The moment is based on the shear-moment diagram with two equal loads, P/2, placed 3.125 inches from each end of the span. Therefore, moment is only dependent upon the applied load. The section modulus differs for the non-tapered and tapered sections and will be defined below.

$$M = \frac{Pa}{2} = \frac{P(3.125)}{2} = 1.563P$$

For the stiffness calculation, the deflection equation can be rewritten to solve for E. The span (*l*) is 9.00 inches and *a*=3.125 inches, so the stiffness is only dependent upon the load-deflection slope and the moment of inertia, *I*. Note that the stiffness (or modulus of elasticity) that is found in this equation is the apparent modulus of elasticity, rather than the true modulus of elasticity, since the shear deformation is not removed. Because the pegs were tested at the actual sizes and lengths used in timber frame joints, the term stiffness is used in the paper because this is the load-deformation response observed.

$$\Delta = \frac{Pa}{24EI}(3l^2 - 4a^2)$$

$$E = \left(\frac{P}{\Delta}\right)\frac{1}{I}\frac{(3l^2 - 4a^2)}{24} = \left(\frac{P}{\Delta}\right)\frac{26.56}{I}$$

a) Non-Tapered Circular Cross-Section

The non-tapered section modulus *S* and moment of inertia *I* values are shown below for a constant diameter *D*.

$$S = \frac{\pi D^3}{32}$$

$$I = \frac{\pi D^4}{64}$$

b) Tapered Circular Cross-Section

The tapered section modulus *S* and moment of inertia *I* values are based off of material presented by McCutcheon (1983). First, the ratio *r* of the diameter at the butt (d_B) and diameter at the tip (d_A) is found. Next, the quantity ξ is defined as the normalized length along the beam (x = 4.5 inches corresponding to midspan of the beam). Next, the tip values of moment of inertia I_A and section modulus S_A are defined. Then, the terms *I* and *S* are calculated.

$$r = \frac{d_B}{d_A} \qquad \xi = \frac{x}{L} = \frac{4.5}{9} = 0.5$$

$$I_A = \frac{\pi d_A^4}{64} \qquad S_A = \frac{\pi d_A^3}{32}$$

$$I = I_A[1 + (r - 1)\xi]^4$$

$$S = S_A[1 + (r - 1)\xi]^3$$

c) Octagonal Cross-Section

The area, moment of inertia and section modulus of an octagon cross-section are found on http://www.engineersedge.com/calculators/section_square_case_18.htm. The website also provides a calculator with the width *d* as an input.

$$A = 2d^2 \tan 22.5° = 0.828d^2$$

$$I = \frac{A}{12}\left[\frac{d^2(1 + 2cos^2\ 22.5°)}{4cos^2 22.5°}\right] = \frac{Ad^2}{15.134}$$

$$S = \frac{I}{d/_2} = \frac{A}{6}\left[\frac{d(1 + 2cos^2\ 22.5°)}{4cos^2 22.5°}\right] = \frac{Ad}{7.567}$$

Appendix 2. Calculation of Two Factor Power Equation

The form of the equation intended was as follows, where *A*, *B* and *C* are constants.

$$F_{yb} = A * Diameter^B * Specific\ Gravity^C$$

The equation can be put into a linear form by taking the natural logarithm of the F_{yb}, diameter and specific gravity values.

$$\ln(F_{yb}) = \ln(A) + B[\ln(Diameter)] + C[\ln(Specific\ Gravity)]$$

This equation now has the form,

$$y = m_1x_1 + m_2x_2 + b$$

This can be solved using a multiple variable regression tool that is available in Excel. For x_1 equal to the diameter, $m_1 = B$ and for x_2 equal to the specific gravity, $m_2 = C$. *A* equals *e* raised to the exponent *b* (e^b).

Appendix 3. Summary Data Sheets From Peg Testing

Data sheets include the measurements of the samples (diameters at each end), test data (slope, load at yield, load at 5% diameter offset, load at failure), and subsequent calculations (section properties, stiffness/ modulus of elasticity, strength at yield, strength at 5% diameter, strength at failure).

Black Locust 1" Diameter Pegs

Group 1

	Left Side		Right Side		Average	Testing Results						Section Properties	
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	A	MOI
O-1-1	0.9655	0.966	0.965	0.945	0.960375	3731.431	486.1	762.71	955.58	Sp / CG		0.764	0.047
O-1-2	0.971	0.955	0.962	0.959	0.96175	4462.094	539.41	923.72	1014.96	CG		0.766	0.047
O-1-3	0.965	0.94	0.967	0.947	0.95475	3846.267	513.49	837.67	999.72	Sp / CG		0.755	0.045
O-1-4	0.943	0.964	0.94	0.942	0.94725	5317.039	546.88	972.85	1322.05	ST / CG / Sp		0.743	0.044
O-1-5	0.95	0.965	0.943	0.979	0.95925	6252.165	740.96	1240.7	1448.7	Sp		0.762	0.046
O-1-6	0.944	0.983	0.941	0.943	0.95275	5402.906	553.9	973	1161.05	CG		0.752	0.045
O-1-7	0.944	0.959	0.961	0.938	0.9505	5230.27	590.13	982.61	1124.82	Sp / CG		0.748	0.045
O-1-8	0.963	0.937	0.957	0.936	0.94825	5979.496	658.15	1142.75	1478.15	Sp		0.745	0.044
O-1-9	0.968	0.979	0.968	0.958	0.96825	5603.165	531.81	934.04	1031.38	ST		0.776	0.048
O-1-10	0.96	0.938	0.941	0.942	0.94525	5134.087	634.89	1094.91	1187.28	CG		0.740	0.044
O-1-11	0.945	0.965	0.944	0.966	0.955	4045.679	500.74	796.34	980.01	Sp		0.755	0.046
O-1-12	0.963	0.941	0.942	0.965	0.95275	5411.839	627.99	1127.24	1350.82	Sp		0.752	0.045
O-1-13	0.967	0.969	0.944	0.962	0.9605	5920.795	579.02	1055.12	1404.91	Sp		0.764	0.047
O-1-14	0.945	0.964	0.941	0.967	0.95425	3919.483	536.19	806.18	894.02	ST / CG		0.754	0.045
O-1-15	0.959	0.935	0.963	0.941	0.9495	5719.321	606.14	1070.29	1390.51	Sp		0.746	0.044
O-1-16	0.935	0.96	0.955	0.957	0.95175	5264.766	592.96	1047.09	1323.56	CG		0.750	0.045
O-1-17	0.961	0.942	0.938	0.97	0.95275	5416.391	659.02	1073.26	1396.88	CG		0.752	0.045
O-1-18	0.934	0.965	0.938	0.969	0.9515	5965.66	604.23	1056.63	1436.37	Sp		0.750	0.045
O-1-19	0.94	0.96	0.936	0.962	0.9495	5350.483	594.22	1063.2	1242.22	CG		0.746	0.044
O-1-20	0.963	0.943	0.946	0.965	0.95425	4785.739	635.25	1002.18	1002.18	CG		0.754	0.045
O-1-21	0.938	0.962	0.956	0.963	0.95475	5481.228	673.2	1080.37	1287.88	Sp / CG		0.755	0.045
O-1-22	0.933	0.958	0.959	0.963	0.95325	5426.927	573.98	1018.52	1133.72	Sp		0.752	0.045
O-1-23	0.969	0.954	0.943	0.96	0.9565	5516.544	593.25	995.31	1375.47	Sp		0.758	0.046
O-1-24	0.966	0.943	0.965	0.939	0.95325	4022.314	519.41	816.58	951.42	ST / CG		0.752	0.045
O-1-25	0.941	0.966	0.94	0.966	0.95325	4497.548	524.03	865.01	865.01	CG		0.752	0.045
O-1-26	0.939	0.959	0.941	0.962	0.95025	5543.9	567.84	988.58	1318.57	Sp		0.748	0.045
O-1-27	0.961	0.944	0.962	0.944	0.95275	5167.696	595.38	973.32	1154.14	CG		0.752	0.045
O-1-28	0.965	0.939	0.956	0.937	0.94925	4949.024	600.29	961.03	1119.66	CG		0.746	0.044
O-1-29	0.959	0.94	0.963	0.941	0.95075	5656.085	728.31	1159.57	1499.85	Sp		0.748	0.045
O-1-30	0.946	0.962	0.942	0.957	0.95175	5305.611	563.41	962.97	1283.55	Sp		0.750	0.045
	Failure Key			Average	0.954	5144	589	993	1204			0.753	0.045
	Sp = Splintering			Std. Dev.	0.005	683	62.1	115	191			0.008	0.001
	CG = Cross-Grain			COV	0.5%	13.3%	10.5%	11.6%	15.8%			1.0%	2.0%
	ST = Simple Tension												

Black Locust 1" Diameter Pegs

Group 1 Page 2

			Unadjusted Values						Moisture Adjusted Stress to 12%			
S		MOE	F(yield)	F(5%)	F(ult)	MC	SG		MOE Adj	F(yield)	F(5%)	F(ult)
0.096924	O-1-1	2.13E+06	7838.906	12299.55	15409.8	13.4%	0.619		2.18E+06	8130.144	12830.31	16107.56
0.09734	O-1-2	2.53E+06	8661.334	14832.22	16297.26	13.1%	0.623		2.57E+06	8919.267	15344.97	16870.51
0.09523	O-1-3	2.25E+06	8427.822	13748.53	16408.23	13.7%	0.600		2.31E+06	8816.15	14480.49	17311.96
0.093004	O-1-4	3.21E+06	9190.742	16349.5	22218.07	14.1%	0.714		3.31E+06	9728.762	17455.95	23790.51
0.096583	O-1-5	3.58E+06	11990.9	20078.15	23444.2	14.1%	0.801		3.70E+06	12762.63	21501.64	25138.96
0.094633	O-1-6	3.18E+06	9148.436	16070.46	19176.37	13.6%	0.711		3.26E+06	9562.014	16909.2	20205.88
0.093964	O-1-7	3.11E+06	9816.207	16344.71	18710.23	14.1%	0.743		3.21E+06	10420.93	17482.85	20041.65
0.093299	O-1-8	3.59E+06	11025.76	19144.1	24762.95	14.0%	0.744		3.70E+06	11705.34	20464.4	26526.69
0.099327	O-1-9	3.09E+06	8368.476	14697.9	16229.63	14.6%	0.690		3.22E+06	8975.217	15949.7	17637.53
0.092416	O-1-10	3.12E+06	10737.69	18517.86	20080.08	12.7%	0.706		3.16E+06	10962.67	18953.15	20557.6
0.095305	O-1-11	2.36E+06	8212.106	13059.93	16072.11	14.0%	0.702		2.43E+06	8656.595	13876.12	17119.26
0.094633	O-1-12	3.19E+06	10372.14	18617.95	22310.69	12.9%	0.706		3.23E+06	10647.22	19178.09	22998.48
0.096961	O-1-13	3.38E+06	9333.7	17008.35	22646.9	14.2%	0.763		3.49E+06	9921.899	18249.01	24366.93
0.095081	O-1-14	2.29E+06	8814.234	13252.5	14696.47	13.8%	0.637		2.36E+06	9250.33	13991.06	15533.43
0.093668	O-1-15	3.42E+06	10114.41	17859.49	23202.86	14.0%	0.745		3.52E+06	10712.12	19058.46	24816.66
0.094336	O-1-16	3.11E+06	9824.47	17348.73	21929.43	13.7%	0.752		3.20E+06	10312.37	18332.1	23214.43
0.094633	O-1-17	3.19E+06	10884.64	17726.4	23071.43	14.0%	0.761		3.29E+06	11536.15	18904.2	24660.39
0.094261	O-1-18	3.53E+06	10019.09	17520.6	23817.29	13.9%	0.739		3.64E+06	10576.72	18628.34	25386.79
0.093668	O-1-19	3.20E+06	9915.503	17741.18	20728.41	14.0%	0.717		3.30E+06	10502.38	18940.37	22161.33
0.095081	O-1-20	2.80E+06	10442.65	16474.48	16474.48	13.2%	0.716		2.86E+06	10817.18	17130.42	17130.42
0.09523	O-1-21	3.20E+06	11049.11	17731.93	21137.75	14.3%	0.726		3.32E+06	11828.87	19115.21	22828.62
0.094782	O-1-22	3.19E+06	9465.176	16795.83	18695.53	14.1%	0.753		3.30E+06	10045.96	17980.51	20036.7
0.095755	O-1-23	3.20E+06	9683.563	16246.35	22451.67	13.8%	0.700		3.29E+06	10175.41	17182.28	23807.49
0.094782	O-1-24	2.36E+06	8565.293	13465.75	15689.32	14.0%	0.655		2.44E+06	9041.949	14322.2	16718.1
0.094782	O-1-25	2.64E+06	8641.479	14264.39	14264.39	13.2%	0.610		2.69E+06	8928.613	14810.82	14810.82
0.09389	O-1-26	3.30E+06	9452.893	16457	21950.37	13.8%	0.712		3.39E+06	9944.428	17437.71	23314.75
0.094633	O-1-27	3.04E+06	9833.537	16075.75	19062.24	14.0%	0.657		3.14E+06	10408.11	17133.78	20351.59
0.093594	O-1-28	2.96E+06	10024.71	16048.98	18698.07	13.5%	0.653		3.03E+06	10461.14	16830.92	19631.94
0.094038	O-1-29	3.36E+06	12105.14	19273.05	24928.79	13.5%	0.741		3.44E+06	12667.9	20252.09	26236.3
0.094336	O-1-30	3.14E+06	9334.87	15954.99	21266.52	14.0%	0.678		3.24E+06	9880.672	17022.95	22753.43
0.094872	Average	3.02E+06	9710	16367	19861	Average	13.8%	0.702	3.11E+06	10209.97	17324.98	21068.89
0.001426	Std. Dev.	410601	1064	1973	3231	Std. Dev.	0.004	0.051	428101	1140	2120	3517
1.5%	COV	13.6%	11.0%	12.1%	16.3%	COV	3.0%	7.2%	13.8%	11.2%	12.2%	16.7%

