

Increasing the Market Share for Softwood Glued-Laminated Lumber by Matching the Performance and Convenience of LVL

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Advanced Wood Products Laboratory**

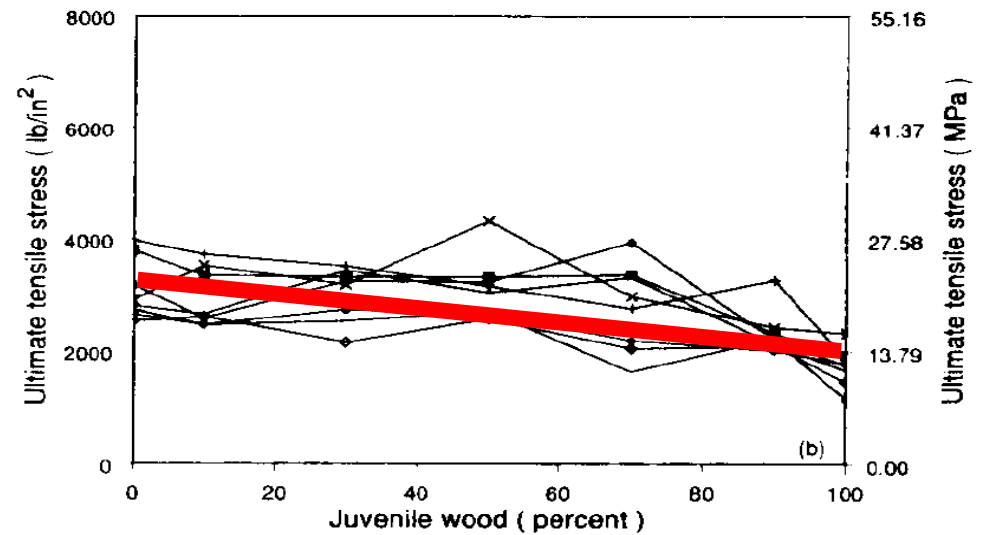
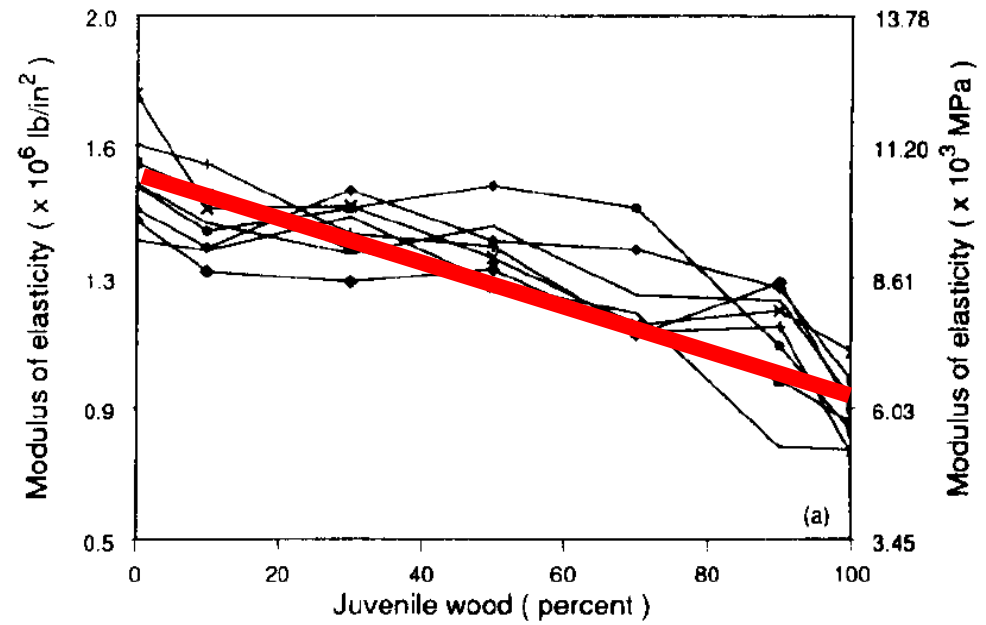
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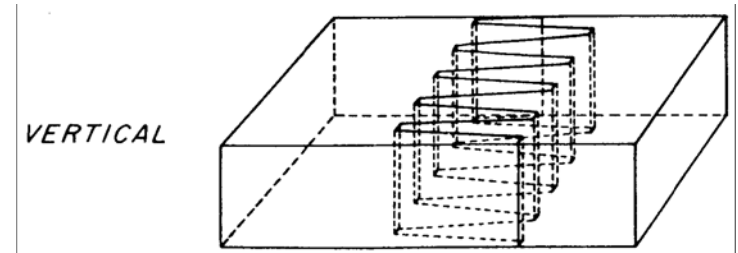
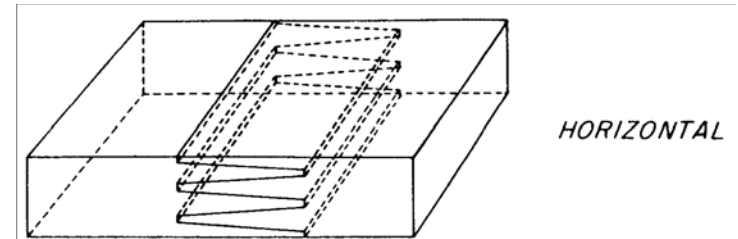
juvenile wood



after Kretschmann and Bendtsen



finger jointed lumber



Glued Laminated Beams (Glulams)

