

Comparing Trus Joist 2.2E Parallam® PSL and Commodity 24F-V4 Glued Laminated Timber

Trus Joist® 2.2E Parallam® PSL and commodity 24F-V4 glued laminated timbers (glulam) are often thought of as interchangeable; however, these two beam technologies have distinct differences which are important to understand when specifying beam material. This Technical Informer highlights the advantages of using 2.2E Parallam® PSL over commodity 24F-V4 glulam for beam, header, and column applications.

MANUFACTURING AND STRENGTH

Parallam PSL beams are manufactured from long strands of wood that are oriented parallel to the length of the member, then glued and pressed together to form one solid cross section with uniform properties. Unlike glulam, Parallam® PSL beams have no "top" or "bottom". As a result, Parallam PSL can be used in any beam application without concerns about a possible strength reduction due to improper installation.



Glued laminated beams (glulams) are composed of individual, dimension-wood laminations, or "lams", which are typically 2x4's or 2x6's. Lams are individually selected and positioned in the beam layup based on their performance characteristics, then bonded together flat-wise with adhesives. For maximum efficiency, high-strength lams are used in the tension zones of bending members where the most critical stresses occur.

Glulams are manufactured in balanced and unbalanced layups:

- A **balanced layup** is symmetrical in strength around the neutral axis of the beam depth, offering high strength in both the top and bottom of the beam. Balanced beams are best in applications that cause bending tension on both sides of the beam, such as cantilevers or when a beam extends over multiple spans.
- In an **unbalanced layup**, one side of the beam has higher strength plies than the other. The side with the higher strength plies is intended to be the tension side of the beam while the lower strength side is intended to be the compression side. Unbalanced beams are primarily intended for simple span applications where only the bottom side of the beam experiences bending tension. To ensure proper installation of unbalanced beams, the top of each glulam is stamped with the word "TOP."

If unbalanced glulams are used in applications where the lower strength side will experience tension, then bending strength reductions must be used. For a commodity 24F-V4 beam, the difference between the allowable bending strength of the tension versus the compression zones is about 25%—a significant capacity reduction. Another factor to consider, because unbalanced layups are more commonly available, obtaining a balanced layup may require a special order, increasing lead time and cost.

Deflection and Stiffness

In addition to considering the anatomical differences between Parallam PSL and commodity glulams, it is also important to consider strength and stiffness. The Modulus of Elasticity (MOE) or "E" value is a function of a beam's stiffness. The larger the E value, the greater the beam's stiffness and the smaller the beam's deflection will be.

When comparing Parallam PSL and glulams, you may notice that the E values are labeled as "apparent" or "true". The difference lays in how the "shear" component is accounted for in the deflection equation. Trus Joist product literature, code reports and design software (Forte®WEB and Javelin®) use E_{true} values for Structural Composite Lumber (SCL). Most glulam manufacturers publish $E_{apparent}$ values. To compensate for this, ForteWEB and Javelin software do not include shear deflection in their glulam beam deflection calculation, nor do they account for any built-in camber.

DESIGN PROPERTIES

Product	MOE (Apparent) x 10 ⁶ (psi)	MOE (True) x 10 ⁶ (psi)	Species	F _b (Tension) (psi)	F _b (Compression) (psi)	F _c (psi)	F _v (psi)	Density (lbs / ft ³)
Parallam® PSL	-	2.2E	DF	2900		625	290	45
24F-V4 Glulam	1.8E	-	DF	2400	1850	650	265	35

Table 1: F_b – Allowable Fiber Bending Stress, F_v – Allowable shear parallel to grain, F_c – Allowable compression perpendicular to grain

- 1) F_b values are based on a 12" beam depth. For other depths:
 Parallam PSL F_b value must be multiplied by (12/d)^{0.111} (ESR-1387)
 Glulam C_v = (21/L)^{1/x}(12/d)^{1/x}(5.125/b)^{1/x} ≤ 1.0 (Ch. 5 2018 National Design Specification)
- 2) Design properties for 2.2E Parallam PSL can be found in Trus Joist [Beam, Headers, and Columns](#) (TJ-9020) specifier guide and ICC-ES code report ESR-1387.

Despite the small difference in MOE presentation, it is easy to recognize that Parallam PSL has higher design properties than the commodity 24F-V4 glulam. This means that an application specifying Parallam PSL may not be suitable for a one-to-one glulam substitution. But to ensure adequate design, any substitution should be verified with the designer of record.

MANUFACTURING AND PERFORMANCE

Camber

Camber is an initial curvature built into a fabricated member that is designed to resist the deflection observed under gravity loads. Due to the high stiffness of Weyerhaeuser's engineered wood products, and manufacturing technology that allows Parallam PSL beams and columns to be produced straight and true, Parallam PSL beams are not manufactured with camber.

Commonly stocked glulams have a 3,500 or 5,000 ft radius camber. It is critical that cambered beams be installed with the "top" side up. If a cambered glulam is installed upside down, the beam deflection will be the sum of the deflection under load plus the beam camber. This may cause unacceptable and/or unsightly deflection, as well as problems with adjacent construction (Figure 1), such as at walls or ceilings.

Additionally, cambered members may lead to floor height difference when used as a rim or beam parallel to joists (more commonly seen in 2-hour fire wall assemblies). Likewise, cambered rim material may create additive elevation difference in shafts and elevator cores in multiple story application. It may also create challenges at the rim to plate connection.