Black Locust 1" Diameter Pegs

Group 2

	Left Side		Right Side		Average	Testing Results						Section Properties	
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	A	MOI
L2-1	0.95	0.941	1.006	0.898	0.94875	5536.742	673.69	1195.73	1443.17	Sp /CG		0.745	0.044
L2-2	0.958	0.932	0.891	0.945	0.9315	5818.391	485.99	955.5	1136.05	Sp /CG		0.718	0.041
L2-3	0.994	0.952	0.991	0.954	0.97275	5109.072	590.25	1092.95	1205.09	Sp /CG		0.783	0.049
L2-4	0.937	0.97	0.946	0.957	0.9525	5690.242	547.82	1152.9	1152.9	CG / ST		0.751	0.045
L2-5	0.949	0.97	0.922	0.966	0.95175	3522.186	428.37	717.62	718.32	CG	Broke	0.750	0.045
L2-6	0.961	0.975	0.96	0.972	0.967	5030.322	538	998.07	1273.84	Sp /CG		0.774	0.048
L2-7	0.96	0.925	0.97	0.968	0.95575	4398.953	509.75	892.14	1021.9	CG		0.756	0.046
L2-8	0.997	0.976	0.931	0.992	0.974	5550.394	597	1144.72	1363.4	Sp /CG		0.786	0.049
L2-9	0.963	0.955	0.96	0.946	0.956	6457.167	484.18	1056.82	1185.44	Sp /CG		0.757	0.046
L2-10	1.029	0.966	0.968	0.95	0.97825	6013.845	621.21	1195.55	1503.78	Sp /CG		0.792	0.050
L2-11	0.968	0.961	0.961	0.963	0.96325	5291.291	565.93	1095.18	1298.54	CG		0.768	0.047
L2-12	0.947	0.928	0.955	0.943	0.94325	5740.227	711.63	1085.27	1086.42	Sp /CG		0.737	0.043
L2-13	0.941	0.93	0.959	0.93	0.94	5999.891	520.63	1198.24	1393.48	Sp /CG		0.732	0.043
L2-14	0.952	0.944	0.945	0.961	0.9505	6257.126	634.16	1290.71	1655.51	Sp /CG		0.748	0.045
L2-15	0.945	0.959	0.944	0.937	0.94625	5801.862	579.08	1272.67	1410.7	CG		0.741	0.044
L2-16	0.928	0.958	0.946	0.961	0.94825	5542.261	572.44	1126.28	1431.85	Sp /CG		0.745	0.044
L2-17	0.947	0.94	0.915	1.019	0.95525	4143.963	506.24	857.21	977.82	CG		0.756	0.046
L2-18	0.951	0.963	0.958	0.936	0.952	6077.403	592.87	1261.15	1426.59	Sp /CG		0.750	0.045
L2-19	0.942	0.946	0.956	0.973	0.95425	5665.73	648.55	1227.81	1509.67	Sp /CG		0.754	0.045
L2-20	0.939	0.977	0.965	0.947	0.957	5865.676	586.58	1185.38	1577.23	Sp /CG		0.758	0.046
L2-21	0.94	0.962	0.907	0.955	0.941	5962.946	582.03	1210.87	1462.02	Sp /CG		0.733	0.043
L2-22	0.947	0.961	0.961	0.96	0.95725	5512.242	607.88	1120.07	1394.22	Sp /CG		0.759	0.046
L2-23	0.94	0.962	0.971	0.951	0.956	4724.541	495.46	628.57	667.52	ST	Broke @ knot	0.757	0.046
L2-24	0.947	0.961	0.932	0.962	0.9505	5785.629	658.45	1258.01	1501.53	Sp /CG		0.748	0.045
L2-25	0.961	0.942	0.946	0.934	0.94575	5426.296	571.57	1107.69	1188.92	Sp /CG		0.741	0.044
L2-26	0.968	0.961	0.965	0.954	0.962	5706.15	675.64	1179.28	1434.61	Sp /CG	Brash @ knot	0.766	0.047
L2-27	0.963	0.96	0.962	0.964	0.96225	5039.621	555.76	1056.53	1126.67	Sp /CG		0.767	0.047
L2-28	0.95	0.964	0.956	0.954	0.956	6211.986	499.06	1080.19	1315	Sp /CG		0.757	0.046
L2-29	0.928	0.957	0.965	0.944	0.9485	6158.226	611.06	1244.4	1603.53	Sp /CG		0.745	0.044
L2-30	0.961	0.937	0.959	0.932	0.94725	5982.153	642.03	1213.75	1635.91	Sp /CG		0.743	0.044
	Failure Key			Average	0.954	5534	576	1103	1303			0.754	0.045
	Sp = Splintering			Std. Dev.	0.010	656	66.7	159	245			0.016	0.002
	CG = Cross-Grain			COV	1.1%	11.8%	11.6%	14.4%	18.8%			2.2%	4.3%
	ST = Simple Tension												

Black Locust 1" Diameter Pegs

Group 2 Page 2

			Unadjusted Values						Moisture Adjusted Stress to 12%			
S		MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
0.093446	L2-1	3.32E+06	11268.27	20000.01	24138.73	13.1%	0.789381	3.37E+06	11636.6	20731.62	25042.54
0.088441	L2-2	3.75E+06	8588.773	16886.3	20077.11	9.6%	0.796047	3.62E+06	8100.188	15741.06	18679.35
0.100719	L2-3	2.77E+06	9159.772	16960.9	18701.14	9.9%	0.77396	2.68E+06	8683.27	15933.27	17550.57
0.094559	L2-4	3.36E+06	9055.143	19056.76	19056.76	9.9%	0.801739	3.25E+06	8585.696	17880.21	17880.21
0.094336	L2-5	2.08E+06	7097.457	11889.9	11901.5	12.8%	0.807058	2.11E+06	7241.141	12180.64	12192.6
0.098943	L2-6	2.79E+06	8498.753	15766.45	20122.77	6.6%	0.85412	2.58E+06	7521.584	13621.95	17278.56
0.09553	L2-7	2.56E+06	8340.204	14596.63	16719.68	9.7%	0.813922	2.47E+06	7891.15	13673.41	15635.56
0.101108	L2-8	2.99E+06	9228.898	17695.99	21076.51	10.4%	0.748018	2.92E+06	8865.816	16881.73	20082.13
0.095605	L2-9	3.75E+06	7915.631	17277.45	19380.2	11.2%	0.850826	3.71E+06	7759.329	16855.13	18898.13
0.102437	L2-10	3.19E+06	9478.536	18241.92	22944.95	11.5%	0.806118	3.16E+06	9353.527	17961.82	22581.62
0.097797	L2-11	2.98E+06	9044.781	17503.34	20753.47	7.6%	0.828633	2.80E+06	8152.228	15472.03	18284.6
0.091831	L2-12	3.52E+06	12112.29	18471.82	18491.4	11.5%	0.725998	3.49E+06	11931.71	18172.81	18192.02
0.090885	L2-13	3.73E+06	8953.607	20606.9	23964.57	11.4%	0.754915	3.70E+06	8816.537	20225.54	23512.82
0.093964	L2-14	3.72E+06	10548.6	21469.64	27537.71	9.9%	0.776517	3.61E+06	9993.581	20169.39	25823.39
0.09271	L2-15	3.51E+06	9762.775	21456.09	23783.15	9.7%	0.740711	3.39E+06	9194.068	19982.33	22129.29
0.093299	L2-16	3.33E+06	9589.894	18868.19	23987.3	10.2%	0.722388	3.24E+06	9146.004	17850.28	22652.68
0.09538	L2-17	2.42E+06	8295.789	14047.16	16023.6	9.0%	0.78299	2.31E+06	7729.176	12926.4	14712.42
0.09441	L2-18	3.59E+06	9815.242	20878.93	23617.87	10.4%	0.771915	3.51E+06	9414.16	19878.21	22468.71
0.095081	L2-19	3.32E+06	10661.28	20183.53	24816.92	10.5%	0.796211	3.24E+06	10234.2	19263.28	23656.71
0.095905	L2-20	3.39E+06	9559.69	19318.53	25704.64	8.1%	0.788591	3.21E+06	8683.275	17245.03	22847.78
0.091175	L2-21	3.69E+06	9977.664	20757.79	25063.22	7.5%	0.864383	3.46E+06	8928.894	18214.06	21922.42
0.09598	L2-22	3.19E+06	9899.063	18239.86	22704.27	10.9%	0.739779	3.13E+06	9611.42	17631.64	21924.47
0.095605	L2-23	2.75E+06	8100.042	10276.2	10912.97	6.4%	0.670805	2.53E+06	7158.951	8974.867	9506.232
0.093964	L2-24	3.44E+06	10952.64	20925.71	24976.41	8.7%	0.787505	3.28E+06	10056.19	18982.08	22607.46
0.092563	L2-25	3.29E+06	9651.454	18704.3	20075.94	10.6%	0.761578	3.22E+06	9303.484	17921.02	19226.7
0.097416	L2-26	3.23E+06	10840.33	18921	23017.65	9.6%	0.792544	3.12E+06	10182.64	17632.52	21409.38
0.097492	L2-27	2.85E+06	8909.963	16938.32	18062.81	6.9%	0.768218	2.65E+06	7911.601	14705.9	15657.53
0.095605	L2-28	3.61E+06	8158.897	17659.52	21498.32	11.4%	0.829833	3.58E+06	8031.255	17320.75	21074.24
0.093372	L2-29	3.69E+06	10228.79	20830.53	26842.16	10.7%	0.811287	3.62E+06	9883.765	20017.38	25763.56
0.093004	L2-30	3.61E+06	10789.81	20398.01	27492.73	11.4%	0.788879	3.57E+06	10615.27	20023.21	26970.07
0.095085	Average	3.25E+06	9483	18161	21448	Average	9.9%	0.785	3.15E+06	9020.557	17135.65	20205.46
0.003078	Std. Dev.	434686	1129	2728	4119	Std. Dev.	0.017	0.042	443730	1202	2770	4068
3.2%	COV	13.4%	11.9%	15.0%	19.2%	COV	17.1%	5.3%	14.1%	13.3%	16.2%	20.1%

Hard Maple 3/4" Diameter Pegs

	Left Side		Right Side		Average		Testing Results					
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI
M-075-1	0.7465	0.748	0.742	0.746	0.745625	2339.914	346.5	462.61	593.53	Sp		0.015
M-075-2	0.7535	0.751	0.74	0.745	0.747375	1630.032	240.29	319.8	459.04	Sp		0.015
M-075-3	0.7445	0.7535	0.74	0.746	0.746	1355.552	220.18	295.44	362.43	CG	Snapped in Two	0.015
M-075-4	0.7485	0.752	0.749	0.7495	0.74975	1290.619	213.41	277.44	339.18	CG	Nearly Snapped in Two	0.016
M-075-5	0.752	0.7475	0.7405	0.7495	0.747375	1379.658	227.05	300.58	380.22	CG		0.015
M-075-6	0.751	0.748	0.7445	0.7435	0.74675	1299.642	210.27	276.25	380.33	CG		0.015
M-075-7	0.743	0.7425	0.7405	0.7415	0.741875	927.7514	197.02	244.69	337.67	ST		0.015
M-075-8	0.752	0.7425	0.74	0.733	0.741875	1357.681	209.23	277.84	362.06	CG	Nearly Snapped in Two	0.015
M-075-9	0.7515	0.7445	0.737	0.736	0.74225	1345.132	216.3	293.32	354.31	CG	Snapped in Two	0.015
M-075-10	0.741	0.7445	0.7525	0.7455	0.745875	1258.011	211.65	272.54	316.43	CG		0.015
M-075-11	0.751	0.749	0.729	0.714	0.73575	1719.841	232.99	325.43	443.84	CG		0.014
M-075-12	0.75	0.7535	0.747	0.7435	0.7485	1450.853	219.43	297.81	397.33	Sp	Extreme Sp - Similar to CG	0.015
M-075-13	0.7495	0.7455	0.7485	0.7445	0.747	2134.674	306.28	414.63	494.21	CG		0.015
M-075-14	0.7535	0.751	0.7325	0.7425	0.744875	2074.017	310.14	425.36	570.96	Sp		0.015
M-075-15	0.7335	0.728	0.7445	0.7405	0.736625	1174.886	212.82	274.3	314	CG	Snapped in Two	0.014
M-075-16	0.7565	0.7525	0.7375	0.7385	0.74625	1653.956	172.38	172.38	176.93	CG		0.015
M-075-17	0.7735	0.747	0.7265	0.7225	0.742375	1746.113	267.22	360.53	440.37	CG		0.015
M-075-18	0.746	0.7555	0.728	0.727	0.739125	1479.896	234.75	308.28	368.8	CG		0.015
M-075-19	0.749	0.753	0.7345	0.7425	0.74475	2466.446	378.37	496.11	623.08	CG	Some Splintering	0.015
M-075-20	0.738	0.745	0.759	0.755	0.74925	1222.545	207.3	275.09	346.78	CG	Snapped in Two	0.015
M-075-21	0.7505	0.746	0.743	0.7365	0.744	1535.603	226.51	307.15	426.98	CG	Both Sides	0.015
M-075-22	0.745	0.741	0.747	0.7405	0.743375	1698.229	228.07	346.81	581.83	Sp	Just Kept Bending	0.015
M-075-23	0.7575	0.745	0.7315	0.728	0.7405	1671.155	255.65	347.31	439.88	ST		0.015
M-075-24	0.7445	0.7475	0.696	0.711	0.72475	1862.991	268.94	322.42	324.03	HS / CG	Damaged / Chip @ Right Side	0.014
M-075-25	0.7505	0.7525	0.7465	0.741	0.747625	1274.707	210.72	273.96	347.42	CG	Nearly Snapped in Two	0.015
M-075-26	0.751	0.747	0.74	0.7345	0.743125	1475.482	217.75	293.84	370.77	CG		0.015
M-075-27	0.7485	0.748	0.742	0.733	0.742875	1472.756	236.87	329.53	363.75	CG		0.015
M-075-28	0.7265	0.725	0.736	0.7435	0.73275	1092.729	200.09	257.29	349.09	CG	Failure Follows Grain	0.014
M-075-29	0.7515	0.74	0.74	0.739	0.742625	2165.46	311.57	430.01	561.17	Sp		0.015
M-075-30	0.748	0.7505	0.7425	0.7395	0.745125	1133.14	177.94	241.2	301.1	CG	Knot 4.5" From Right Side (Face Up)	0.015

Failure Key	Average	0.743	1556	239	317	404	0.015
Sp = Splintering	Std. Dev.	0.005	379	48.1	70	101	0.000
CG = Cross-Grain	COV	0.7%	24.3%	20.1%	22.0%	25.1%	2.8%
ST = Simple Tension							
HS = Horizontal Shear							