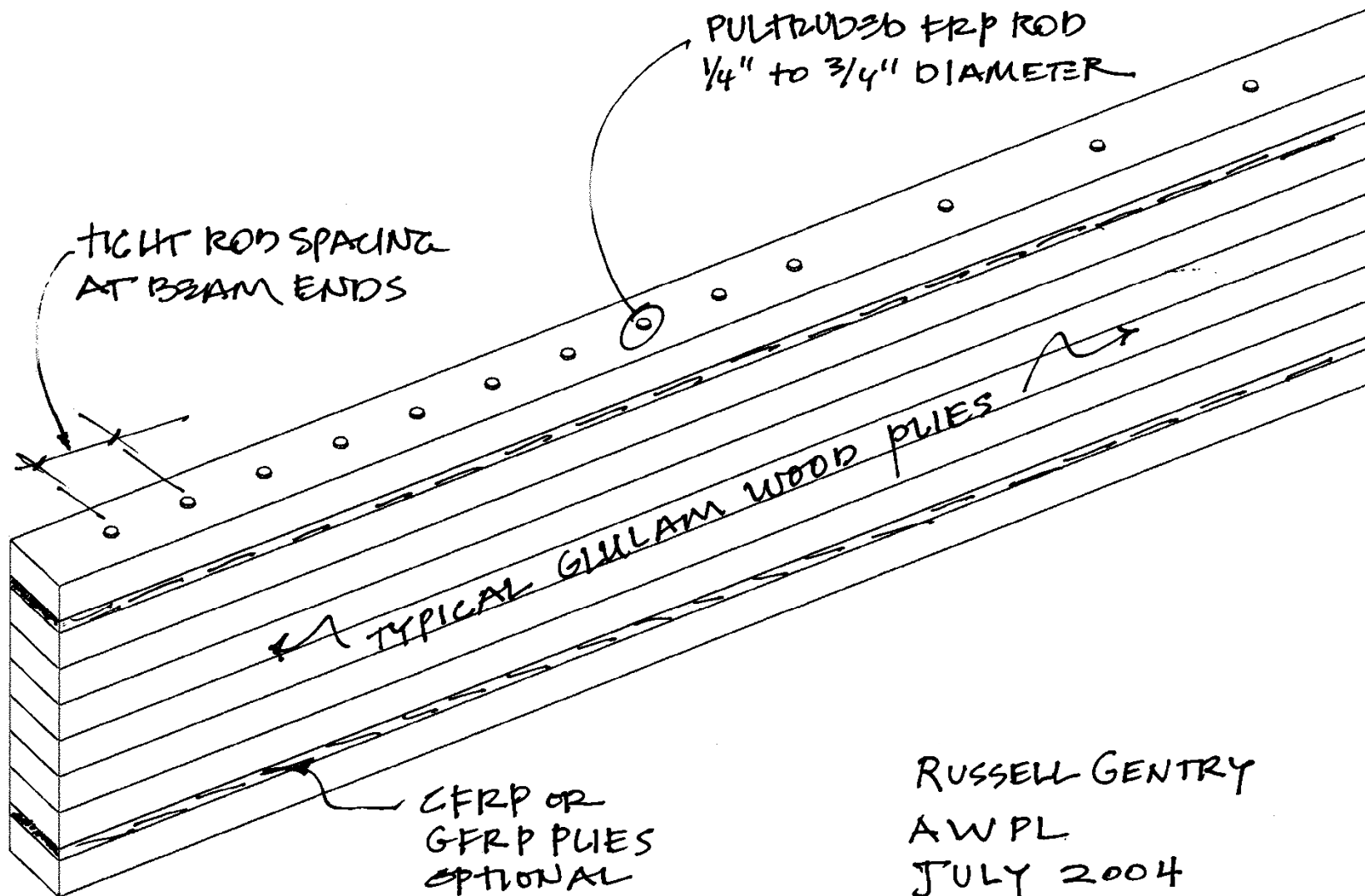


(Anthony Forest Products)

F_v varies from 175 to 300 psi depending on wood grading –

For the highest rating, much of the beam is No. 1 Dense, $E = 3.0$

A juvenile pine glulam is likely to have F_v in the 100 to 150 psi range



RUSSELL GENTRY
AWPL
JULY 2004

Laminated Veneer Lumber



1.9E Microllam® LVL Allowable Design Stresses (100% Load Duration)

Shear modulus of elasticity $G = 118,750 \text{ psi}$

Modulus of elasticity $E = 1.9 \times 10^6 \text{ psi}$

Flexural stress $F_b = 2,600 \text{ psi}^{(1)}$

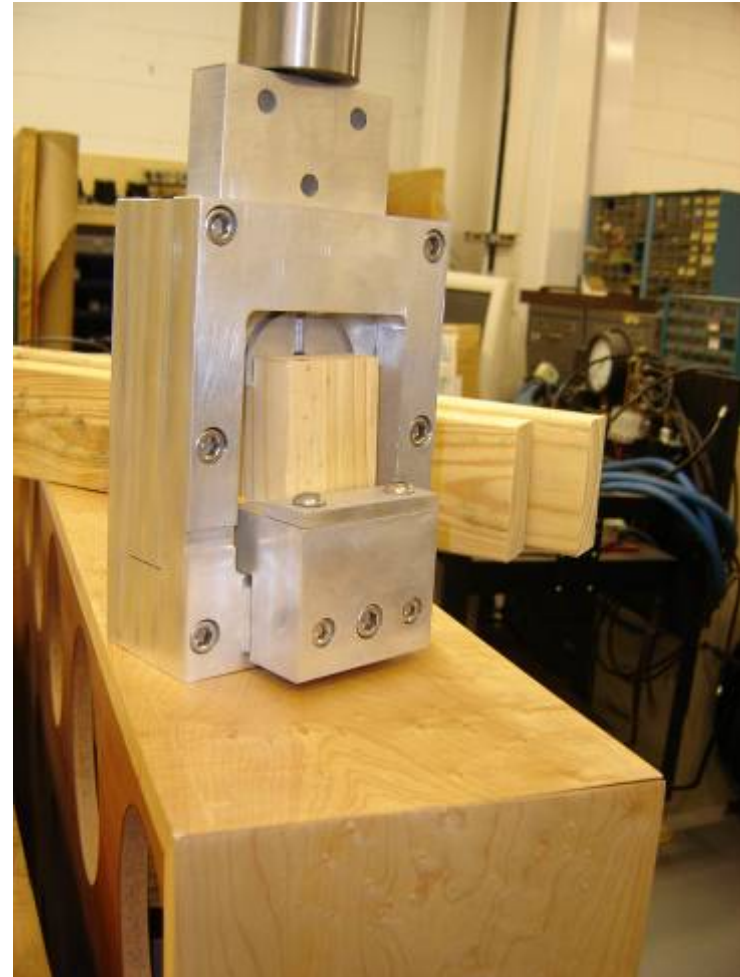
Tension Stress $F_t = 1,555 \text{ psi}^{(2)}$