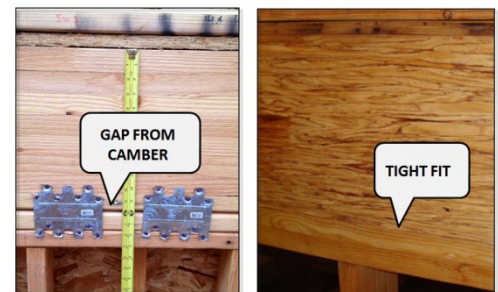


Figure 1: Comparison of glulam with camber to tight fitting PSL

Tolerances & Dimensional Compatibility

Weyerhaeuser manufactures Parallam PSL to within ±1/16" of the published sizes at an expected end use moisture content of about 10%.

Per the *ANSI A190.1: Standard for Wood Products – Structural Glued Laminated Timber*, depth tolerances of minus 3/16" or 1/16" per foot of depth, whichever is larger for undersized product. Oversized product meets the standard up to 1/8" oversize per foot of depth. These tolerances may present compatibility issues with other engineered lumber products (ELP). Likewise, be mindful of product depth when selecting glulam beams to use in conjunction with ELP. Glulams come in depths that may not be compatible with TJI joists and other Trus Joist SCL.

Moisture Content

Glulam beams are manufactured with a moisture content (MC) between 12-14%. TJI Joists are manufactured with an intended end-use MC of 8-12%. I-Joist compatible glulams, while manufactured to be the same height as TJI joists, may

shrink once in a dry environment. This can lead to uneven floors, which may cause finished surface problems and potential floor noise. Parallam PSL is manufactured to similar MC tolerances as TJI joists, which provides a more dimensionally stable and joist compatible beam solution.

Checks and Splits

Seasonal checking is common with glulams. Checks can be caused by differential drying stress as the individual laminates throughout the cross section dry at different rates. The American Institute of Timber Construction (AITC) Technical Note 18, *Evaluation of Checks in Structural Glued Laminated Timbers*, gives basic rules of thumb for evaluating seasonal checking. Checks that form but do not penetrate more than 15% across the width of the glulam are acceptable.

Parallam PSL may develop side checks if not protected from moisture, however, it does not typically check from differential drying stress to the extent seen in glulam. Parallam PSL has some small, naturally occurring voids that do not affect its structural performance and add to its unique grain appearance.

Beam Modifications

Parallam PSL can be drilled and tapered-end-cut per the tables available in the *Trus Joist Beam, Headers, and Columns* specifier guide. [Forte®WEB](#), Weyerhaeuser's free single member sizing software, can analyze holes in Trus Joist SCL up to 2/3 the member depth, as well as tapered end cuts. Furthermore, untreated Parallam PSL can be resawn in the field down to custom depths of 3-1/2" and thicknesses of 1-3/4" (per Weyerhaeuser's Technical Bulletin #305 [Re-Sawing Microllam® LVL, Parallam® PSL and TimberStrand® LSL](#)). Individual glulam manufacturers, as well as the APA, provide guidelines for cutting and notching glulam beams; however, glulam beams may not be field ripped⁽⁴⁾. Any field modifications outside of published guidelines must be analyzed by a qualified design professional.

Column Applications



Parallam PSL can be used in column applications when both vertical and lateral wind loads are applied. Its homogeneous cross-section makes it a good solution for columns in tall walls. Allowable lateral and vertical loads for Parallam PSL can be found in TJ-9003, Weyerhaeuser's [US Wall Guide](#), or columns can be sized using Forte®WEB and Javelin software.

Balanced glulam beams can be used in column applications, however the commonly available 24F-V4 unbalanced glulam is not recommended for column applications due to the increased eccentricity which results from a non-homogeneous cross-section and camber. Additionally, using a cambered member as a column in a wall may cause issues with drywall installation.

Warranty and Service

Parallam PSL comes with a limited lifetime warranty, which warrants against manufacturing defects for the lifetime of the structure provided that the product is properly stored and installed per Weyerhaeuser's instructions. Additionally, Weyerhaeuser has an experienced team of field and technical support representatives available to assist with member sizing or answer questions about installation or beam modifications. For warranties regarding glulams, contact the manufacturer.

Additional Resources

- For additional information on Parallam® PSL, please refer to [ESR-1387](#) and Trus Joist [Beam Headers, and Columns](#) (TJ-9020) specifier guide.
- A library of Trus Joist® Technical Bulletins can be found at <http://www.weyerhaeuser.com/woodproducts/document-library/>
- All specifier guides for Weyerhaeuser Trus Joist® products listed here can be found at www.Weyerhaeuser.com
- For further information and additional Technical Informers, contact Weyerhaeuser's Western Technical Support Team via email at TechSupport@Weyerhaeuser.com, or call 1-888-453-8358.
- The Trus Joist® Parallam® PSL warranty can be found at <http://www.weyerhaeuser.com/woodproducts/document-library/tj-1007>
- Other documents referenced for this informer include:
 - (1) APA – TT-082 *True and Apparent Moduli of Elasticity*
 - (2) APA - S550 *Glulam Beam Camber*
 - (3) APA TT-111A *Wood Moisture Content and the Importance of Drying in Wood Building Structures*

- (4) AITC 115 - 2008 *Standards for Fabricated Structural Glued Laminated Timber Components and Assemblies*
- (5) APA F450 *Understanding Checks in Glued Laminated Timber*
- (6) AITC Technical Note 18 *Checking in Glued Laminated Timber*
- (7) AITC Technical Note 19 *Guidelines for Evaluation of Drilled Holes and Notches in Structural Laminated Timber Beams*
- (8) ASD/LRFD National Design Specification (NDS) for Wood Construction 2018 Edition
- (9) ANSI A190.1-2017 Standard for Wood Products - Structural Glued Laminated Timber