Hard Maple 3/4" Diameter Pegs

		Unadjusted Values					Moisture Adjusted Stress to 12%			
S		MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
0.040697	M-075-1	4.10E+06	13307.64	17766.94	22795.04	14.2%	0.70022	4.23E+06	14220.81	19053.96	24503.59
0.040984	M-075-2	2.83E+06	9163.873	12196.12	17506.28	14.3%	0.601744	2.93E+06	9753.925	13051.28	18825.71
0.040758	M-075-3	2.37E+06	8443.46	11329.53	13898.46	14.2%	0.566837	2.45E+06	8951.247	12080.41	14865.73
0.041376	M-075-4	2.21E+06	8061.659	10480.42	12812.68	14.2%	0.544257	2.29E+06	8554.416	11184.25	13720.03
0.040984	M-075-5	2.39E+06	8658.943	11463.14	14500.35	14.5%	0.570597	2.49E+06	9282.086	12366.14	15706.46
0.040881	M-075-6	2.26E+06	8039.161	10561.74	14540.99	14.5%	0.552916	2.35E+06	8579.218	11344.03	15705.38
0.040086	M-075-7	1.66E+06	7682.051	9540.763	13166.17	13.9%	0.546898	1.70E+06	8055.156	10045.53	13927.75
0.040086	M-075-8	2.43E+06	8158.134	10833.32	14117.16	13.9%	0.575188	2.49E+06	8565.896	11431.02	14948.02
0.040147	M-075-9	2.40E+06	8421.026	11419.58	13794.05	14.1%	0.585786	2.48E+06	8906.281	12147.1	14713.42
0.040738	M-075-10	2.20E+06	8120.433	10456.62	12140.56	14.2%	0.529283	2.28E+06	8618.05	11157.99	12988.8
0.039101	M-075-11	3.18E+06	9313.342	13008.46	17741.68	14.4%	0.606701	3.30E+06	9961.76	14004.2	19182.33
0.041169	M-075-12	2.50E+06	8330.665	11306.36	15084.64	14.0%	0.601906	2.58E+06	8787.507	11993.01	16063.07
0.040922	M-075-13	3.71E+06	11698.12	15836.46	18875.95	10.1%	0.658445	3.61E+06	11108.85	14984.49	17831.05
0.040574	M-075-14	3.65E+06	11947.21	16385.72	21994.52	14.6%	0.705621	3.79E+06	12910.65	17797.77	23973.46
0.039241	M-075-15	2.16E+06	8476.804	10925.61	12506.89	13.2%	0.548154	2.20E+06	8750.602	11310.01	12962.72
0.040799	M-075-16	2.89E+06	6603.785	6603.785	6778.093	14.6%	0.719376	3.00E+06	7023.683	7023.683	7215.464
0.040167	M-075-17	3.11E+06	10398.2	14029.12	17135.9	14.3%	0.605457	3.22E+06	11096.07	15044.4	18422.75
0.039642	M-075-18	2.68E+06	9255.737	12154.88	14541.07	14.0%	0.548576	2.77E+06	9776.669	12896.59	15464.49
0.040554	M-075-19	4.34E+06	14582.91	19120.78	24014.38	14.4%	0.732576	4.50E+06	15710.33	20668.66	26015.68
0.041293	M-075-20	2.10E+06	7846.539	10412.47	13126.01	14.0%	0.562447	2.17E+06	8275.245	11043.7	13971.42
0.040431	M-075-21	2.71E+06	8756.442	11873.83	16506.23	14.3%	0.562963	2.81E+06	9335.301	12737.25	17792.5
0.04033	M-075-22	3.01E+06	8839.005	13440.85	22549.21	14.5%	0.783333	3.13E+06	9470.683	14525.03	24529.02
0.039863	M-075-23	3.01E+06	10023.74	13617.62	17247.18	14.0%	0.598266	3.10E+06	10612.07	14483.84	18394.06
0.037374	M-075-24	3.65E+06	11247.34	13483.93	13551.26	14.0%	0.711638	3.76E+06	11911.53	14316.31	14388.71
0.041025	M-075-25	2.21E+06	8028.111	10437.46	13236.17	14.1%	0.551471	2.28E+06	8491.049	11099.11	14128.64
0.040289	M-075-26	2.62E+06	8447.567	11399.46	14383.95	13.7%	0.588106	2.69E+06	8845.533	11992.16	15173.53
0.040248	M-075-27	2.62E+06	9198.604	12796.96	14125.86	14.3%	0.704112	2.71E+06	9801.591	13719.8	15166.82
0.038625	M-075-28	2.05E+06	8096.867	10411.53	14126.32	14.2%	0.560209	2.12E+06	8569.964	11077.36	15101.46
0.040208	M-075-29	3.85E+06	12111.73	16715.87	21814.48	14.0%	0.720654	3.97E+06	12865.92	17828.16	23323.33
0.040615	M-075-30	1.99E+06	6847.709	9282.159	11587.3	14.1%	0.565374	2.05E+06	7207.893	9840.157	12332.61
0.040307	Average	2.76E+06	9270	12310	15673	Average	14.0%	0.614	2.85E+06	9799.999	13074.91	16711.27
0.000848	Std. Dev.	677757	1874	2699	3886	Std. Dev.	0.008	0.072	694176	2002	2888	4230
2.1%	COV	24.5%	20.2%	21.9%	24.8%	COV	5.6%	11.8%	24.4%	20.4%	22.1%	25.3%

Hard Maple 1" Diameter Pegs

	Left Side		Right Side		Average	Testing Results						
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI	S
M-1-1	1.0135	1.0025	1.001	0.9955	1.003125	5118.374	536.85	947.22	1104.1	ST		0.050	0.099098
M-1-2	1.003	1.0155	1.0095	1.009	1.00925	4701.833	584.09	959.73	1060.05	CG		0.051	0.100924
M-1-3	1.0045	1.0005	1.004	1.0025	1.002875	5378.713	712.75	1075.72	1250.08	Sp / CG		0.050	0.099024
M-1-4	1.001	1.002	1.0005	1	1.000875	4478.33	545.38	885.13	1093.83	ST		0.049	0.098433
M-1-5	1.0065	1.003	1.012	1.0195	1.01025	4222.929	541.44	826.62	1066.76	CG		0.051	0.101225
M-1-6	0.999	1.0095	1.002	1.007	1.004375	4164.899	493.58	786.08	1067.72	ST / CG		0.050	0.099469
M-1-7	0.9975	1.004	0.9915	1.002	0.99875	5687.674	690.7	1034.71	1274.29	Sp		0.049	0.097807
M-1-8	0.994	1.003	0.998	1.003	0.9995	4782.113	507.06	842.15	1049.07	CG		0.049	0.098028
M-1-9	1.001	1.0045	0.989	0.9905	0.99625	4429.846	563.35	891.57	1091.99	CG		0.048	0.097074
M-1-10	1.0005	1.0065	1.001	1.0065	1.003625	4763.897	588.99	919.47	1030.98	CG		0.050	0.099246
M-1-11	0.992	1.003	0.997	1.0065	0.999625	5083.168	590.01	946.49	1161.65	CG / Sp		0.049	0.098064
M-1-12	1.0055	0.9985	1.0045	0.999	1.001875	4117.485	507.72	813.22	1128.5	ST		0.049	0.098728
M-1-13	1.002	1	0.991	0.9875	0.995125	4490.362	583.53	912.36	941.56	CG		0.048	0.096746
M-1-14	1.003	0.9975	1.0015	0.995	0.99925	5541.85	731.04	1087.32	1319.61	Sp		0.049	0.097954
M-1-15	1.0055	1.009	1.004	1.005	1.005875	4210.88	510.28	826.42	881.86	ST / CG		0.050	0.099915
M-1-16	1.0015	0.999	1.0035	0.997	1.00025	5911.545	735.28	1137.66	1415.05	CG		0.049	0.098248
M-1-17	1.002	1.003	1.004	1.0025	1.002875	2708.948	358.83	559.27	605.45	CG	Snapped in 2	0.050	0.099024
M-1-18	1.003	1.002	1.0035	1.0045	1.00325	4347.111	555.69	912.46	1072.77	CG		0.050	0.099135
M-1-19	1.0005	1.011	1.0055	1.009	1.0065	4910.92	577.1	967.33	1212.87	ST		0.050	0.100102
M-1-20	1.0055	1.001	1.004	1.002	1.003125	4196.509	492.57	518.6	647.85	B		0.050	0.099098
M-1-21	1.001	1.002	1.002	1.0065	1.002875	5930.723	609	1038.31	1354.12	Sp		0.050	0.099024
M-1-22	1.007	1.0005	1.0035	0.999	1.0025	4451.612	544.64	873.43	1145.94	ST		0.050	0.098913
M-1-23	1.0055	1.0015	1.006	0.9995	1.003125	3902.999	543.09	840.65	1002.15	CG		0.050	0.099098
M-1-24	0.997	1.0035	0.998	1.0045	1.00075	4873.742	659.9	966.92	1178.7	Sp		0.049	0.098396
M-1-25	1.0065	0.998	1.0095	1.0005	1.003625	4921.607	607.57	960.91	1207.37	Sp		0.050	0.099246
M-1-26	0.998	1.0005	1.002	1.002	1.000625	4606.919	533.42	873.37	947.58	CG		0.049	0.098359
M-1-27	1.004	0.997	1.001	1.011	1.00325	5118.675	608.62	947.85	1161.89	ST		0.050	0.099135
M-1-28	0.999	1.0045	1.002	1.0045	1.0025	6050.714	652.33	1078	1364.25	Sp		0.050	0.098913
M-1-29	1	1.0005	0.998	1.0045	1.00075	5096.421	608.89	970.68	1072.2	CG		0.049	0.098396
M-1-30	0.999	1.0075	1.004	1.001	1.002875	2736.331	394.2	596.99	694.19	CG	Snapped in 2	0.050	0.099024

Failure Key	Average	1.002	4698	572	900	1087		0.050	0.098862
Sp = Splintering	Std. Dev.	0.003	786	86.0	145	195		0.001	0.000943
CG = Cross-Grain	COV	0.3%	16.7%	15.0%	16.2%	17.9%		1.3%	1.0%
ST = Simple Tension									
B = Brash									

Hard Maple 1" Diameter Pegs

	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
M-1-1	2.74E+06	8467.338	14939.8	17414.15	14.9%	0.635092	2.86E+06	9153.754	16360.28	19115.26
M-1-2	2.45E+06	9045.708	14863.18	16416.82	14.9%	0.669221	2.56E+06	9808.415	16295.05	18027.4
M-1-3	2.88E+06	11250.09	16979.23	19731.34	14.6%	0.670423	3.00E+06	12172.08	18499.09	21538.4
M-1-4	2.41E+06	8660.017	14054.86	17368.78	15.3%	0.685507	2.54E+06	9497.851	15616.47	19374.99
M-1-5	2.19E+06	8360.319	12763.75	16471.73	15.0%	0.614176	2.30E+06	9078.126	14013.21	18168.87
M-1-6	2.21E+06	7755.842	12352.02	16777.56	15.1%	0.649382	2.32E+06	8423.315	13593.91	18572.52
M-1-7	3.09E+06	11037.69	16535.12	20363.71	14.9%	0.666804	3.24E+06	12052.17	18196.39	22475.43
M-1-8	2.59E+06	8084.814	13427.65	16726.89	14.6%	0.646843	2.70E+06	8667.545	14559.51	18197.83
M-1-9	2.43E+06	9070.524	14355.21	17582.18	14.7%	0.640064	2.54E+06	9772.813	15615.14	19182.62
M-1-10	2.54E+06	9275.826	14480.46	16236.59	15.0%	0.628039	2.66E+06	10089.22	15910.9	17875.24
M-1-11	2.75E+06	9403.881	15085.64	18514.97	14.9%	0.67459	2.88E+06	10225.46	16575.15	20407.62
M-1-12	2.21E+06	8037.903	12874.39	17865.7	14.9%	0.685726	2.31E+06	8688.167	14083.97	19652.51
M-1-13	2.48E+06	9427.344	14739.83	15211.57	14.5%	0.642971	2.58E+06	10125.16	15966.3	16484.99
M-1-14	3.01E+06	11664.81	17349.78	21056.31	14.8%	0.670174	3.14E+06	12690.4	19005.7	23123.2
M-1-15	2.23E+06	7982.439	12927.9	13795.16	15.2%	0.717427	2.34E+06	8688.987	14262.06	15239.38
M-1-16	3.20E+06	11697.31	18098.64	22511.54	15.4%	0.784105	3.37E+06	12985.71	20275.55	25300.97
M-1-17	1.45E+06	5663.794	8827.55	9556.458	15.1%	0.650718	1.52E+06	6064.382	9618.242	10437.03
M-1-18	2.32E+06	8761.211	14386.18	16913.68	15.1%	0.690939	2.44E+06	9552.846	15879.48	18722.27
M-1-19	2.59E+06	9010.913	15104.01	18937.91	15.1%	0.671888	2.71E+06	9821.016	16662.46	20967.23
M-1-20	2.24E+06	7768.942	8179.494	10218.06	15.1%	0.662119	2.35E+06	8433.3	8894.796	11186.32
M-1-21	3.17E+06	9612.491	16388.75	21373.51	15.1%	0.755135	3.33E+06	10523.76	18157.95	23773.83
M-1-22	2.38E+06	8606.28	13801.75	18107.89	15.2%	0.671642	2.51E+06	9403.801	15268.51	20129.35
M-1-23	2.09E+06	8565.757	13258.95	15806.17	15.4%	0.609163	2.20E+06	9407.198	14742.43	17638.12
M-1-24	2.63E+06	10482.39	15359.35	18723.44	15.7%	0.743238	2.78E+06	11702.16	17316.5	21189.22
M-1-25	2.62E+06	9568.437	15133.08	19014.51	15.3%	0.680783	2.76E+06	10510.46	16807.91	21200.48
M-1-26	2.49E+06	8476.456	13878.52	15057.78	15.1%	0.696327	2.61E+06	9237.423	15317.68	16644.98
M-1-27	2.73E+06	9595.725	14944.15	18318.78	15.3%	0.634863	2.88E+06	10570.15	16644.35	20476.92
M-1-28	3.24E+06	10307.97	17034.32	21557.57	15.1%	0.733037	3.40E+06	11289.36	18852.03	23937.69
M-1-29	2.75E+06	9672.108	15419.08	17031.7	14.9%	0.741591	2.87E+06	10503.59	16909.02	18706.41
M-1-30	1.46E+06	6222.076	9422.925	10957.14	15.0%	0.636883	1.53E+06	6677.286	10260.86	11978.52
Average	2.52E+06	9051	14232	17187	Average	15.0%	0.675	2.64E+06	9860.531	15672.03	18990.85
Std. Dev.	428414	1384	2326	3106	Std. Dev.	0.003	0.043	449106	1558	2614	3511
COV	17.0%	15.3%	16.3%	18.1%	COV	1.7%	6.3%	17.0%	15.8%	16.7%	18.5%

Hard Maple 1-1/4" Diameter Pegs

	Left Side		Right Side		Average	Testing Results						
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI	S
M-125-1	1.259	1.2655	1.257	1.2675	1.26225	9114.621	1615.54	2117.59	2268.97	CG		0.125	0.19744
M-125-2	1.2645	1.2625	1.2565	1.265	1.262125	12778.13	2090.21	2778.66	3077.63	CG / Sp		0.125	0.197382
M-125-3	1.2555	1.2655	1.2565	1.262	1.259875	9820.462	1299.22	1968.46	2283.53	CG / Sp		0.124	0.196328
M-125-4	1.2685	1.269	1.264	1.265	1.266625	7287.976	1110.07	1644.03	1772.17	CG	Snapped in 2	0.126	0.199501
M-125-5	1.2595	1.265	1.2625	1.262	1.26225	9132.947	1160.36	1919.87	2093.11	ST		0.125	0.19744
M-125-6	1.259	1.2655	1.256	1.261	1.260375	9440.98	1246.88	1912.87	1987.72	CG		0.124	0.196562
M-125-7	1.268	1.264	1.2615	1.261	1.263625	10001.23	1382.02	2053.99	2265.33	CG		0.125	0.198086
M-125-8	1.2675	1.261	1.2665	1.2655	1.265125	9081.171	1101.3	1908.62	2022.13	CG		0.126	0.198793
M-125-9	1.257	1.2595	1.2605	1.258	1.25875	8196.304	1216.29	1807.66	2028.65	ST		0.123	0.195803
M-125-10	1.265	1.264	1.264	1.259	1.263	8948.098	1210.1	1984.48	2186.27	CG		0.125	0.197793
M-125-11	1.26	1.26	1.2595	1.257	1.259125	9988.539	1325.66	2148.54	2326.04	CG		0.123	0.195978
M-125-12	1.265	1.2635	1.265	1.262	1.263875	7495.534	1015.38	1700.03	1926.78	CG		0.125	0.198204
M-125-13	1.264	1.267	1.262	1.264	1.26425	7748.176	970.65	1457.36	1612.6	ST		0.125	0.19838
M-125-14	1.262	1.262	1.258	1.2605	1.260625	10490.17	1553.68	2350.88	2413.53	CG		0.124	0.196679
M-125-15	1.265	1.26	1.262	1.262	1.26225	10042	1212.18	2107.5	2380.41	CG		0.125	0.19744
M-125-16	1.26	1.261	1.262	1.2635	1.261625	9687.539	1495.1	2014.76	2041.14	CG		0.124	0.197147
M-125-17	1.263	1.2685	1.262	1.259	1.263125	9101.906	1104.94	1891.08	2125.72	CG		0.125	0.197851
M-125-18	1.263	1.257	1.265	1.2595	1.261125	7590.419	1239.42	1750.29	1990.37	CG		0.124	0.196913
M-125-19	1.2635	1.2655	1.2665	1.2655	1.26525	9248.341	1086.08	1843.95	2260.67	CG		0.126	0.198852
M-125-20	1.263	1.2665	1.268	1.263	1.265125	9366.917	1329.06	2079.6	2245.42	CG		0.126	0.198793
M-125-21	1.2585	1.258	1.255	1.2615	1.25825	9001.416	1313.14	1962.77	2155.91	ST		0.123	0.195569
M-125-22	1.2615	1.2605	1.2545	1.259	1.258875	8404.633	1041.34	1776.15	2176.38	CG		0.123	0.195861
M-125-23	1.262	1.254	1.2595	1.2535	1.25725	9092.377	1170.74	1967.02	2026.59	CG		0.123	0.195103
M-125-24	1.259	1.2665	1.2605	1.261	1.26175	8211.862	1379.67	1987.14	2088.61	CG		0.124	0.197206
M-125-25	1.259	1.2575	1.258	1.258	1.258125	8690.764	1125.48	1860.17	2043.82	CG		0.123	0.195511
M-125-26	1.26	1.2575	1.2535	1.253	1.256	8281.383	1005.25	1773.63	2136.71	CG		0.122	0.194522
M-125-27	1.263	1.2585	1.2585	1.2545	1.258625	9805.548	1212.12	2046.27	2405.49	CG		0.123	0.195744
M-125-28	1.261	1.2685	1.256	1.264	1.262375	11088.27	1530.48	2318.45	2583.01	CG	mulitple failures	0.125	0.197499
M-125-29	1.2575	1.2655	1.258	1.263	1.261	10706.37	1309.24	2153.72	2460.92	CG		0.124	0.196854
M-125-30	1.2615	1.261	1.2575	1.261	1.26025	9943.763	1283.36	1992.14	2174.5	CG		0.124	0.196503
	Failure Key			Average	1.261	9260	1271	1976	2185			0.124	0.197058
	Sp = Splintering			Std. Dev.	0.003	1159	225.6	241	263			0.001	0.001222
	CG = Cross-Grain			COV	0.2%	12.5%	17.7%	12.2%	12.0%			0.8%	0.6%
	ST = Simple Tension												