Compression perpendicular to grain $F_{c\perp} = 750 \text{ psi}^{(3)}$

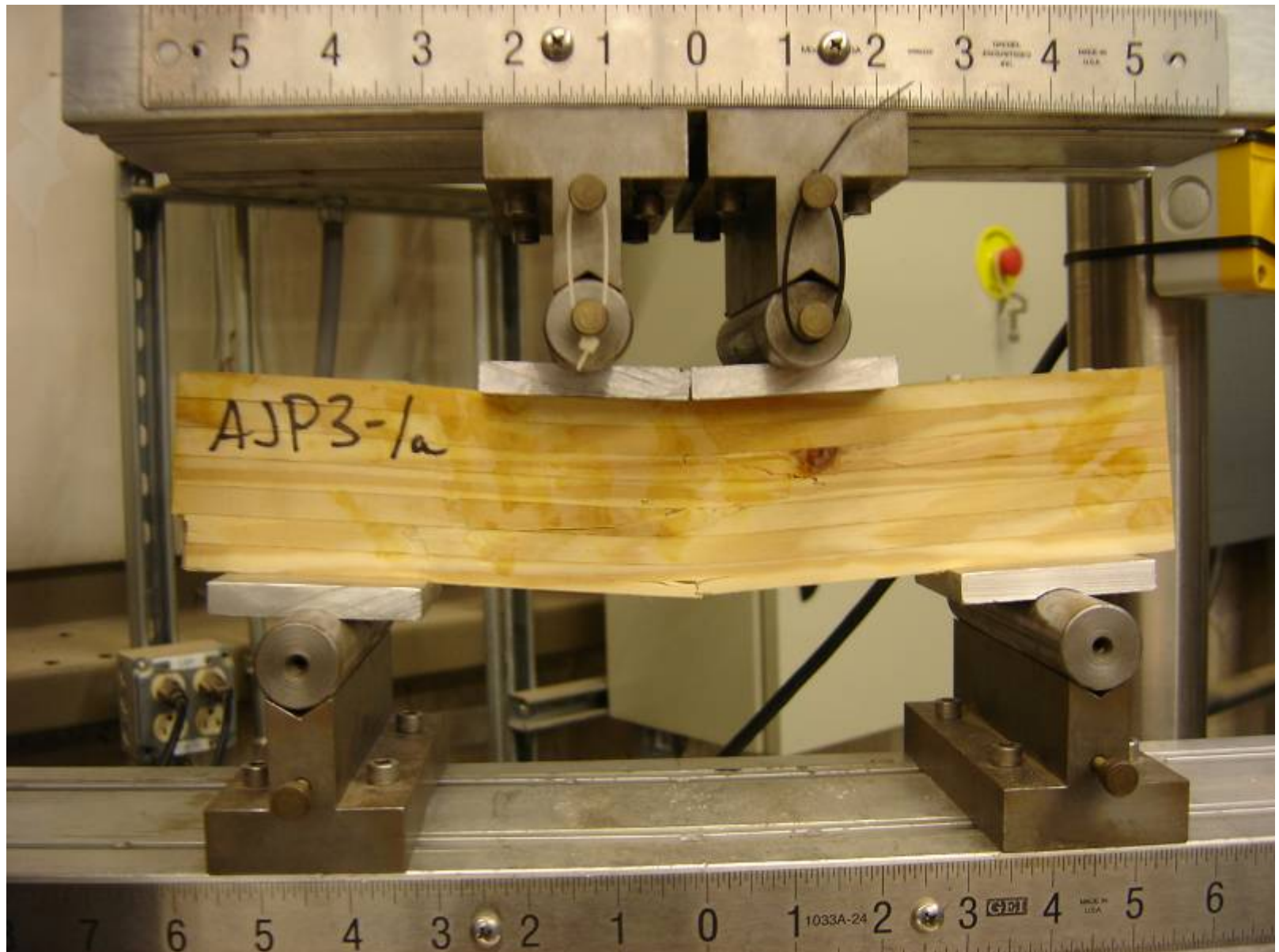
Compression parallel to grain $F_{c\parallel} = 2,510 \text{ psi}$

Horizontal shear parallel to grain $F_v = 285 \text{ psi}$

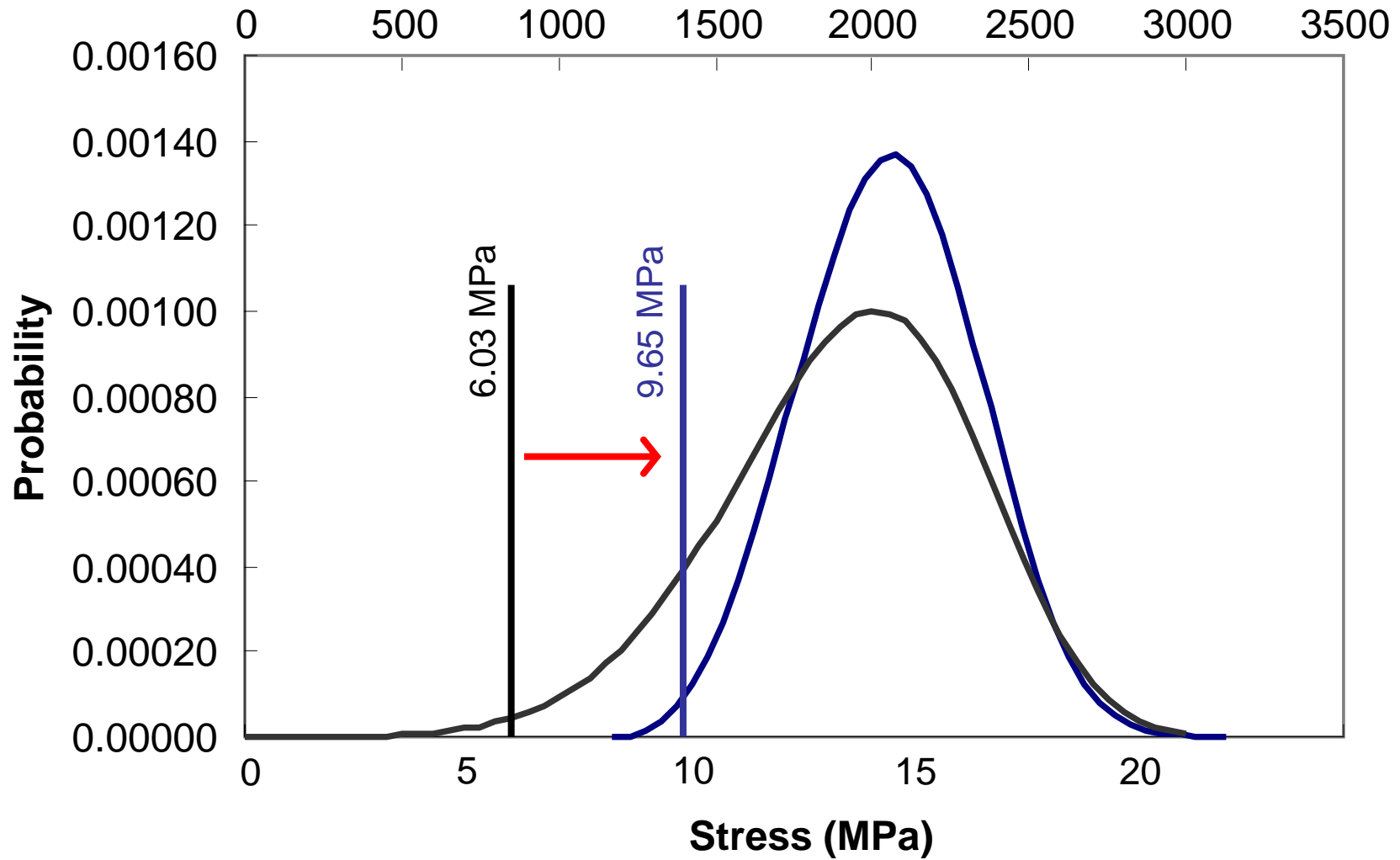
(Trus Joist / Weyerhaeuser)

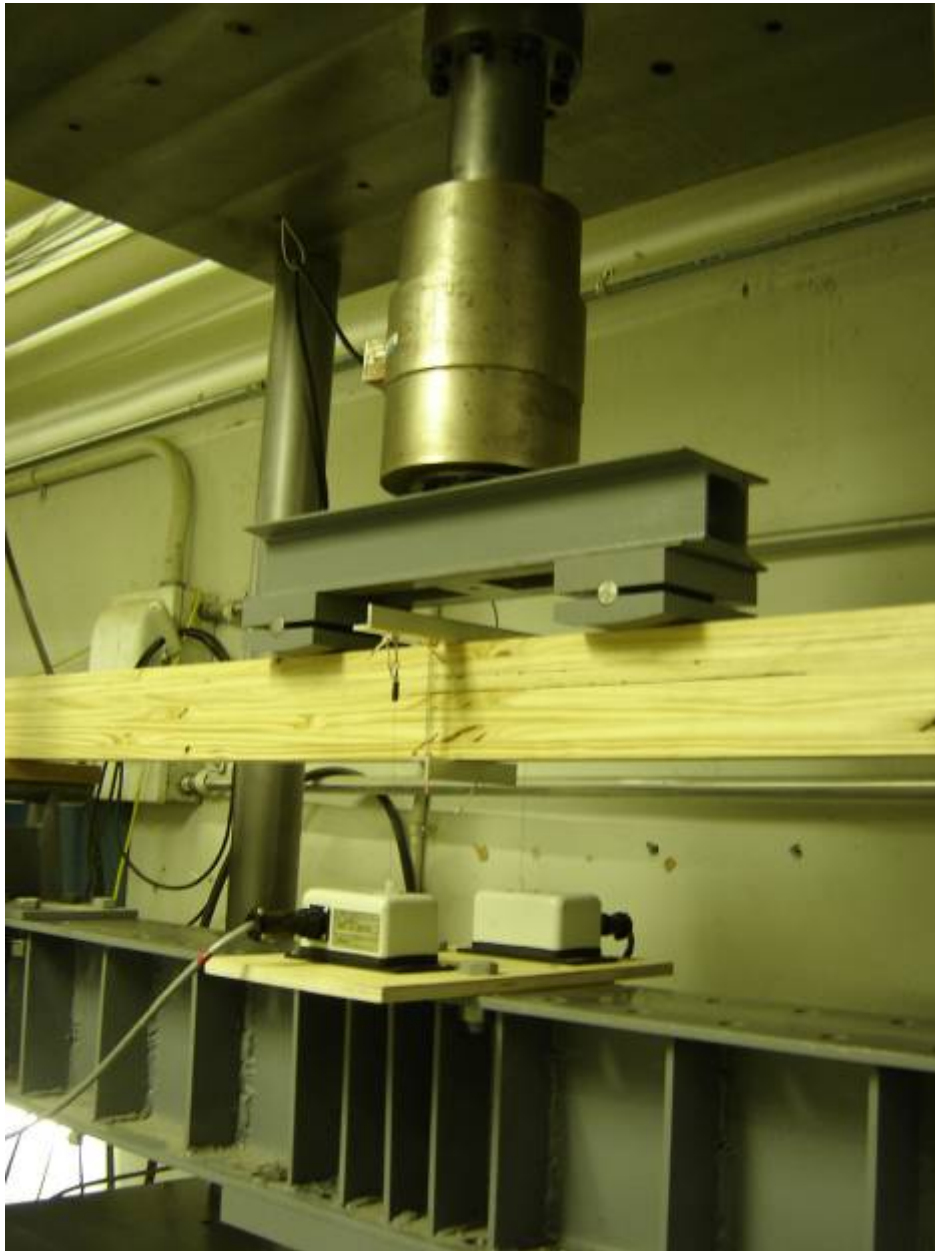


block shear strength of juvenile southern pine



delam





finger-jointed glulams

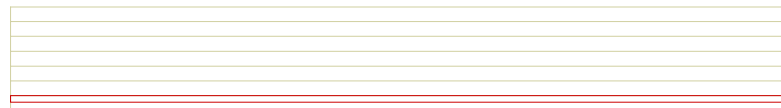
Series	N	Description	Weibull Distribution			99% Exceed. (psi)	Improv (%)
			Scale	Shape	Locate		
Baseline	42	No Pins	14.36	5.57	0	6.03	—
S-1☀	44	6.3 mm pins @ 50 mm spacing	6.05	3.47	8.10	9.65	60%
S-2	30	6.3 mm pins – no clearance holes	8.43	2.84	8.47	11.72	60%
S-3	30	4.6 mm pins	8.49	2.96	9.89	11.38	89%
S-4	24	3.2 mm pins	9.61	1.68	8.47	8.96	49%
S-5☀	10	6.3 mm pins @ 44 mm spacing	19.04	10.4	0	11.72	94%

Small-Scale Specimens – Weibull Shear Stress Distributions and A-Basis Allowables