Hard Maple 1-1/4" Diameter Pegs

	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
M-125-1	1.94E+06	12789.12	16763.5	17961.88	14%	0.68629	1.99E+06	13445.04	17670.71	18944.85
M-125-2	2.72E+06	16551.67	22003.28	24370.72	13%	0.762295	2.79E+06	17318.6	23065.96	25561.84
M-125-3	2.11E+06	10343.31	15671.24	18179.56	14%	0.620778	2.18E+06	11053.98	16859.49	19592.66
M-125-4	1.53E+06	8696.916	12880.26	13884.18	14%	0.703666	1.58E+06	9202.466	13722.47	14807.19
M-125-5	1.95E+06	9185.773	15198.29	16569.71	14%	0.734094	1.99E+06	9578.732	15940.2	17391.22
M-125-6	2.02E+06	9914.81	15210.56	15805.74	13%	0.612669	2.06E+06	10262.54	15803.83	16426.61
M-125-7	2.12E+06	10904.83	16207.01	17874.58	14%	0.711032	2.19E+06	11590.54	17320.98	19123.24
M-125-8	1.92E+06	8658.934	15006.46	15898.93	13%	0.685316	1.96E+06	9008.274	15710.94	16653.34
M-125-9	1.77E+06	9709.073	14429.7	16193.76	13%	0.681864	1.80E+06	10085.05	15049	16903.99
M-125-10	1.90E+06	9562.475	15681.79	17276.38	14%	0.682815	1.96E+06	10069.19	16622.33	18329.97
M-125-11	2.15E+06	10572.67	17135.47	18551.1	13%	0.720972	2.20E+06	11027.91	17956.95	19451.58
M-125-12	1.59E+06	8007.101	13406.13	15194.24	13%	0.616329	1.62E+06	8312.467	14006.31	15892.07
M-125-13	1.64E+06	7647.559	11482.25	12705.36	14%	0.751659	1.68E+06	7968.113	12037.72	13335.76
M-125-14	2.25E+06	12347.04	18682.36	19180.24	13%	0.72401	2.30E+06	12883.91	19561.68	20086.47
M-125-15	2.14E+06	9595.996	16683.63	18844.07	13%	0.698734	2.18E+06	9934.612	17356.46	19618.77
M-125-16	2.07E+06	11853.28	15973.19	16182.33	13%	0.64906	2.11E+06	12313.57	16634.41	16853.75
M-125-17	1.93E+06	8728.885	14939.29	16792.92	14%	0.689919	1.98E+06	9096.975	15669.44	17631.13
M-125-18	1.62E+06	9837.918	13892.96	15798.6	13%	0.667087	1.66E+06	10249.08	14528.73	16539.92
M-125-19	1.95E+06	8536.736	14493.7	17769.17	13%	0.752049	1.99E+06	8814.487	15041.72	18465.81
M-125-20	1.98E+06	10449.69	16350.78	17654.54	14%	0.669622	2.04E+06	11017.42	17335.48	18731.36
M-125-21	1.94E+06	10494.68	15686.56	17230.14	14%	0.642656	1.99E+06	10969.21	16466.02	18100.26
M-125-22	1.81E+06	8310.053	14173.95	17367.85	13%	0.716233	1.84E+06	8529.905	14612.49	17925.5
M-125-23	1.97E+06	9378.958	15758.07	16235.29	14%	0.673366	2.02E+06	9780.022	16526.51	17031.22
M-125-24	1.75E+06	10934.89	15749.53	16553.75	14%	0.719765	1.80E+06	11477.59	16598.91	17454.36
M-125-25	1.88E+06	8997.575	14871.01	16339.18	14%	0.625931	1.94E+06	9545.322	15907.49	17497.84
M-125-26	1.80E+06	8077.263	14251.26	17168.63	13%	0.645695	1.84E+06	8395.766	14917.05	17998.53
M-125-27	2.11E+06	9678.669	16339.28	19207.62	13%	0.708887	2.16E+06	10071.5	17092.33	20115.8
M-125-28	2.36E+06	12112.16	18348.12	20441.84	14%	0.725325	2.43E+06	12841.74	19546.87	21798.11
M-125-29	2.29E+06	10395.21	17100.27	19539.4	13%	0.72962	2.34E+06	10813.16	17869.39	20436.27
M-125-30	2.13E+06	10207.92	15845.6	17296.11	14%	0.666157	2.20E+06	10786.67	16843.04	18401.26
Average	1.98E+06	10083	15674	17336	Average	13.6%	0.689	2.03E+06	10548.13	16475.83	18236.69
Std. Dev.	248602	1787	1920	2096	Std. Dev.	0.003	0.042	254738	1898	2037	2216
COV	12.6%	17.7%	12.3%	12.1%	COV	2.3%	6.1%	12.6%	18.0%	12.4%	12.2%

Red Oak 3/4" Diameter Pegs

	Left Side		Right Side		Average	Testing Results						
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI	S
ST-075-1	0.741	0.751	0.742	0.747	0.74525	1980.418	255.67	358.2	499.09	Sp / CG		0.015	0.040636
ST-075-2	0.758	0.764	0.755	0.763	0.76	1795.452	262.66	387.84	485.61	Sp		0.016	0.043096
ST-075-3	0.744	0.746	0.75	0.747	0.74675	1422.565	228.67	306.82	427.27	CG		0.015	0.040881
ST-075-4	0.764	0.761	0.763	0.763	0.76275	2402.044	345.33	505.47	699.15	Sp / CG		0.017	0.043566
ST-075-5	0.763	0.761	0.76	0.759	0.76075	2389.237	340.67	498.92	596.1	CG		0.016	0.043224
ST-075-6	0.763	0.761	0.76	0.759	0.76075	1777.267	249.69	369.71	457.57	CG		0.016	0.043224
ST-075-7	0.761	0.758	0.764	0.765	0.762	1648.486	256.8	379.85	477.26	Sp / CG		0.017	0.043437
ST-075-8	0.762	0.765	0.755	0.761	0.76075	1763.167	283.12	394.58	472.4	CG		0.016	0.043224
ST-075-9	0.761	0.757	0.762	0.763	0.76075	2569.239	338.72	499.85	503.86	CG		0.016	0.043224
ST-075-10	0.765	0.759	0.764	0.766	0.7635	2434.168	344.21	503.47	612.9	CG		0.017	0.043695
ST-075-11	0.747	0.743	0.743	0.744	0.74425	1802.706	231.95	346.84	546.52	Sp		0.015	0.040472
ST-075-12	0.763	0.758	0.761	0.764	0.7615	2196.463	273.65	405.06	620.58	Sp		0.017	0.043352
ST-075-13	0.758	0.751	0.756	0.749	0.7535	1482.658	241.88	338.92	396.97	Sp		0.016	0.042
ST-075-14	0.759	0.762	0.752	0.757	0.7575	2004.597	295.87	435.69	558	CG		0.016	0.042672
ST-075-15	0.758	0.756	0.764	0.761	0.75975	2497.152	350.36	512.06	684.98	CG		0.016	0.043054
ST-075-16	0.757	0.761	0.765	0.754	0.75925	2509.374	375.69	535.6	688.07	CG		0.016	0.042969
ST-075-17	0.764	0.761	0.764	0.76	0.76225	2341.522	353.53	497.52	666.23	Sp		0.017	0.04348
ST-075-18	0.751	0.75	0.753	0.749	0.75075	1269.816	219.02	285.5	351.9	CG / ST		0.016	0.041542
ST-075-19	0.747	0.748	0.745	0.752	0.748	1693.583	243.15	345.64	486.32	Sp		0.015	0.041087
ST-075-20	0.756	0.765	0.763	0.758	0.7605	1892.084	343.23	459.14	541.21	Sp / CG		0.016	0.043181
ST-075-21	0.768	0.764	0.764	0.767	0.76575	2245.074	342.15	487.4	617.46	CG		0.017	0.044082
ST-075-22	0.762	0.76	0.759	0.762	0.76075	2562.747	278.87	433.82	613.41	CG		0.016	0.043224
ST-075-23	0.756	0.763	0.762	0.763	0.761	2345.318	270.13	445.41	620.91	CG		0.016	0.043267
ST-075-24	0.748	0.749	0.749	0.752	0.7495	2040.308	295.89	425.54	544.86	CG / ST		0.015	0.041335
ST-075-25	0.762	0.763	0.76	0.761	0.7615	2022.129	264.1	415.11	515.38	CG		0.017	0.043352
ST-075-26	0.761	0.766	0.762	0.765	0.7635	2202.794	300.74	442.44	593.17	CG		0.017	0.043695
ST-075-27	0.763	0.761	0.76	0.759	0.76075	1933.694	298.58	423.15	507.29	CG		0.016	0.043224
ST-075-28	0.74	0.745	0.743	0.746	0.7435	1616.942	223.88	309.14	380.09	Sp / CG		0.015	0.04035
ST-075-29	0.749	0.746	0.742	0.751	0.747	1935.791	276.83	402.25	514.4	Sp		0.015	0.040922
ST-075-30	0.765	0.768	0.762	0.766	0.76525	2294.447	304.22	430.23	501.34	CG		0.017	0.043996
	Failure Key			Average	0.757	2036	290	419	539			0.016	0.042649
	Sp = Splintering			Std. Dev.	0.007	361	45.2	68	91			0.001	0.001149
	CG = Cross-Grain			COV	0.9%	17.7%	15.6%	16.2%	17.0%			3.6%	2.7%
	ST = Simple Tension												

Red Oak 3/4" Diameter Pegs

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	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
ST-075-1	3.47E+06	9834.061	13777.76	19196.94	12.6%	0.579096	3.50E+06	9985.74	14010.07	19540.04
ST-075-2	2.91E+06	9526.037	14066.01	17611.89	10.4%	0.579055	2.84E+06	9142.086	13436.93	16791.35
ST-075-3	2.48E+06	8742.64	11730.51	16335.63	12.8%	0.591451	2.51E+06	8927.839	12003.16	16743.06
ST-075-4	3.84E+06	12389.3	18134.59	25083.19	9.9%	0.713907	3.72E+06	11701.37	17050.42	23519.77
ST-075-5	3.86E+06	12318.76	18041.15	21555.21	10.7%	0.677793	3.78E+06	11864.28	17324.06	20676.86
ST-075-6	2.87E+06	9028.89	13368.86	16545.91	10.7%	0.635302	2.82E+06	8736.024	12883.82	15920.19
ST-075-7	2.65E+06	9240.366	13668.04	17173.12	10.3%	0.607545	2.58E+06	8860.232	13041.31	16351.18
ST-075-8	2.85E+06	10237.73	14268.17	17082.17	10.4%	0.562797	2.78E+06	9808.373	13617.6	16277.15
ST-075-9	4.15E+06	12248.25	18074.77	18219.78	10.7%	0.769912	4.07E+06	11811.48	17379.2	17517.77
ST-075-10	3.88E+06	12312.76	18009.66	21924.09	10.6%	0.703854	3.79E+06	11830.79	17250.29	20974.1
ST-075-11	3.18E+06	8957.709	13394.66	21106.13	14.2%	0.844689	3.29E+06	9522.16	14341.9	22718.65
ST-075-12	3.53E+06	9866.084	14603.9	22374.18	10.4%	0.643001	3.45E+06	9467.294	13951.53	21305.94
ST-075-13	2.49E+06	9001.384	12612.65	14772.94	11.4%	0.55144	2.47E+06	8872.869	12413.68	14531.81
ST-075-14	3.29E+06	10837.08	15958.38	20438.33	10.4%	0.655172	3.22E+06	10388.59	15237.18	19478.56
ST-075-15	4.06E+06	12719.25	18589.5	24867.08	11.1%	0.708333	4.00E+06	12394.79	18080.21	24160.12
ST-075-16	4.09E+06	13665.78	19482.53	25028.64	10.6%	0.749484	4.00E+06	13115.52	18647.78	23922.65
ST-075-17	3.75E+06	12708.46	17884.52	23949.2	9.7%	0.641672	3.63E+06	11933.64	16720.08	22328.25
ST-075-18	2.16E+06	8240.562	10741.85	13240.13	12.8%	0.570355	2.19E+06	8415.072	10991.29	13564.41
ST-075-19	2.93E+06	9249.72	13148.56	18500.2	14.1%	0.78692	3.02E+06	9809.525	14027.71	19817.68
ST-075-20	3.06E+06	12423.58	16619.06	19589.68	10.4%	0.677139	2.99E+06	11871.47	15835.52	18642.26
ST-075-21	3.53E+06	12131.5	17281.59	21893.08	10.5%	0.723347	3.46E+06	11650.29	16545.32	20928.43
ST-075-22	4.14E+06	10084.05	15687.1	22181.15	10.3%	0.709177	4.04E+06	9639.226	14917.29	21034.66
ST-075-23	3.78E+06	9758.385	16090.33	22430.23	10.6%	0.693505	3.71E+06	9416.832	15454.27	21499.29
ST-075-24	3.50E+06	11188.57	16091.06	20602.94	13.0%	0.678303	3.55E+06	11519.3	16606.59	21288.55
ST-075-25	3.25E+06	9521.772	14966.23	18581.34	10.0%	0.634681	3.16E+06	9057.551	14146.38	17525.34
ST-075-26	3.51E+06	10757.79	15826.55	21218.33	11.0%	0.694444	3.46E+06	10472.89	15368.55	20576.2
ST-075-27	3.12E+06	10796.77	15301.27	18343.81	10.1%	0.597232	3.04E+06	10269.92	14491.28	17342.57
ST-075-28	2.86E+06	8672.243	11974.89	14723.21	12.3%	0.607244	2.88E+06	8735.608	12071.69	14847.85
ST-075-29	3.36E+06	10573.3	15363.61	19647.09	13.0%	0.685133	3.42E+06	10875.14	15842.68	20284.64
ST-075-30	3.62E+06	10807.79	15284.45	17810.72	10.3%	0.634454	3.53E+06	10318.05	14533.49	16912.35
Average	3.34E+06	10595	15335	19734	Average	11.2%	0.664	3.30E+06	10347.13	14940.71	19234.06
Std. Dev.	535231	1497	2238	3118	Std. Dev.	0.013	0.071	509277	1320	1951	2898
COV	16.0%	14.1%	14.6%	15.8%	COV	11.4%	10.7%	15.5%	12.8%	13.1%	15.1%