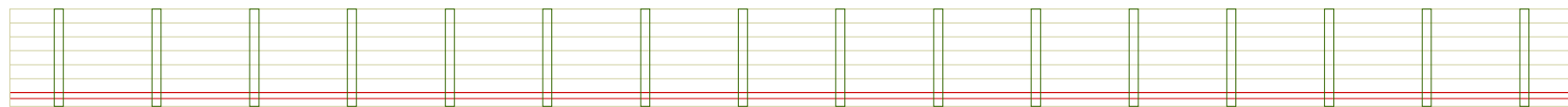




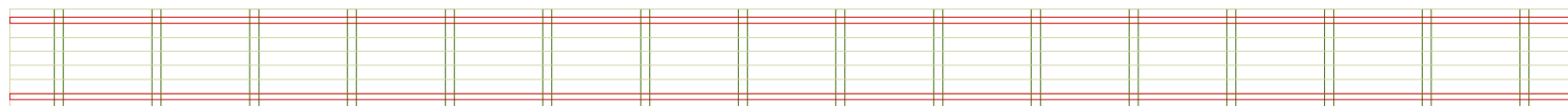
pins no laminates



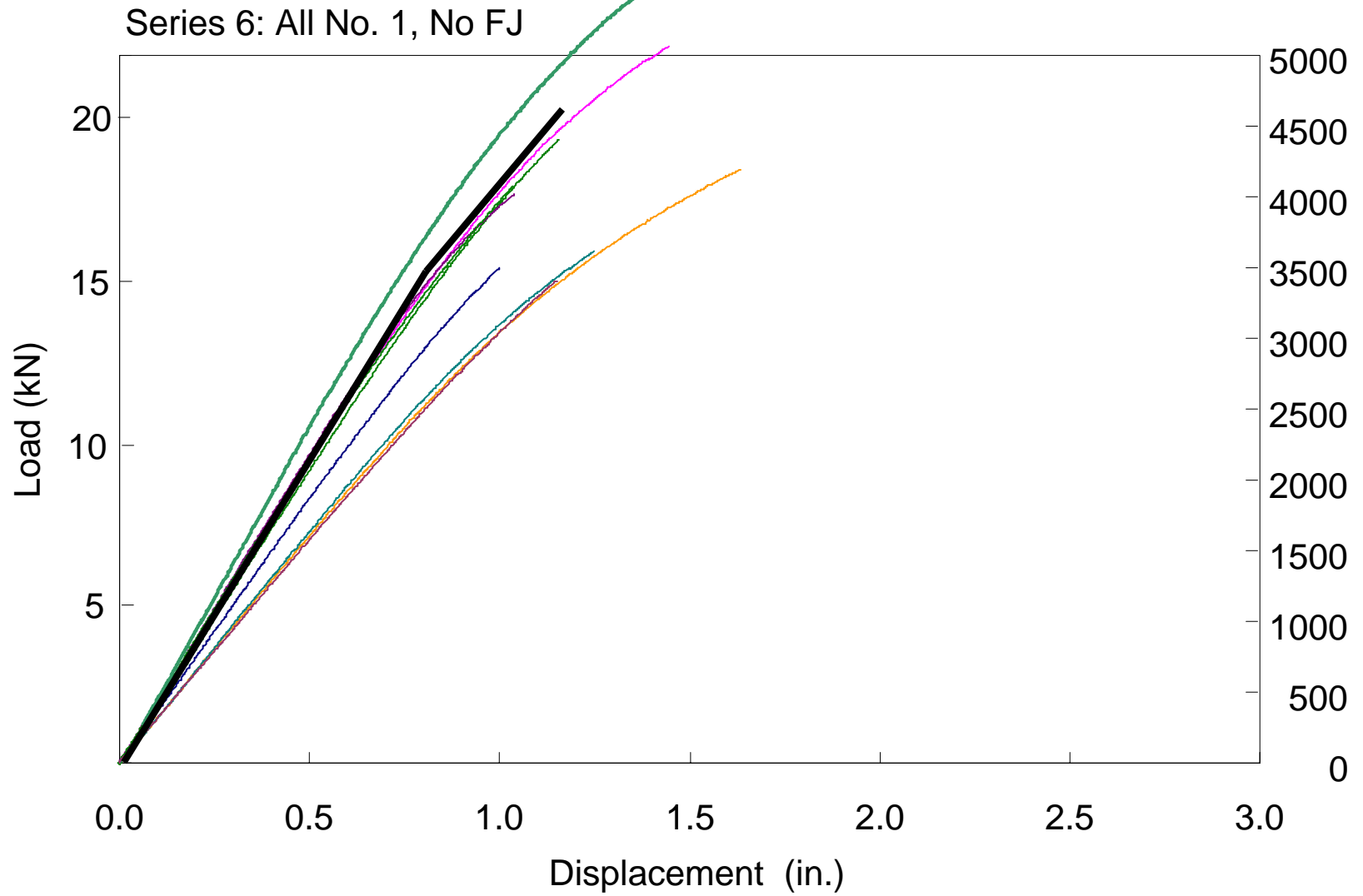
laminate tension side no pins