Red Oak 1" Diameter Pegs

	Left Side		Right Side		Average			Testing Results				Section Properties	
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI	S
RO-1-1	1.0065	1.01	1.012	1.0115	1.01	5938.163	512.98	899.32	1236.37	Sp		0.051	0.10115
RO-1-2	1.011	0.9945	1.007	0.9865	0.99975	3484.87	417.68	678.32	718.94	CG		0.049	0.098101
RO-1-3	1.009	1.0035	1.01	1.012	1.008625	4514.856	579.74	909.06	1122.44	CG		0.051	0.100737
RO-1-4	1.0055	1.0185	1.007	1.027	1.0145	4060.162	516.71	764.34	1000.18	CG		0.052	0.102508
RO-1-5	1.016	1.0375	1.0185	1.0155	1.021875	4137.421	605.24	895.82	1021.17	CG		0.054	0.104759
RO-1-6	1.01	1.008	1.0125	1.01	1.010125	4437.095	641.3	945.05	1062.59	CG		0.051	0.101187
RO-1-7	1.013	1.014	1.0175	1.013	1.014375	4449.495	507.15	849.64	1029.27	B		0.052	0.10247
RO-1-8	1.0005	1.0205	1.012	1.0175	1.012625	4016.58	491.1	827.93	1062.99	ST		0.052	0.10194
RO-1-9	1.011	1.0065	1.0075	1.0145	1.009875	3940.881	535.15	885.31	1002.24	B / ST		0.051	0.101112
RO-1-10	1.0065	1.025	1.004	1.0215	1.01425	4500.253	474.48	803.53	1039.16	CG		0.052	0.102432
RO-1-11	1.013	1.0045	1	1.001	1.004625	4799.127	564.27	964.85	1225.55	CG		0.050	0.099543
RO-1-12	1.005	1.015	1.006	1.0095	1.008875	4891.531	757.04	1064.76	1265.42	ST		0.051	0.100812
RO-1-13	1.01	1.0155	1.011	1.0135	1.0125	4888.397	752.19	1032.06	1233.84	CG		0.052	0.101903
RO-1-14	1.0145	0.997	1.0095	1	1.00525	5203.366	885.53	1110.86	1369.96	CG		0.050	0.099729
RO-1-15	0.999	1.0105	0.9995	1.012	1.00525	4971.135	661.29	1013.38	1230.14	Sp		0.050	0.099729
RO-1-16	1.011	1.0085	1.015	1.015	1.012375	5354.843	368.83	892.58	1169.06	Sp		0.052	0.101865
RO-1-17	1.0165	1.0195	1.01	1.01	1.014	4823.939	637.02	981.51	1168.22	CG		0.052	0.102356
RO-1-18	1.005	1.006	1.011	1.011	1.00825	4585.573	548.42	870.1	1128.09	CG		0.051	0.100625
RO-1-19	1.012	1.0085	1.015	1.007	1.010625	4998.637	812.06	1096.43	1339.32	CG		0.051	0.101337
RO-1-20	1.014	1.0135	1.0085	1.0085	1.011125	4336.776	504.15	823.84	986.09	CG / ST		0.051	0.101488
RO-1-21	1.001	1.0105	1.0035	1.013	1.007	4954.818	543.22	908.14	1205.67	Sp		0.050	0.100251
RO-1-22	1.013	1.003	1.016	1.0075	1.009875	5390.047	731.86	1078.18	1266.33	CG		0.051	0.101112
RO-1-23	1.015	1.013	1.009	1.014	1.01275	4259.339	689.73	942.42	1016.74	CG		0.052	0.101978
RO-1-24	1.0185	1.01	1.0155	1.011	1.01375	5223.783	516.47	1000.31	1167.9	Sp		0.052	0.10228
RO-1-25	1.016	1.01	1.0095	1.0035	1.00975	2546.004	388.53	614.56	647.16	CG		0.051	0.101074
RO-1-26	1.013	1.004	1.0125	1.006	1.008875	4699.423	599.06	947.45	1139.37	CG		0.051	0.100812
RO-1-27	1.003	1.0105	1.0105	1.0155	1.009875	2402.374	466.18	618.6	619.38	CG		0.051	0.101112
RO-1-28	1.0095	1.011	1.0045	1.015	1.01	3115.61	483.48	718.53	782.41	CG		0.051	0.10115
RO-1-29	1.004	1.0185	1	1.015	1.009375	4036.573	575.24	895.47	977.25	CG		0.051	0.100962
RO-1-30	1.019	1.0085	1.013	1	1.010125	4633.94	673.78	936.96	1064.11	CG		0.051	0.101187
	Failure Key			Average	1.010	4453	581	899	1077			0.051	0.101257
	Sp = Splintering			Std. Dev.	0.004	791	123.7	129	188			0.001	0.001184
	CG = Cross-Grain			COV	0.4%	17.8%	21.3%	14.4%	17.4%			1.6%	1.2%
	ST = Simple Tension												
	B = Brash												

Red Oak 1" Diameter Pegs

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	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
RO-1-1	3.09E+06	7926.754	13896.62	19104.84	13.2%	0.670866	3.14E+06	8174.434	14412.57	19854.83
RO-1-2	1.89E+06	6654.701	10807.36	11454.54	13.2%	0.53442	1.92E+06	6842.221	11178.55	11854.35
RO-1-3	2.36E+06	8995.041	14104.65	17415.38	13.4%	0.61849	2.41E+06	9336.468	14711.21	18193.73
RO-1-4	2.07E+06	7878.614	11654.39	15250.4	12.9%	0.61483	2.10E+06	8061.61	11963.85	15680.3
RO-1-5	2.05E+06	9030.117	13365.54	15235.75	13.1%	0.630164	2.09E+06	9303.868	13818.7	15766.3
RO-1-6	2.31E+06	9905.923	14597.84	16413.43	13.1%	0.639357	2.34E+06	10202.21	15079.7	16967.1
RO-1-7	2.27E+06	7735.705	12959.8	15699.75	13.1%	0.627982	2.31E+06	7960.674	13405.66	16261.46
RO-1-8	2.07E+06	7529.794	12694.24	16298.3	13.2%	0.630252	2.11E+06	7760.081	13157.05	16923.38
RO-1-9	2.05E+06	8272.404	13685.21	15492.73	12.9%	0.622611	2.08E+06	8470.417	14066.21	15934.83
RO-1-10	2.30E+06	7240.056	12261.01	15856.47	13.1%	0.627112	2.34E+06	7446.614	12682.51	16431.89
RO-1-11	2.55E+06	8860.008	15149.8	19243.24	13.5%	0.71044	2.61E+06	9222.313	15865.69	20189.24
RO-1-12	2.55E+06	11737.24	16508.16	19619.22	13.2%	0.679207	2.60E+06	12141.08	17118.68	20364.51
RO-1-13	2.52E+06	11537.23	15829.93	18924.87	13.1%	0.66841	2.56E+06	11897.71	16360.05	19577.29
RO-1-14	2.76E+06	13878.42	17409.9	21470.63	13.1%	0.695277	2.80E+06	14326.71	17996.28	22215.81
RO-1-15	2.63E+06	10364.03	15882.15	19279.31	13.0%	0.678892	2.68E+06	10666.15	16393.98	19920.25
RO-1-16	2.76E+06	5659.279	13695.63	17937.9	13.2%	0.638777	2.81E+06	5807.606	14211.38	18647.6
RO-1-17	2.47E+06	9727.434	14987.87	17838.97	13.4%	0.652156	2.52E+06	10115.87	15655.75	18658.3
RO-1-18	2.40E+06	8518.589	13515.23	17522.58	12.8%	0.644068	2.43E+06	8708.429	13860.48	17992.47
RO-1-19	2.59E+06	12524.98	16911.02	20657.29	12.9%	0.686971	2.63E+06	12845.21	17370.18	21235.11
RO-1-20	2.24E+06	7764.336	12687.83	15186.62	12.9%	0.621922	2.28E+06	7941.807	13028.65	15610.33
RO-1-21	2.61E+06	8469.279	14158.7	18797.46	13.2%	0.653414	2.65E+06	8729.302	14663.08	19501.06
RO-1-22	2.80E+06	11313.17	16666.62	19575.06	13.3%	0.760684	2.86E+06	11754.33	17373.2	20425.84
RO-1-23	2.19E+06	10571.37	14444.31	15583.4	13.3%	0.649818	2.23E+06	10953.95	15008.55	16201.07
RO-1-24	2.68E+06	7892.445	15286.25	17847.28	13.0%	0.672314	2.72E+06	8101.657	15777.87	18436.72
RO-1-25	1.33E+06	6008.168	9503.461	10007.58	13.0%	0.497032	1.34E+06	6138.174	9759.932	10282.29
RO-1-26	2.45E+06	9287.896	14689.37	17664.92	13.0%	0.639614	2.49E+06	9543.111	15145.17	18231.21
RO-1-27	1.25E+06	7206.259	9562.383	9574.44	13.0%	0.533041	1.27E+06	7382.751	9825.666	9838.168
RO-1-28	1.62E+06	7470.91	11102.99	12090.09	13.2%	0.582101	1.65E+06	7692.914	11484.48	12514.92
RO-1-29	2.10E+06	8905.34	13862.85	15128.89	13.0%	0.633493	2.14E+06	9144.937	14285.46	15598.24
RO-1-30	2.41E+06	10407.63	14472.87	16436.91	13.2%	0.670204	2.45E+06	10770.37	15020.11	17073.29
Average	2.31E+06	8976	13878	16620	13.1%	0.639	2.35E+06	9248.099	14356.02	17212.73
Std. Dev.	412833	1925	2014	2922	0.002	0.053	421194	2004	2107	3056
COV	17.9%	21.4%	14.5%	17.6%	1.2%	8.2%	17.9%	21.7%	14.7%	17.8%

Red Oak 1-1/4" Diameter Pegs

	Left Side		Right Side		Average			Testing Results				Section Properties	
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	MOI	S
RO-125-1	1.2595	1.254	1.2535	1.256	1.25575	7441.148	788.96	1612.72	1882.77	CG / ST		0.122	0.194406
RO-125-2	1.2545	1.2405	1.2585	1.2595	1.25325	7633.338	1257.22	1848.39	2498.26	ST		0.121	0.193247
RO-125-3	1.261	1.262	1.2715	1.264	1.264625	7896.779	1319.6	1319.6	1623.3	CG		0.126	0.198557
RO-125-4	1.244	1.2565	1.253	1.268	1.255375	8268.477	1588.68	1983.23	2103.3	CG		0.122	0.194232
RO-125-5	1.255	1.26	1.26	1.268	1.26075	7696.497	1188.02	1719.02	1719.02	ST		0.124	0.196737
RO-125-6	1.2595	1.2675	1.259	1.263	1.26225	8876.994	1504.46	2020.06	2078.97	CG		0.125	0.19744
RO-125-7	1.2615	1.262	1.265	1.263	1.262875	6423.761	1333.79	1629.54	1629.54	CG / ST		0.125	0.197734
RO-125-8	1.261	1.2565	1.263	1.2555	1.259	9240.403	1502.11	2175.68	2327.82	ST		0.123	0.195919
RO-125-9	1.2595	1.256	1.2585	1.26	1.2585	11156.54	1200.77	2300.35	2743.88	Sp		0.123	0.195686
RO-125-10	1.2615	1.2665	1.2545	1.2595	1.2605	9823.049	1647.19	2366.96	2702.15	CG		0.124	0.19662
RO-125-11	1.253	1.256	1.254	1.2555	1.254625	9109.184	1398.4	2155.74	2469.17	Sp		0.122	0.193884
RO-125-12	1.2585	1.256	1.257	1.26	1.257875	9751.991	1380.51	1491.56	1730.9	ST		0.123	0.195395
RO-125-13	1.253	1.2565	1.24	1.26	1.252375	8687.757	1550.65	2134.97	2200.44	CG		0.121	0.192843
RO-125-14	1.257	1.2575	1.216	1.2625	1.24825	8220.366	1613.78	2066.16	2066.16	CG		0.119	0.190943
RO-125-15	1.2545	1.255	1.254	1.257	1.255125	8241.13	1211.46	1811.59	2167.87	Sp / CG		0.122	0.194116
RO-125-16	1.256	1.257	1.252	1.2545	1.254875	6698.15	1005.91	1621.98	1653.68	ST		0.122	0.194
RO-125-17	1.2535	1.2575	1.2595	1.26	1.257625	9006.429	1589.25	2209.66	2451.11	Sp		0.123	0.195278
RO-125-18	1.26	1.261	1.258	1.264	1.26075	8876.311	1364.14	2038	2165.79	CG		0.124	0.196737
RO-125-19	1.257	1.261	1.2525	1.259	1.257375	9187.512	2150.07	2630.59	2939.42	CG		0.123	0.195162
RO-125-20	1.2635	1.2555	1.2565	1.264	1.259875	8000.618	1883.94	2098.82	2157.17	CG		0.124	0.196328
RO-125-21	1.25	1.2555	1.253	1.247	1.251375	6277.921	971.98	1575.81	1693.99	CG		0.120	0.192381
RO-125-22	1.254	1.258	1.247	1.2465	1.251375	9279.658	2211.69	2550.91	2748.94	CG		0.120	0.192381
RO-125-23	1.2565	1.252	1.2675	1.2575	1.258375	9676.952	1505.47	2125	2173.29	CG / ST		0.123	0.195628
RO-125-24	1.255	1.253	1.256	1.256	1.255	7744.603	1295.05	1837.83	1911.3	ST		0.122	0.194058
RO-125-25	1.264	1.2585	1.2585	1.2665	1.261875	7786.907	1519.02	1960.56	2014.77	CG		0.124	0.197264
RO-125-26	1.2565	1.2585	1.257	1.259	1.25775	8596.583	1444.07	2200.08	2200.08	CG		0.123	0.195336
RO-125-27	1.263	1.262	1.256	1.256	1.25925	7837.565	999.71	1761.88	2029.92	CG		0.123	0.196036
RO-125-28	1.2555	1.2585	1.2585	1.261	1.258375	7667.064	1558.1	1906.61	1906.61	CG		0.123	0.195628
RO-125-29	1.2565	1.265	1.2655	1.26	1.26175	7360.923	1046.91	1694.34	1710.48	CG		0.124	0.197206
RO-125-30	1.255	1.2605	1.2575	1.262	1.25875	9651.928	1086.14	1977.56	1977.56	ST		0.123	0.195803
	Failure Key			Average	1.258	8404	1404	1961	2123			0.123	0.195233
	Sp = Splintering			Std. Dev.	0.004	1094	321.0	307	362			0.001	0.001779
	CG = Cross-Grain			COV	0.3%	13.0%	22.9%	15.6%	17.0%			1.2%	0.9%
	ST = Simple Tension												

Red Oak 1-1/4" Diameter Pegs

	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
RO-125-1	1.62E+06	6343.143	12966.07	15137.24	9.6%	0.564168	1.56E+06	6038.406	12147.54	14150.28
RO-125-2	1.67E+06	10168.51	14949.94	20206.15	10.2%	0.762712	1.63E+06	9705.612	14201.59	19143.99
RO-125-3	1.67E+06	10387.62	10387.62	12778.29	9.9%	0.587335	1.62E+06	9841.892	9841.892	12068.91
RO-125-4	1.80E+06	12784.24	15959.22	16925.44	9.3%	0.645736	1.73E+06	11879.61	14777.59	15659.51
RO-125-5	1.65E+06	9438.346	13656.93	13656.93	9.9%	0.626796	1.60E+06	8951.965	12878.4	12878.4
RO-125-6	1.89E+06	11909.78	15991.43	16457.78	9.2%	0.625128	1.82E+06	11049.41	14761.21	15185.3
RO-125-7	1.37E+06	10543.03	12880.81	12880.81	9.0%	0.547401	1.31E+06	9763.951	11877.65	11877.65
RO-125-8	1.99E+06	11983.5	17357.09	18570.83	9.7%	0.656396	1.92E+06	11269.92	16242.76	17365.99
RO-125-9	2.41E+06	9590.898	18373.56	21916.16	9.3%	0.684047	2.31E+06	8956.174	16961.99	20191.25
RO-125-10	2.11E+06	13094.06	18815.75	21480.28	9.7%	0.737794	2.03E+06	12271.68	17552.75	20012.1
RO-125-11	1.99E+06	11273.24	17378.55	19905.28	9.8%	0.621622	1.92E+06	10614.62	16266	18604.86
RO-125-12	2.11E+06	11042.98	11931.29	13845.82	10.3%	0.717672	2.05E+06	10542.34	11379.11	13182.55
RO-125-13	1.91E+06	12568.1	17304.05	17834.69	9.3%	0.702983	1.84E+06	11663.71	15977.8	16461.17
RO-125-14	1.83E+06	13209.87	16912.91	16912.91	9.2%	0.649213	1.76E+06	12221.39	15585.34	15585.34
RO-125-15	1.80E+06	9754.55	14586.73	17455.46	10.0%	0.628339	1.74E+06	9266.198	13776.86	16454.72
RO-125-16	1.46E+06	8104.324	13067.82	13323.22	9.9%	0.564129	1.42E+06	7712.112	12333.43	12571.23
RO-125-17	1.95E+06	12720.31	17686.06	19618.62	9.7%	0.627114	1.88E+06	11935.67	16523.32	18308.73
RO-125-18	1.90E+06	10837.55	16191.1	17206.34	9.2%	0.661252	1.82E+06	10069.82	14935.38	15858.08
RO-125-19	1.99E+06	17219.37	21067.73	23541.07	10.0%	0.745932	1.93E+06	16245.39	19840.57	22151.19
RO-125-20	1.72E+06	14998.36	16709.06	17173.59	10.0%	0.69852	1.67E+06	14174.04	15772.67	16206.77
RO-125-21	1.39E+06	7896.852	12802.67	13762.82	9.8%	0.581775	1.34E+06	7493.842	12039	12928.56
RO-125-22	2.05E+06	17968.88	20724.87	22333.76	9.7%	0.71131	1.98E+06	16793.39	19341.1	20828.4
RO-125-23	2.09E+06	12028.21	16978.05	17363.87	9.1%	0.68151	2.00E+06	11113.66	15592.6	15941.72
RO-125-24	1.69E+06	10430.72	14802.44	15394.19	10.0%	0.660026	1.64E+06	9905.151	13990.22	14543.17
RO-125-25	1.66E+06	12035.76	15534.25	15963.77	9.6%	0.605077	1.60E+06	11264.24	14482.17	14877.25
RO-125-26	1.86E+06	11554.85	17604.13	17604.13	9.4%	0.639876	1.79E+06	10783.81	16322.77	16322.77
RO-125-27	1.69E+06	7970.714	14047.52	16184.61	10.1%	0.621699	1.64E+06	7616.373	13305.6	15306.39
RO-125-28	1.65E+06	12448.7	15233.18	15233.18	9.9%	0.645212	1.60E+06	11734.8	14321.17	14321.17
RO-125-29	1.57E+06	8297.524	13428.88	13556.8	9.4%	0.577588	1.51E+06	7803.385	12503.7	12620.87
RO-125-30	2.08E+06	8670.147	15785.93	15785.93	9.4%	0.656145	2.00E+06	8135.833	14643.79	14643.79
Average	1.82E+06	11242	15704	17000	Average	9.7%	0.648	1.76E+06	10560.61	14672.53	15875.07
Std. Dev.	236390	2593	2486	2933	Std. Dev.	0.004	0.056	226590	2401	2275	2719
COV	13.0%	23.1%	15.8%	17.3%	COV	3.7%	8.6%	12.9%	22.7%	15.5%	17.1%

Red Oak 3/4" Diameter Tapered Pegs

	Left Side		Right Side					Testing Results							
Name	Diameters		Diameters		d(a)	r	xi	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	I(a)	S(a)
T-075-1	0.754	0.764	0.733	0.734	0.7335	1.034765	0.5	2175.311	296.21	410.26	579.8	Sp		0.014209	0.038744
T-075-2	0.7685	0.7615	0.733	0.724	0.7285	1.050103	0.5	1205.105	163.29	237.39	298.87	CG		0.013826	0.037957
T-075-3	0.762	0.75	0.737	0.734	0.7355	1.027872	0.5	1699.735	215.54	327.04	392.57	CG		0.014365	0.039061
T-075-4	0.768	0.7515	0.73	0.724	0.727	1.045048	0.5	1977.591	238.66	354.89	508.78	CG		0.013712	0.037723
T-075-5	0.7595	0.766	0.733	0.732	0.7325	1.041297	0.5	1721.379	208.86	320.29	442.74	CG		0.014132	0.038585
T-075-6	0.766	0.773	0.739	0.737	0.738	1.042683	0.5	1403.508	191.75	277.68	374.55	CG		0.014561	0.039461
T-075-7	0.773	0.771	0.731	0.74	0.7355	1.049626	0.5	1582.844	224.27	315.16	417.9	Sp		0.014365	0.039061
T-075-8	0.751	0.7635	0.735	0.733	0.734	1.031676	0.5	2111.836	278.61	390.37	545.8	CG		0.014248	0.038823
T-075-9	0.77	0.7555	0.732	0.715	0.7235	1.05425	0.5	1880.534	216.45	326.32	448.59	Sp		0.01345	0.037181
T-075-10	0.7505	0.77	0.722	0.708	0.715	1.063287	0.5	1350.229	160.59	245.89	402.42	CG		0.012829	0.035885
T-075-11	0.764	0.7785	0.734	0.735	0.7345	1.050034	0.5	1525.02	203.6	300.57	389.64	CG / ST		0.014287	0.038902
T-075-12	0.762	0.7485	0.729	0.725	0.727	1.038858	0.5	1782.164	242.03	347.07	486.34	Sp / CG		0.013712	0.037723
T-075-13	0.7575	0.7705	0.73	0.727	0.7285	1.04873	0.5	1945.561	257.44	398.52	458.73	CG		0.013826	0.037957
T-075-14	0.7685	0.77	0.731	0.735	0.733	1.049454	0.5	1717.453	287.88	382.15	480.06	CG		0.014171	0.038664
T-075-15	0.759	0.766	0.731	0.73	0.7305	1.043806	0.5	1979.822	280.31	397.88	493.07	CG		0.013978	0.03827
T-075-16	0.7685	0.777	0.735	0.725	0.73	1.058562	0.5	1150.711	201.24	262.36	294.56	CG	Almost Brash	0.01394	0.038192
T-075-17	0.7735	0.7595	0.732	0.735	0.7335	1.04499	0.5	1313.331	208.84	291.94	343.2	CG		0.014209	0.038744
T-075-18	0.747	0.7525	0.738	0.737	0.7375	1.01661	0.5	1708.202	456.65	516.42	607.09	Sp		0.014522	0.039381
T-075-19	0.75	0.766	0.731	0.733	0.732	1.035519	0.5	1250.883	225.76	296.94	363.55	Sp / CG		0.014093	0.038506
T-075-20	0.767	0.7625	0.734	0.726	0.73	1.047603	0.5	1538.322	313.93	375.24	395.94	CG		0.01394	0.038192
T-075-21	0.7695	0.747	0.735	0.737	0.736	1.030231	0.5	2198.132	283.15	447.07	588.81	CG		0.014404	0.039141
T-075-22	0.765	0.7795	0.732	0.735	0.7335	1.052829	0.5	1389.817	229.13	308.81	368.71	Sp		0.014209	0.038744
T-075-23	0.77	0.7605	0.736	0.73	0.733	1.043997	0.5	1650.808	255.73	345.88	480	Sp		0.014171	0.038664
T-075-24	0.7595	0.768	0.731	0.729	0.73	1.046233	0.5	1559.301	333.72	391	419.46	Sp / CG		0.01394	0.038192
T-075-25	0.77	0.761	0.736	0.728	0.732	1.045765	0.5	1702.192	286.28	381.38	450.54	Sp		0.014093	0.038506
T-075-26	0.7595	0.7725	0.736	0.733	0.7345	1.042886	0.5	1214.546	186.31	266.28	342.96	CG	Almost Brash	0.014287	0.038902
T-075-27	0.768	0.7695	0.739	0.732	0.7355	1.045207	0.5	1380.013	261.91	322.85	400.38	Sp		0.014365	0.039061
T-075-28	0.772	0.7715	0.734	0.736	0.735	1.05	0.5	1461.89	215.82	303.24	392.9	Sp		0.014326	0.038982
T-075-29	0.7605	0.764	0.733	0.736	0.7345	1.037781	0.5	1807.976	372.68	446.03	499.24	CG		0.014287	0.038902
T-075-30	0.7705	0.767	0.736	0.734	0.735	1.045918	0.5	1654.237	257.51	346.5	425.96	Sp / CG		0.014326	0.038982

Failure Key	Average	1635	252	344	436	0.039
Sp = Splintering	Std. Dev.	292	62.4	64	80	0.001
CG = Cross-Grain	COV	17.9%	24.8%	18.6%	18.3%	1.9%
ST = Simple Tension						

Red Oak 3/4" Diameter Tapered Pegs

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	Section Properties			Unadjusted Values					Moisture Adjusted Stress to 12%			
	MOI	S	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
T-075-1	0.015	0.040799	3.80E+06	11347.65	15716.84	22211.83	14.07%	0.670432	3.92E+06	12061.98	16780.58	23794.97
T-075-2	0.015	0.040881	2.10E+06	6242.995	9076.028	11426.57	14.45%	0.558594	2.18E+06	6610.427	9715.389	12291.54
T-075-3	0.015	0.040717	2.97E+06	8273.841	12553.94	15069.42	13.84%	0.681011	3.06E+06	8686.296	13267.71	15960.27
T-075-4	0.015	0.04033	3.50E+06	9249.428	13754	19718.11	13.57%	0.634576	3.59E+06	9654.963	14426.82	20744.83
T-075-5	0.015	0.041025	2.98E+06	7957.248	12202.56	16867.72	13.56%	0.686516	3.05E+06	8284.099	12779.78	17720.06
T-075-6	0.016	0.042042	2.35E+06	7128.735	10323.38	13924.73	14.19%	0.609249	2.43E+06	7528.981	10994.88	14902.03
T-075-7	0.016	0.042042	2.65E+06	8337.739	11716.78	15536.37	13.66%	0.534929	2.72E+06	8711.921	12304.44	16365.34
T-075-8	0.015	0.040697	3.70E+06	10700.26	14992.5	20961.93	14.00%	0.671662	3.81E+06	11336.2	15957.89	22385.5
T-075-9	0.015	0.040289	3.34E+06	8397.134	12659.52	17402.96	13.58%	0.722222	3.42E+06	8754.943	13272.27	18299.43
T-075-10	0.015	0.039401	2.47E+06	6370.459	9754.232	15963.63	14.63%	0.706849	2.57E+06	6780.811	10515.63	17369.21
T-075-11	0.016	0.041896	2.57E+06	7595.707	11213.37	14536.3	14.55%	0.625759	2.67E+06	8114.217	12093.95	15749.46
T-075-12	0.015	0.039964	3.20E+06	9465.725	13573.81	19020.62	14.31%	0.749491	3.31E+06	10100.19	14577.95	20514.89
T-075-13	0.015	0.040799	3.39E+06	9862.388	15267.09	17573.7	13.65%	0.684959	3.48E+06	10328.69	16071.79	18522.83
T-075-14	0.016	0.041604	2.92E+06	10815.18	14356.76	18035.08	13.97%	0.667117	3.01E+06	11450.1	15259.35	19215.69
T-075-15	0.015	0.04084	3.45E+06	10727.74	15227.26	18870.27	14.06%	0.640077	3.56E+06	11387.14	16243.57	20175.57
T-075-16	0.016	0.041646	1.95E+06	7552.716	9846.604	11055.1	13.84%	0.534699	2.01E+06	7914.979	10370.61	11664.32
T-075-17	0.016	0.041417	2.25E+06	7881.139	11017.14	12951.57	13.97%	0.575352	2.31E+06	8294.766	11668.07	13748.89
T-075-18	0.015	0.04037	3.02E+06	17679.93	19994.02	23504.46	13.62%	0.703628	3.10E+06	18616.54	21072.62	24798.44
T-075-19	0.015	0.040595	2.20E+06	8692.351	11432.97	13997.63	13.73%	0.587797	2.26E+06	9104.595	12025.19	14758.28
T-075-20	0.015	0.040984	2.67E+06	11972.26	14310.42	15099.85	13.55%	0.553016	2.73E+06	12531.43	15006.39	15842.01
T-075-21	0.015	0.040943	3.82E+06	10809.26	17066.91	22477.83	13.51%	0.707703	3.91E+06	11287.17	17901.09	23620.08
T-075-22	0.016	0.041896	2.34E+06	8548.155	11520.78	13755.47	13.80%	0.60521	2.41E+06	8968.744	12145.22	14533.15
T-075-23	0.015	0.041273	2.84E+06	9684.515	13098.5	18177.64	13.86%	0.598232	2.92E+06	10202.86	13860.28	19301.58
T-075-24	0.015	0.040902	2.71E+06	12752.57	14941.43	16028.98	13.78%	0.583909	2.79E+06	13453.62	15790.92	16952.23
T-075-25	0.015	0.041211	2.93E+06	10857.74	14464.6	17087.63	13.92%	0.623592	3.02E+06	11479.77	15352.36	18168.65
T-075-26	0.016	0.041459	2.07E+06	7023.882	10038.75	12929.58	14.02%	0.568654	2.14E+06	7381.562	10630.4	13745.58
T-075-27	0.016	0.041771	2.33E+06	9800.339	12080.64	14981.71	14.56%	0.600000	2.43E+06	10542.1	13051.42	16243.87
T-075-28	0.016	0.041979	2.46E+06	8035.579	11290.47	14628.76	13.68%	0.546744	2.52E+06	8394.168	11856.72	15407.99
T-075-29	0.015	0.041149	3.12E+06	14155.9	16942.03	18963.16	13.76%	0.661943	3.20E+06	14944.1	17917.27	20074.08
T-075-30	0.016	0.041729	2.80E+06	9645.311	12978.53	15954.79	13.75%	0.573064	2.88E+06	10126.9	13682.13	16856.63
Average	0.015	0.041088	2.83E+06	9585	13114	16624	Average	13.9%	0.629	2.91E+06	10101.14	13886.42	17657.58
Std. Dev.	0.000	0.000653	529550	2417	2508	3159	Std. Dev	0.003	0.061	540860	2554	2631	3342
COV	2.1%	1.6%	18.7%	25.2%	19.1%	19.0%	COV	2.3%	9.7%	18.6%	25.3%	18.9%	18.9%