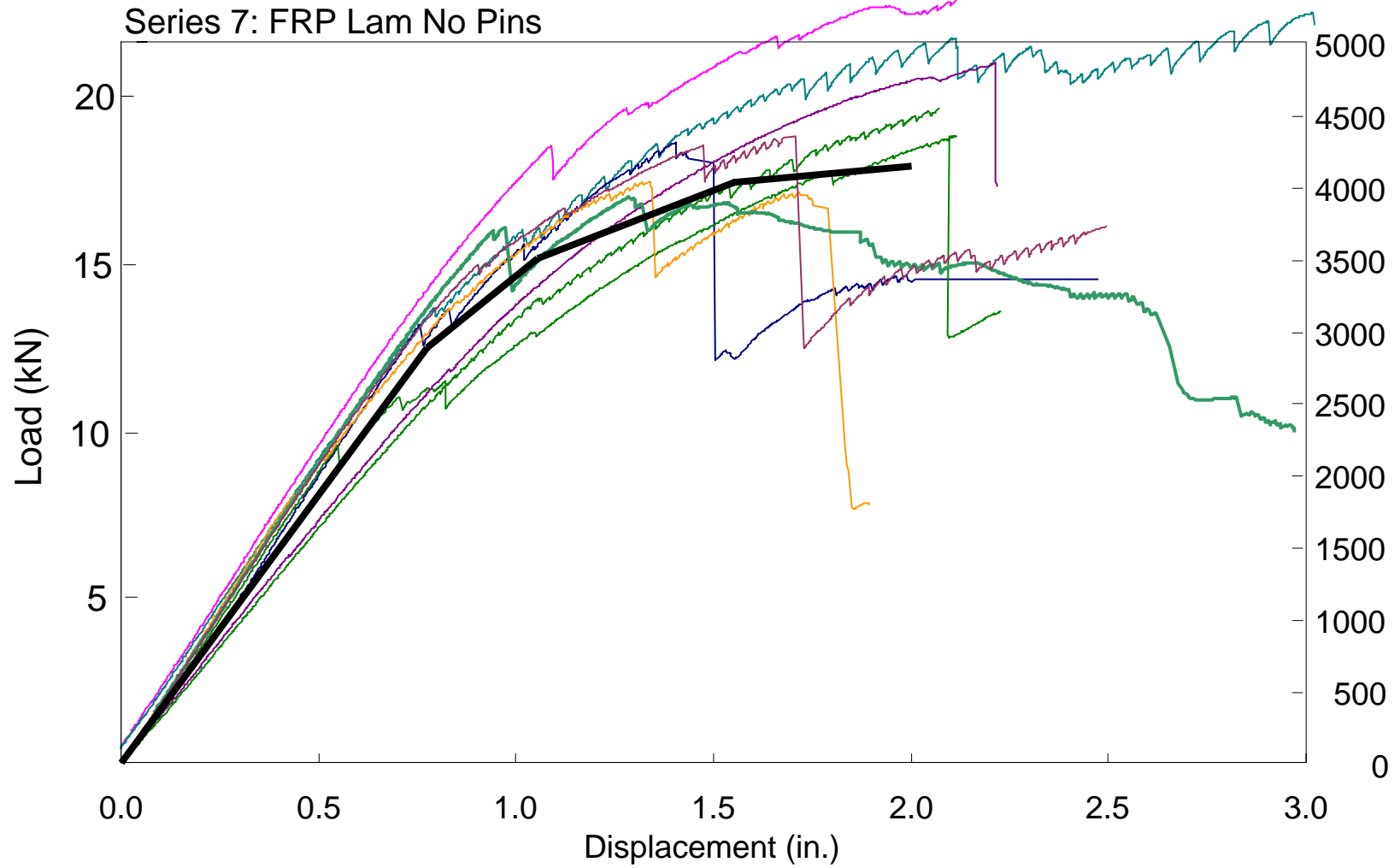


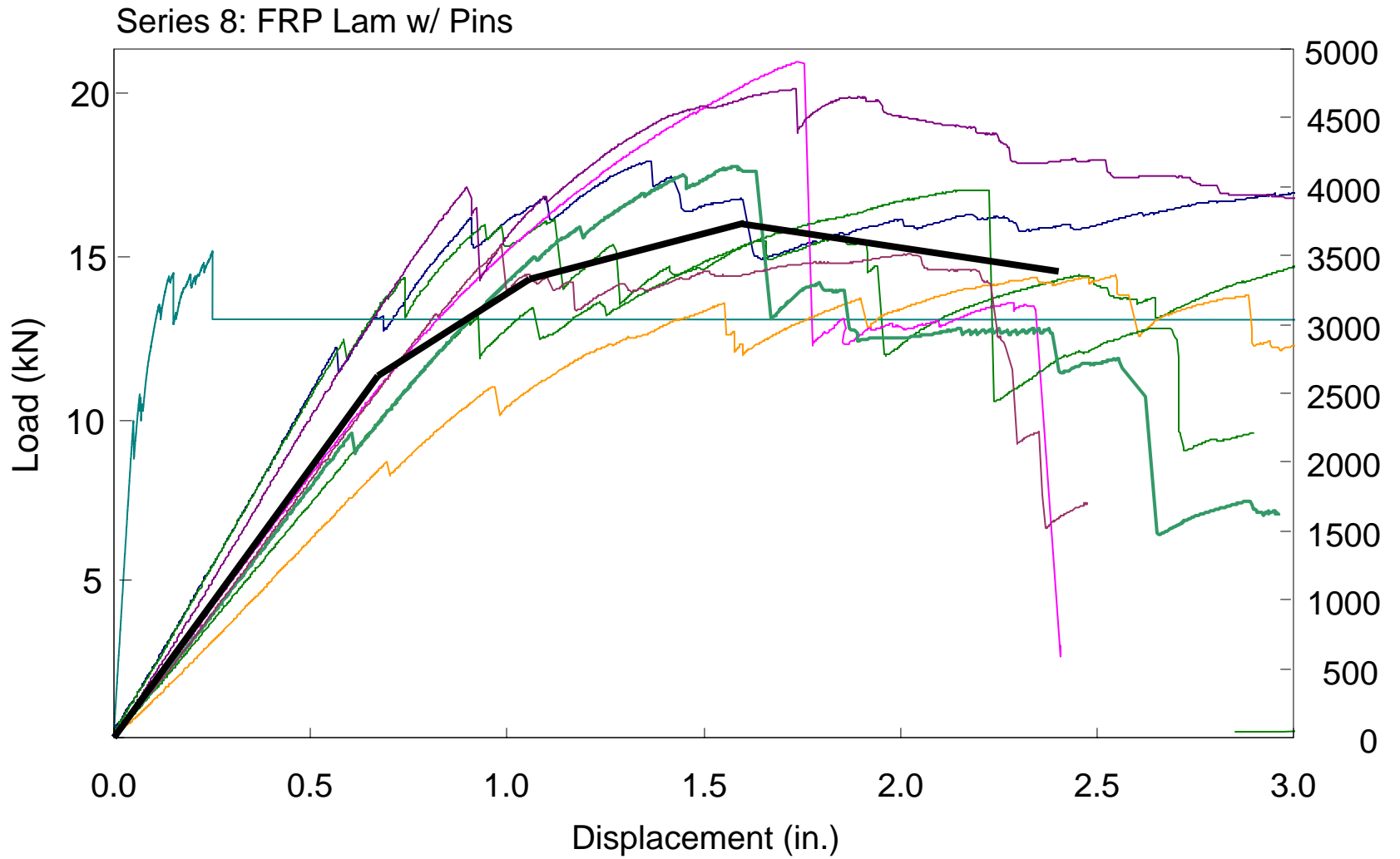
pins and laminate tension side



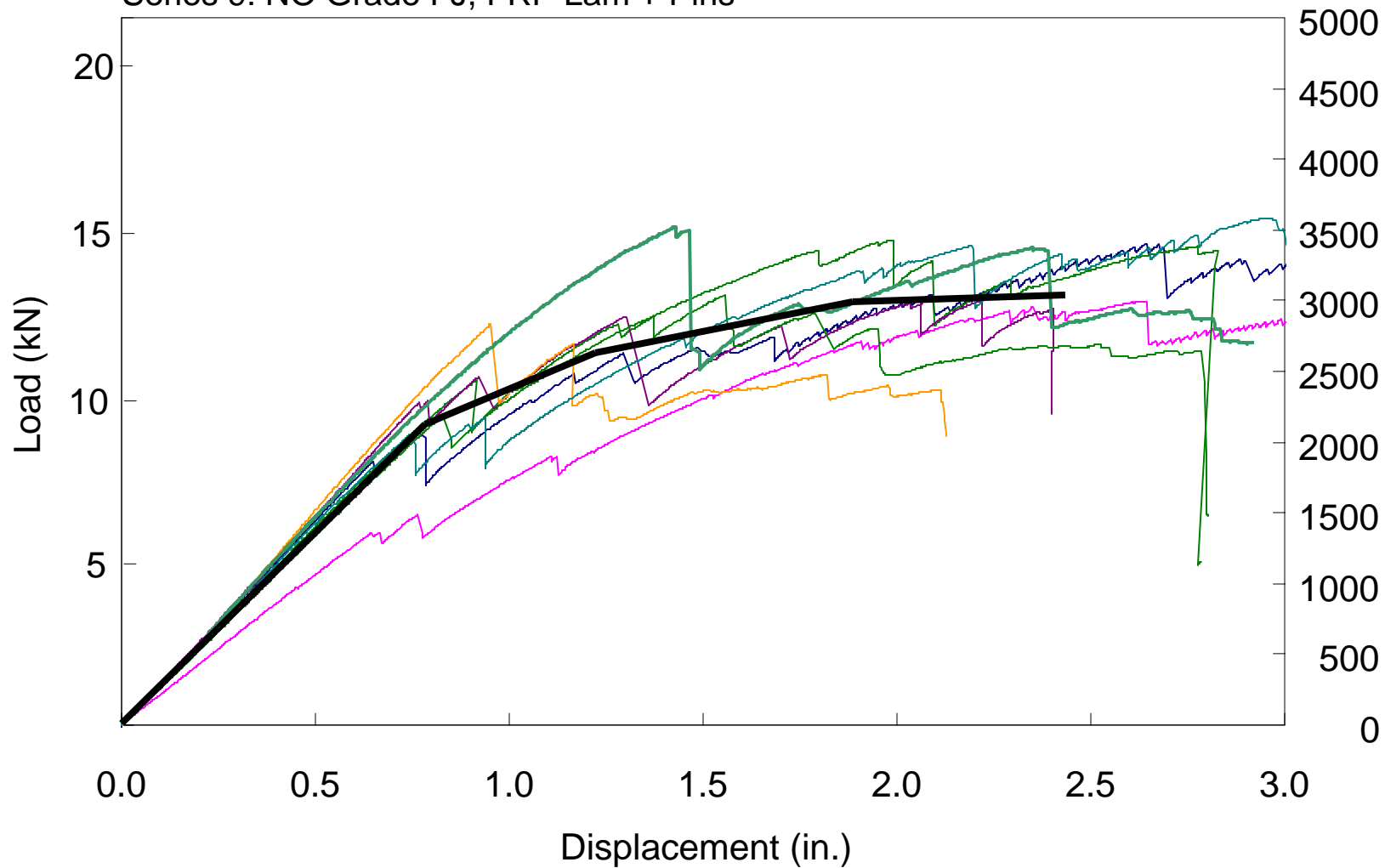
pins and laminate tension and compression side

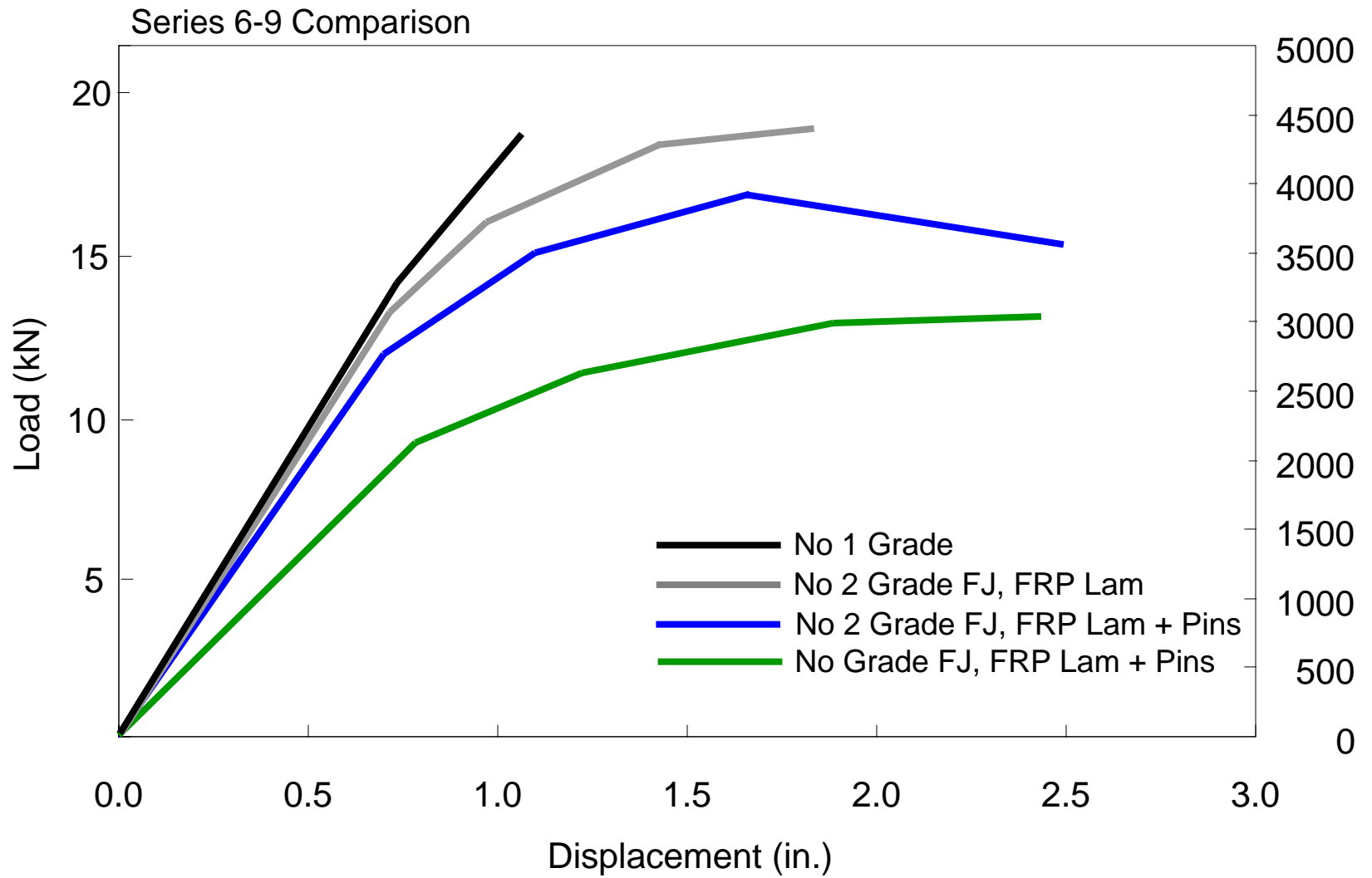




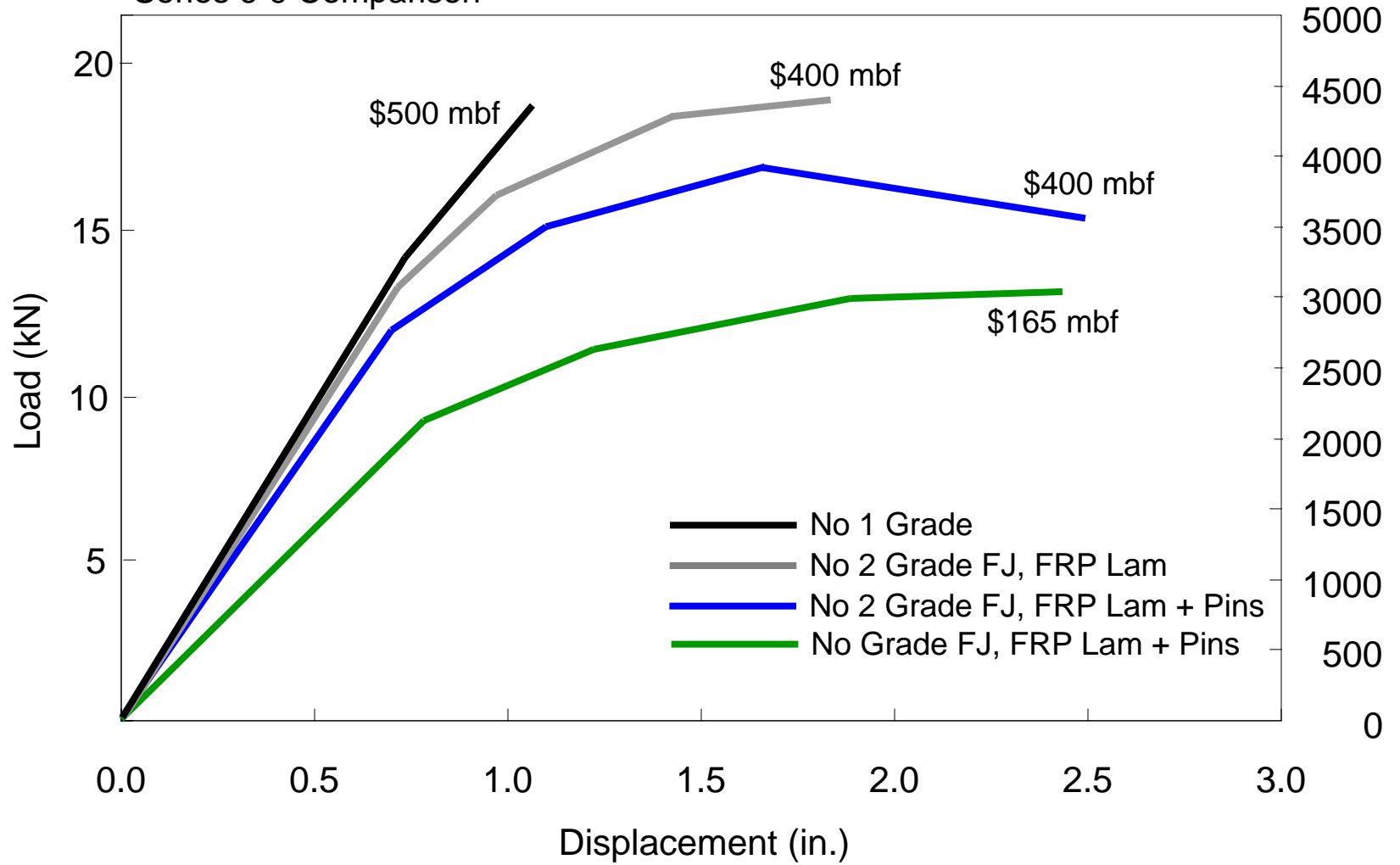


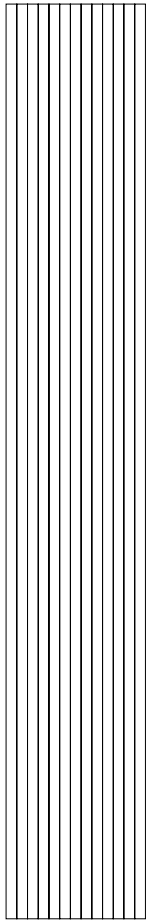
Series 9: NO Grade FJ, FRP Lam + Pins





Series 6-9 Comparison





Laminated Veneer Lumber

13 Plies of SYP Veneer (0 degree)

Neat PF adhesive

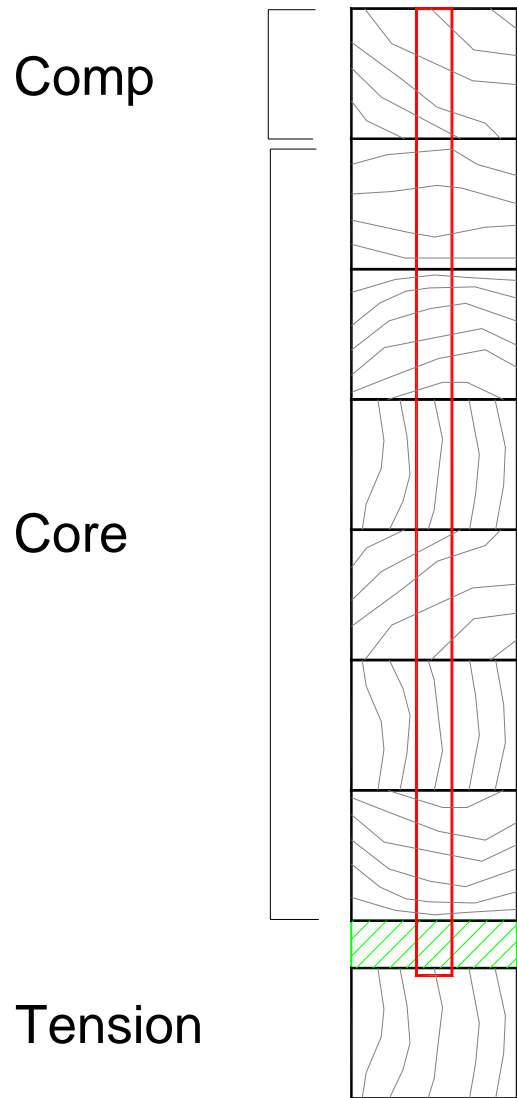
$E = 1,900,000$ psi

$F_b = 2,600$ psi

$F_v = 285$ psi

Nail laminate up to three plies

Example: 20 ft. span beam – garage door header



FRP Glulam

Top and Bottom Ply of N1M lumber

FJ Utility grade core stock (< N3C)

Neat PF adhesive

3/8" FRP long. ply, $E = 6,000,000$

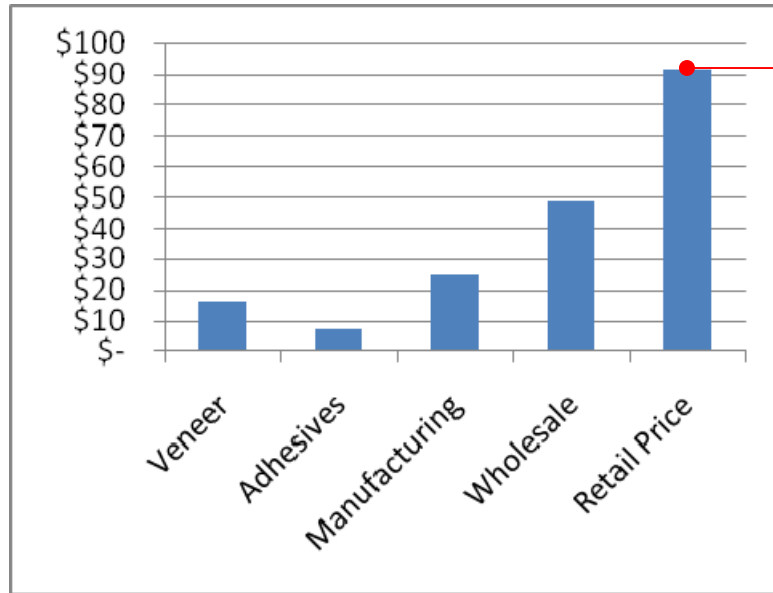
3/8" round FRP rods @ 12" centers

$E_t = 1,900,000$ psi

F_b , F_v not determined

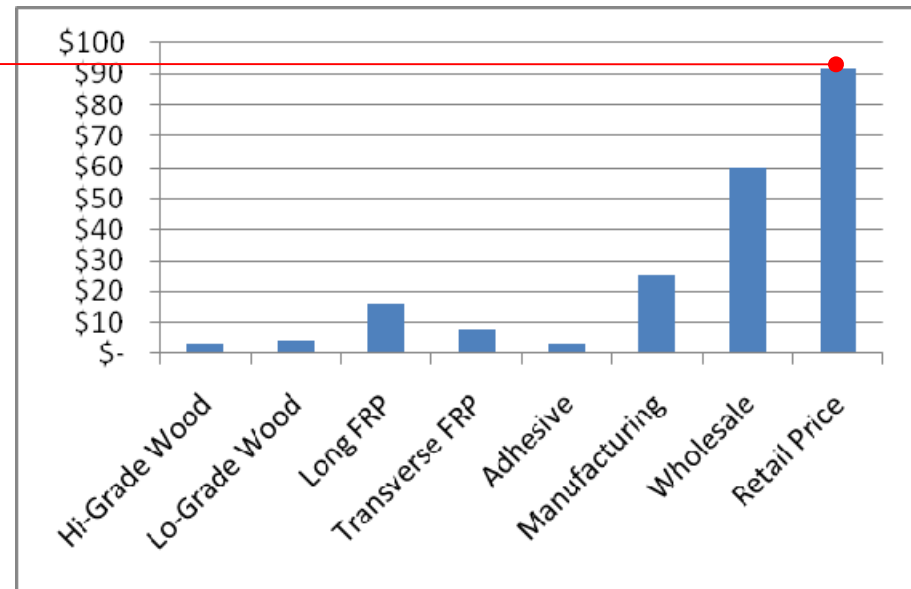
Side nail?

Laminated Veneer Lumber



- Peeler logs @ \$500 / MBF
- PF resin @ \$30 / gallon

FRP - Glulam



- Hi-Grade Wood @ \$400 / MBF
- Lo-Grade Wood @ \$175 / MBF
- PF resin @ \$30 / gallon
- 3/8" FRP Ply @ \$23.83
- FRP transverse rods @ \$7.96

Summary

- It appears that a commodity FRP-glulam is possible, but the properties and cost of the composite materials must be carefully balance
- Need to assess the feedstock for high-grade veneers – is $E = 1,900,000$ likely over the long term – at what cost?
- We must assess the potential for low-grade core plies, densely finger-jointed, with little or no grading
- Manufacturing process will be complex, but can be automated within the context of current glulam production
- Need to assess potential of nail-laminating multiple members in the way that LVL is currently laminate

Acknowledgements

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