Red Oak 7/8" Diameter Tapered Pegs

	Left Side		Right Side						Testing Results						
Name	Diameters		Diameters		d(a)	r	xi	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	I(a)	S(a)
T-0875-1	0.8215	0.8325	0.794	0.795	0.7945	1.040906	0.5	1939.441	256.06	399.24	610.63	Sp		0.019559	0.049236
T-0875-2	0.8385	0.8285	0.802	0.798	0.8	1.041875	0.5	2175.609	307.19	457.51	564.08	CG		0.020106	0.050265
T-0875-3	0.818	0.8385	0.796	0.795	0.7955	1.041169	0.5	2136.239	239.53	393.93	499.45	Sp / CG / ST		0.019658	0.049422
T-0875-4	0.842	0.8285	0.803	0.796	0.7995	1.044715	0.5	2136.239	239.53	393.93	499.45	CG		0.020056	0.050171
T-0875-5	0.8345	0.823	0.797	0.801	0.799	1.037234	0.5	2043.78	292.72	456.83	613.58	Sp / CG		0.020006	0.050077
T-0875-6	0.8175	0.836	0.794	0.799	0.7965	1.037979	0.5	2123.306	280.63	421.8	503.43	Sp / CG		0.019757	0.049609
T-0875-7	0.8155	0.831	0.799	0.792	0.7955	1.034884	0.5	2024.525	310.71	462.02	624.06	Sp		0.019658	0.049422
T-0875-8	0.828	0.832	0.797	0.79	0.7935	1.045999	0.5	2311	289.33	459.65	527.49	ST		0.019461	0.04905
T-0875-9	0.842	0.8325	0.799	0.8	0.7995	1.047217	0.5	1641.541	263.45	389.89	461.53	CG		0.020056	0.050171
T-0875-10	0.829	0.8525	0.803	0.802	0.8025	1.047664	0.5	1993.029	294.94	432.55	535.75	CG	Almost Brash	0.020359	0.050738
T-0875-11	0.834	0.843	0.798	0.803	0.8005	1.04747	0.5	2018.995	311.34	414.4	434.92	Sp / CG		0.020157	0.05036
T-0875-12	0.8185	0.837	0.801	0.795	0.798	1.037281	0.5	2045.07	255.51	407.22	580.01	Sp		0.019906	0.049889
T-0875-13	0.837	0.826	0.792	0.795	0.7935	1.047889	0.5	2391.631	318.16	496.36	601.45	CG		0.019461	0.04905
T-0875-14	0.83	0.8525	0.797	0.793	0.795	1.058176	0.5	1614.431	246.8	368.86	452.61	CG / B		0.019608	0.049329
T-0875-15	0.829	0.829	0.794	0.795	0.7945	1.043424	0.5	2310.483	260.64	434.27	623.77	Sp / CG		0.019559	0.049236
T-0875-16	0.8335	0.8245	0.799	0.798	0.7985	1.038197	0.5	2273.512	317.57	479.29	638.01	CG		0.019956	0.049983
T-0875-17	0.843	0.84	0.799	0.802	0.8005	1.051218	0.5	2592.885	432.82	627.29	790.6	CG		0.020157	0.05036
T-0875-18	0.816	0.828	0.799	0.794	0.7965	1.032015	0.5	2070.858	247.47	391.94	433.28	CG		0.019757	0.049609
T-0875-19	0.8435	0.8535	0.807	0.806	0.8065	1.052077	0.5	2693.357	435	579.29	743.63	CG		0.020768	0.051501
T-0875-20	0.822	0.839	0.797	0.8	0.7985	1.040075	0.5	1734.235	243.39	365.1	469.95	ST / Sp		0.019956	0.049983
T-0875-21	0.835	0.822	0.798	0.807	0.8025	1.032399	0.5	1981.223	250.83	413.02	556.71	ST		0.020359	0.050738
T-0875-22	0.839	0.8275	0.8	0.796	0.798	1.044173	0.5	2698.589	359.43	563.74	639.2	CG		0.019906	0.049889
T-0875-23	0.8295	0.8245	0.79	0.793	0.7915	1.044852	0.5	1845.741	247.9	388.41	589.59	ST		0.019265	0.04868
T-0875-24	0.838	0.823	0.796	0.797	0.7965	1.042687	0.5	2056.785	264.31	417.38	528.17	CG		0.019757	0.049609
T-0875-25	0.8235	0.8125	0.796	0.793	0.7945	1.029578	0.5	1845.669	237.21	378.59	582.61	CG / Sp		0.019559	0.049236
T-0875-26	0.8275	0.825	0.791	0.796	0.7935	1.041273	0.5	2158.855	274.55	441.8	536.75	Sp / CG / ST		0.019461	0.04905
T-0875-27	0.8325	0.82	0.795	0.801	0.798	1.035401	0.5	1748.16	226.04	350.48	522.98	CG		0.019906	0.049889
T-0875-28	0.839	0.837	0.797	0.799	0.798	1.050125	0.5	1890.59	291.55	422.91	459.17	B		0.019906	0.049889
T-0875-29	0.8215	0.836	0.8	0.798	0.799	1.037234	0.5	1696.164	285.91	404.23	537.44	Sp / ST		0.020006	0.050077
T-0875-30	0.8305	0.8425	0.796	0.799	0.7975	1.048903	0.5	2147.668	343.74	481.78	607.32	Sp / CG		0.019856	0.049796

Failure Key	Average	2078	287	436	559	0.050
Sp = Splintering	Std. Dev.	280	51.8	64	84	0.001
CG = Cross-Grain	COV	13.5%	18.0%	14.6%	15.1%	1.2%
ST = Simple Tension						
B = Brash						

Red Oak 7/8" Diameter Tapered Pegs

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	Section Properties			Unadjusted Values					Moisture Adjusted Stress to 12%			
	MOI	S	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
T-0875-1	0.021	0.052319	2.43E+06	7649.622	11927.03	18242.16	14.2%	0.692	2.51E+06	8104.333	12753.3	19617.01
T-0875-2	0.022	0.053489	2.65E+06	8976.328	13368.79	16482.85	14.5%	0.706	2.75E+06	9620.501	14444.21	17863.99
T-0875-3	0.021	0.052537	2.66E+06	7126.093	11719.54	14858.8	14.1%	0.678	2.75E+06	7516.231	12490.07	15889.3
T-0875-4	0.022	0.053612	2.59E+06	6983.208	11484.55	14560.86	14.2%	0.629	2.68E+06	7371.951	12256.35	15594.44
T-0875-5	0.022	0.052926	2.52E+06	8644.47	13490.89	18119.96	14.0%	0.629	2.60E+06	9113.317	14324.49	19301.96
T-0875-6	0.021	0.052489	2.65E+06	8356.548	12560.28	14991.05	13.8%	0.664	2.72E+06	8762.351	13253.2	15849.98
T-0875-7	0.021	0.052053	2.55E+06	9329.642	13873	18738.55	14.3%	0.605	2.65E+06	9959.786	14917.19	20226.15
T-0875-8	0.021	0.052513	2.88E+06	8611.636	13681.05	15700.24	13.9%	0.698	2.96E+06	9054.142	14485.57	16648.95
T-0875-9	0.022	0.053809	1.98E+06	7652.445	11325.15	13406.08	14.1%	0.627	2.04E+06	8067.705	12031.61	14277.53
T-0875-10	0.022	0.054453	2.37E+06	8465.874	12415.79	15378.02	13.9%	0.738	2.44E+06	8914.01	13156.46	16338.07
T-0875-11	0.022	0.054031	2.42E+06	9006.315	11987.59	12581.19	13.8%	0.598	2.49E+06	9468.813	12659.28	13294.52
T-0875-12	0.021	0.052732	2.53E+06	7573.484	12070.27	17191.88	14.0%	0.624	2.61E+06	7967.574	12807.9	18320.78
T-0875-13	0.021	0.052659	2.97E+06	9443.534	14732.82	17852.07	13.6%	0.633	3.04E+06	9875.178	15489.29	18800.1
T-0875-14	0.022	0.05376	1.95E+06	7175.386	10724.12	13159.04	14.1%	0.619	2.01E+06	7552.25	11381.93	14009.61
T-0875-15	0.021	0.052513	2.88E+06	7757.705	12925.64	18565.93	14.4%	0.627	2.98E+06	8247.421	13889.05	20046.33
T-0875-16	0.022	0.052902	2.81E+06	9382.651	14160.69	18850.1	14.9%	0.679	2.94E+06	10201.48	15541.03	20781.53
T-0875-17	0.022	0.054329	3.09E+06	12451.94	18046.71	22745.03	13.2%	0.675	3.15E+06	12913.31	18765.25	23679.54
T-0875-18	0.021	0.052029	2.61E+06	7434.188	11774.18	13016.06	14.3%	0.650	2.71E+06	7883.002	12611.07	13964.01
T-0875-19	0.023	0.055629	3.11E+06	12222.06	16276.13	20893.54	13.2%	0.698	3.17E+06	12665.78	16903.28	21729.6
T-0875-20	0.022	0.053049	2.13E+06	7171.146	10757.16	13846.42	13.8%	0.567	2.19E+06	7491.867	11319.7	14617.27
T-0875-21	0.022	0.053244	2.42E+06	7363.201	12124.34	16342.41	14.1%	0.709	2.50E+06	7769.429	12921.44	17485.8
T-0875-22	0.022	0.053269	3.30E+06	10546.34	16541.17	18755.31	13.1%	0.680	3.35E+06	10865.61	17095.82	19396.89
T-0875-23	0.021	0.052029	2.33E+06	7447.105	11668.13	17711.73	13.8%	0.694	2.39E+06	7782.579	12285.01	18731.52
T-0875-24	0.021	0.052853	2.54E+06	7816.278	12342.92	15619.25	14.2%	0.625	2.63E+06	8284.491	13203.53	16763.87
T-0875-25	0.021	0.051453	2.36E+06	7205.811	11500.56	17698.15	14.4%	0.716	2.45E+06	7664.804	12371.02	19162.38
T-0875-26	0.021	0.05215	2.72E+06	8228.611	13241.31	16087.08	13.9%	0.700	2.80E+06	8650.817	14027.55	17079.99
T-0875-27	0.021	0.052586	2.17E+06	6718.553	10417.26	15544.46	14.5%	0.691	2.26E+06	7133.588	11189	16810.66
T-0875-28	0.022	0.053735	2.28E+06	8480.32	12301.19	13355.89	14.1%	0.655	2.36E+06	8960.257	13083.47	14221.62
T-0875-29	0.022	0.052926	2.09E+06	8443.36	11937.53	15871.43	13.5%	0.548	2.14E+06	8773.078	12458.36	16607.42
T-0875-30	0.022	0.053538	2.61E+06	10035.13	14065.06	17730.07	13.6%	0.578	2.67E+06	10485.51	14753.63	18635.25
Average	0.022	0.053054	2.55E+06	8457	12848	16463	Average	14.0%	0.654	2.63E+06	8904.039	13628.97	17524.87
Std. Dev.	0.000	0.000877	328736	1418	1769	2411	Std. Dev.	0.004	0.048	332159	1447	1789	2525
COV	2.2%	1.7%	12.9%	16.8%	13.8%	14.6%	COV	3.0%	7.3%	12.6%	16.2%	13.1%	14.4%

Red Oak 3/4" Diameter Tapered Pegs

	Left Side		Right Side					Testing Results						
Name	Diameters		Diameters		d(a)	r	xi	Slope	Yield Load	5% Offset	Ultimate	Failure	Comment	I(a)	S(a)
T-1-1	1.016		0.98		0.98	1.036735	0.5	4414.423	514.18	887.73	1091.79	Sp / CG		0.045277	0.092401
T-1-2	1.02		0.98		0.98	1.040816	0.5	5202.028	594.34	984.5	1276.06	SP / CG		0.045277	0.092401
T-1-3	1.01		0.98		0.98	1.030612	0.5	4249.937	539.56	896.95	1074.62	CG		0.045277	0.092401
T-1-4	1.03		0.98		0.98	1.05102	0.5	3988.594	484.39	794.38	832.06	Sp		0.045277	0.092401
T-1-5	1.02		0.98		0.98	1.040816	0.5	4447.19	498.36	498.36	498.36	Sp / CG		0.045277	0.092401
T-1-6	1.023		0.98		0.98	1.043878	0.5	4909.065	598.75	1035.18	1145.24	CG		0.045277	0.092401
T-1-7	1.021		0.981		0.981	1.040775	0.5	2913.077	465.76	683.38	847.35	CG		0.045462	0.092684
T-1-8	1.02		0.986		0.986	1.034483	0.5	4401.941	568.52	907.72	1112.97	Sp		0.046396	0.094109
T-1-9	1.022		0.981		0.981	1.041794	0.5	3816.316	484.14	788.6	913.86	Sp / CG		0.045462	0.092684
T-1-10	1.023		0.931		0.931	1.098818	0.5	5317.803	581.41	1010.11	1244.5	CG		0.036878	0.079223
T-1-11	1.029	1.03	0.981	0.974	0.9775	1.053197	0.5	4953.112	613.93	980.58	1224.48	Sp / CG		0.044816	0.091696
T-1-12	1.036	1.032	0.97	0.979	0.9745	1.061057	0.5	4723.62	504.74	906.8	1255.27	Sp / CG		0.044269	0.090854
T-1-13	1.035	1.034	0.966	0.981	0.9735	1.062661	0.5	4439.845	536.12	912.78	1109.84	Sp		0.044087	0.090575
T-1-14	1.031	1.033	0.98	0.985	0.9825	1.050382	0.5	5111.742	669.24	1038.76	1173.65	CG		0.04574	0.09311
T-1-15	1.032	1.035	0.974	0.978	0.976	1.058914	0.5	3675.373	512.59	797.01	972.71	ST / Sp		0.044542	0.091274
T-1-16	0.98	0.979	1.03	1.037	1.0335	0.94775	0.5	3690.472	467.4	727.11	894.92	Sp		0.056003	0.108376
T-1-17	0.984	0.982	1.033	1.04	1.0365	0.948384	0.5	3790.625	467.58	718.05	958	Sp		0.056656	0.109322
T-1-18	0.98	0.982	1.021	1.027	1.024	0.958008	0.5	3966.114	479.09	759.05	931.74	Sp		0.053972	0.105414
T-1-19	0.981	0.985	1.037	1.033	1.035	0.949758	0.5	4276.136	525.68	896.69	1116.46	CG		0.056329	0.108848
T-1-20	0.975	0.982	1.037	1.035	1.036	0.944498	0.5	4371.908	552.46	898.22	1061.88	Sp		0.056547	0.109164
T-1-21	0.985	0.981	1.036	1.03	1.033	0.951597	0.5	4873.087	553.41	933.33	1066.68	CG		0.055895	0.108218
T-1-22	0.985	0.988	1.034	1.036	1.035	0.95314	0.5	3060.388	463.29	668.34	811.67	CG / ST		0.056329	0.108848
T-1-23	0.974	0.979	1.034	1.033	1.0335	0.944848	0.5	5090.388	483.32	854.5	1128.15	Sp / CG		0.056003	0.108376
T-1-24	0.974	0.983	1.032	1.036	1.034	0.946325	0.5	3872.258	509.6	791.48	963.93	Sp / CG		0.056112	0.108533
T-1-25	0.978	0.975	1.031	1.035	1.033	0.945305	0.5	3889.23	507.41	783.69	999.05	Sp		0.055895	0.108218
T-1-26	0.978	0.974	1.031	1.032	1.0315	0.946195	0.5	3049.97	474.42	725.03	772.28	CG / ST		0.055571	0.107748
T-1-27	0.981	0.985	1.035	1.037	1.036	0.948842	0.5	4100.276	464.25	726.51	959.55	CG		0.056547	0.109164
T-1-28	0.981	0.979	1.021	1.026	1.0235	0.957499	0.5	3985.182	492.22	812.06	977.37	CG		0.053867	0.10526
T-1-29	0.979	0.972	1.035	1.033	1.034	0.943424	0.5	3690.224	504.75	793.47	972.1	CG		0.056112	0.108533
T-1-30	0.983	0.985	1.037	1.034	1.0355	0.950266	0.5	4613.757	506.69	866.09	1152.27	Sp / CG		0.056438	0.109006

Failure Key	Average	4229	521	836	1018	0.100
Sp = Splintering	Std. Dev.	638	51.3	122	168	0.009
CG = Cross-Grain	COV	15.1%	9.9%	14.5%	16.5%	9.0%
ST = Simple Tension						

Red Oak 3/4" Diameter Tapered Pegs

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	Section Properties			Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOI	S	MOE	F(yield)	F(5%)	F(ult)	MC	SG		MOE Adj	F(yield)	F(5%)	F(ult)
T-1-1	0.049	0.097587	2.41E+06	8235.361	14218.32	17486.65	13.2%	0.585		2.45E+06	8502.631	14760.33	18178.74
T-1-2	0.049	0.098175	2.81E+06	9462.242	15673.82	20315.62	15.1%	0.683		2.95E+06	10327.1	17300.98	22512.44
T-1-3	0.048	0.096709	2.35E+06	8720.263	14496.33	17367.8	13.2%	0.619		2.39E+06	8992.675	15018.29	18013.82
T-1-4	0.050	0.099655	2.12E+06	7597.244	12459.17	13050.15	13.6%	0.665		2.17E+06	7905.823	13057.26	13683.43
T-1-5	0.049	0.098175	2.41E+06	7934.184	7934.184	7934.184	13.4%	0.626		2.46E+06	8217.067	8217.067	8217.067
T-1-6	0.049	0.098617	2.64E+06	9489.684	16406.73	18151.09	13.2%	0.691		2.69E+06	9803.705	17027.78	18849.56
T-1-7	0.049	0.09847	1.57E+06	7392.972	10847.24	13449.92	14.4%	0.633		1.63E+06	7858.677	11636.1	14482.27
T-1-8	0.050	0.099061	2.35E+06	8970.198	14322.15	17560.62	13.7%	0.659		2.42E+06	9393.114	15090.35	18537.75
T-1-9	0.049	0.098617	2.05E+06	7673.212	12498.65	14483.91	13.6%	0.587		2.10E+06	7991.659	13109.33	15214.83
T-1-10	0.045	0.091555	3.16E+06	9925.626	17244.24	21245.66	13.4%	0.558		3.22E+06	10308.28	17999.77	22205.06
T-1-11	0.050	0.099209	2.64E+06	9672.212	15448.63	19291.17	13.5%	0.546		2.70E+06	10077.23	16176.03	20233.02
T-1-12	0.050	0.099432	2.51E+06	7934.166	14254.27	19731.98	13.2%	0.636		2.56E+06	8190.346	14803.81	20535.77
T-1-13	0.050	0.099358	2.36E+06	8433.735	14359	17458.96	13.6%	0.626		2.42E+06	8792.65	15071.25	18356.07
T-1-14	0.051	0.100326	2.69E+06	10426.27	16183.13	18284.62	13.7%	0.591		2.76E+06	10953.25	17088.78	19328.5
T-1-15	0.050	0.09958	1.95E+06	8045.539	12509.76	15267.52	12.9%	0.688		1.98E+06	8224.409	12830.44	15675.81
T-1-16	0.050	0.100102	1.95E+06	7298.044	11353.19	13973.4	13.2%	0.675		1.98E+06	7514.431	11749.28	14485.6
T-1-17	0.051	0.101074	1.97E+06	7230.585	11103.81	14814.36	13.4%	0.596		2.02E+06	7492.258	11575.95	15488.13
T-1-18	0.050	0.098913	2.12E+06	7570.474	11994.34	14723.15	13.4%	0.588		2.17E+06	7835.797	12487.33	15356.58
T-1-19	0.051	0.100849	2.23E+06	8147.175	13897.22	17303.29	13.4%	0.650		2.28E+06	8443.3	14490.39	18072.42
T-1-20	0.051	0.100326	2.30E+06	8606.927	13993.62	16543.32	13.5%	0.668		2.35E+06	8953.569	14641.82	17334.27
T-1-21	0.051	0.10055	2.55E+06	8602.496	14508.17	16581.04	13.4%	0.690		2.61E+06	8925.251	15138.98	17319.97
T-1-22	0.051	0.101375	1.59E+06	7143.002	10304.46	12514.32	13.8%	0.575		1.63E+06	7469.279	10848.91	13211.27
T-1-23	0.050	0.099655	2.70E+06	7580.462	13402.1	17694.07	13.4%	0.627		2.76E+06	7860.693	13998.16	18522.98
T-1-24	0.050	0.100027	2.04E+06	7962.892	12367.48	15062.15	12.7%	0.618		2.06E+06	8095.108	12604.67	15363.55
T-1-25	0.050	0.09958	2.06E+06	7964.235	12300.69	15680.95	13.8%	0.703		2.12E+06	8334.335	12960	16565.7
T-1-26	0.050	0.099283	1.63E+06	7468.707	11414.01	12157.86	13.6%	0.653		1.67E+06	7777.808	11964.42	12753.77
T-1-27	0.051	0.100999	2.14E+06	7184.425	11242.99	14849.36	14.1%	0.703		2.20E+06	7561.654	11941.22	15832.83
T-1-28	0.049	0.098691	2.14E+06	7795.434	12860.83	15478.9	13.5%	0.624		2.19E+06	8096.529	13445.39	16209.97
T-1-29	0.050	0.09958	1.96E+06	7922.484	12454.19	15257.94	13.3%	0.681		2.00E+06	8199.581	12959.29	15904.11
T-1-30	0.051	0.101074	2.40E+06	7835.376	13393.08	17818.53	13.3%	0.571		2.45E+06	8109.202	13947.67	18596.68
Average	0.050	0.09922	2.26E+06	8208	13182	16051	Average	13.5%	0.634	2.31E+06	8540.247	13798.04	16834.73
Std. Dev.	0.001	0.001814	367632	866	2014	2742	Std. Dev.	0.004	0.046	377800	937	2147	2939
COV	2.4%	1.8%	16.3%	10.6%	15.3%	17.1%	COV	3.2%	7.2%	16.3%	11.0%	15.6%	17.5%

White Oak 7/8" Diameter Pegs

	Left Side		Right Side		Average	Testing Results					Section Properties	
Name	Diameters		Diameters		Diameter	Slope	Yield Load	5% Offset	Ultimate	Failure Comment	MOI	S
1	0.8845	0.881	0.8775	0.8765	0.879875	2378.356	279.04	448.21	567.2	Cross Grain	0.029	0.066875
2	0.8795	0.882	0.874	0.876	0.877875	2950.555	357.91	526.86	737.53	Splintering	0.029	0.06642
3	0.885	0.8915	0.888	0.883	0.886875	3222.907	429.62	644.86	778.52	Splintering	0.030	0.068484
4	0.881	0.886	0.872	0.8815	0.880125	2241.392	238.59	422.79	617.93	Simple Tension	0.029	0.066932
5	0.881	0.88	0.8825	0.8815	0.88125	2753.395	338.99	524.02	656.41	Splintering	0.030	0.067189
6	0.887	0.8765	0.88	0.8895	0.88325	2666.266	353.04	522.84	670.82	Splintering	0.030	0.067647
7	0.8765	0.8765	0.8795	0.888	0.880125	2355.289	290.95	463.5	605.3	Cross Grain	0.029	0.066932
8	0.878	0.881	0.8825	0.8775	0.87975	2562.026	301.34	494.82	639.8	Cross Grain	0.029	0.066846
9	0.8825	0.887	0.884	0.8835	0.88425	2621.294	256.05	478.76	743.09	Splintering	0.030	0.067877
10	0.8815	0.8805	0.879	0.8805	0.880375	2733.552	355.85	532.48	677.58	Splintering	0.029	0.066989
11	0.8825	0.883	0.885	0.8815	0.883	2306.465	285.48	454.13	634.21	Splintering + Simple T	0.030	0.06759
12	0.883	0.8805	0.881	0.88	0.881125	2216.767	274.19	419.24	566.87	Cross Grain	0.030	0.06716
13	0.8855	0.881	0.885	0.886	0.884375	2668.339	296.65	537.99	753.27	Cross Grain	0.030	0.067906
14	0.8835	0.8895	0.8815	0.8895	0.886	2164.349	244.49	407.9	630.2	Cross Grain	0.030	0.068281
15	0.8875	0.8835	0.8845	0.8825	0.8845	2711.336	307.68	507.63	855.15	Splintering	0.030	0.067935
16	0.8835	0.8815	0.8815	0.8845	0.88275	2072.616	284.48	422.32	501.86	Cross Grain Snapped i	0.030	0.067533
17	0.8755	0.8785	0.8865	0.888	0.882125	2658.118	296.82	498.71	697.51	Splintering	0.030	0.067389
18	0.883	0.884	0.882	0.886	0.88375	2335.763	266.73	452.34	552.6	Brash	0.030	0.067762
19	0.8795	0.8805	0.863	0.873	0.874	3132.941	414.44	613.34	747.65	Splintering	0.029	0.065544
20	0.8805	0.885	0.881	0.8915	0.8845	2376.792	264.88	439.11	644.28	Cross Grain	0.030	0.067935
21	0.8785	0.8835	0.8795	0.883	0.881125	2369.204	300.4	467.52	596.72	Splintering	0.030	0.06716
22	0.8785	0.885	0.876	0.8805	0.88	2151.315	259.17	425.75	617.28	Cross Grain	0.029	0.066903
23	0.8845	0.8815	0.8805	0.8935	0.885	2847.908	339.67	530.36	682.99	Cross Grain	0.030	0.06805
24	0.881	0.8755	0.8795	0.881	0.87925	2457.117	302.6	457.9	630.15	Splintering	0.029	0.066732
25	0.8785	0.878	0.8785	0.8795	0.878625	2952.647	351.21	549.28	705.03	Cross Grain	0.029	0.06659
26	0.8825	0.887	0.881	0.885	0.883875	2862.439	356.57	560.47	786.16	Splintering	0.030	0.067791
27	0.881	0.8785	0.881	0.8805	0.88025	2916.01	396.71	567.51	770.3	Simple Tension	0.029	0.06696
28	0.881	0.888	0.884	0.88	0.88325	2331.792	258.51	441.61	618.09	Splintering	0.030	0.067647
29	0.8855	0.8845	0.874	0.8735	0.879375	2949.297	352.59	548.93	738.16	Cross Grain	0.029	0.066761
30	0.883	0.88	0.877	0.877	0.87925	2011.81	269.77	417.56	717.8	Brash	0.029	0.066732
				Average	0.882	2566	311	493	671		0.030	0.067285
				Std. Dev.	0.003	325	50.5	61	81		0.000	0.000634
				COV	0.3%	12.7%	16.2%	12.4%	12.0%		1.3%	0.9%

Failure Key
Sp = Splintering
CG = Cross-Grain
ST = Simple Tension

White Oak 7/8" Diameter Pegs

	Unadjusted Values						Moisture Adjusted Stress to 12%			
	MOE	F(yield)	F(5%)	F(ult)	MC	SG	MOE Adj	F(yield)	F(5%)	F(ult)
1	2.15E+06	6521.727	10475.57	13256.61	14.9%	0.574324	2.25E+06	7002.081	11418.4	14524.72
2	2.69E+06	8422.381	12398.13	17355.64	14.1%	0.617043	2.77E+06	8899.426	13190.89	18542.08
3	2.82E+06	9805.197	14717.61	17768.13	14.5%	0.670925	2.93E+06	10520.41	15908.23	19253.97
4	2.02E+06	5571.578	9873.036	14429.97	14.8%	0.61951	2.11E+06	5927.779	10714.63	15785.78
5	2.47E+06	7885.851	12190.16	15269.92	14.0%	0.678974	2.55E+06	8317.66	12961.71	16284.55
6	2.37E+06	8157.03	12080.28	15499.37	14.4%	0.633437	2.46E+06	8701.787	12997.24	16740.71
7	2.12E+06	6794.295	10823.7	14135.03	13.9%	0.633576	2.19E+06	7121.363	11451.71	15010.34
8	2.31E+06	7045.925	11569.87	14959.79	14.9%	0.672199	2.42E+06	7579.321	12624.34	16404.72
9	2.32E+06	5896.016	11024.32	17111	14.5%	0.730093	2.41E+06	6240.054	11875.2	18563.44
10	2.46E+06	8302.769	12423.94	15809.44	14.1%	0.627823	2.54E+06	8791.368	13254.53	16920.99
11	2.05E+06	6601.653	10501.64	14665.95	14.8%	0.627621	2.14E+06	7072.922	11411.91	16044.97
12	1.99E+06	6381.138	9756.841	13192.59	14.1%	0.572382	2.05E+06	6699.527	10346.22	14057.78
13	2.36E+06	6828.009	12382.94	17338.06	14.1%	0.693284	2.44E+06	7187.915	13195.89	18555.12
14	1.90E+06	5596.532	9337.092	14425.68	15.2%	0.627871	2.00E+06	6007.524	10231.29	15977.22
15	2.40E+06	7078.885	11679.19	19674.69	15.4%	0.773991	2.53E+06	7733.682	12979.86	22097.9
16	1.85E+06	6584.119	9774.343	11615.25	14.9%	0.583248	1.93E+06	7063.247	10620.1	12672.57
17	2.38E+06	6884.333	11566.89	16177.79	14.5%	0.648478	2.47E+06	7319.08	12457.13	17516.54
18	2.07E+06	6152.373	10433.64	12746.23	14.9%	0.607752	2.17E+06	6581.02	11353.31	13931.14
19	2.91E+06	9882.947	14626.02	17828.84	14.8%	0.68019	3.03E+06	10710.98	15979.96	19537.91
20	2.10E+06	6094.172	10102.73	14823.14	14.7%	0.627883	2.19E+06	6485.826	10921.11	16144.01
21	2.13E+06	6991.115	10880.45	13887.28	14.7%	0.586101	2.22E+06	7486.308	11796.51	15128.72
22	1.94E+06	6054.744	9946.395	14420.93	15.2%	0.69821	2.04E+06	6518.57	10906.15	15950.89
23	2.51E+06	7801.65	12181.48	15687.13	14.0%	0.626294	2.59E+06	8208.641	12919.39	16689.92
24	2.22E+06	7087.464	10724.88	14759.3	14.4%	0.598674	2.31E+06	7524.556	11502.24	15914.07
25	2.68E+06	8243.569	12892.65	16548.4	15.0%	0.696033	2.81E+06	8949.769	14162.14	18260.83
26	2.54E+06	8221.127	12922.27	18125.81	15.9%	0.71504	2.70E+06	9172.191	14643.4	20699.3
27	2.63E+06	9260.067	13246.91	17980.46	14.7%	0.681137	2.74E+06	9996.343	14412.02	19654.73
28	2.07E+06	5972.903	10203.45	14281.04	14.7%	0.625644	2.16E+06	6357.667	11045.72	15564.27
29	2.67E+06	8254.803	12851.5	17281.73	13.3%	0.672783	2.72E+06	8529.423	13342.28	17980.85
30	1.82E+06	6318.523	9780.045	16812.23	14.4%	0.706612	1.89E+06	6684.576	10470.7	18162.33
Average	2.30E+06	7223	11446	15596	Average	14.6%	0.650	2.39E+06	7713.034	12369.81	16952.41
Std. Dev.	296312	1191	1436	1869	Std. Dev.	0.005	0.049	305352	1302	1573	2113
COV	12.9%	16.5%	12.5%	12.0%	COV	3.6%	7.6%	12.8%	16.9%	12.7%	12.5%