Glued Laminated Timber Columns and Beam-Columns

An Online Continuing Education Course for Engineers

Course Number: S-3011

Credit: 3 Hours / 3 PDH / 3 CPD

Glued Laminated Timber Columns and Beam-Columns

An AITC Continuing Education Course

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Glued Laminated Timber Columns and Beam-Columns

Structural glued laminated timber (glulam) is a material that combines the warmth and beauty of wood with modern engineering to create structures for the most demanding applications. From short–span headers and beams in residential construction, to graceful exposed arches and curved beams in churches, to long span beams and trusses for commercial spaces, glulam has the answer.

This three–hour course builds on the knowledge obtained from previous courses *Glued Laminated Timber Fundamentals* and *Glued Laminated Timber Design Values, Adjustment Factors, and Beam Design* and will provide the student with the tools necessary to evaluate structural glued laminated timber columns and beam–columns. In addition, the analysis of glulam tension members and members subject to combined bending and tension loads will be addressed.

To receive PDH credit for this course, the student must pass a multiple–choice quiz consisting of 15 questions.

Learning Objectives

Upon successful completion of this course the student should be able to:

1. Discuss the effect of column slenderness on its capacity and failure mode.
2. Recall the maximum permitted slenderness ratio for timber columns.
3. Calculate the critical buckling design value for a glulam column.
4. Calculate the column stability factor for a glulam column.
5. Calculate the capacity of a concentrically loaded glulam column.
6. Discuss reasons for designing columns for eccentric loads.
7. Evaluate glulam beam–columns for structural adequacy.
8. Analyze glulam tension members.
9. Analyze glulam members subject to combined bending and tension.

Required Texts

The following document is included as an Appendix to this course document. The student is required to review the Appendix as part of the course text.

> AITC 117–2004. *Standard Specifications for Structural Glued Laminated Timber of Softwood Species*. American Institute of Timber Construction. (http://www.aitc–glulam.org/shopcart/Pdf/aitc_117–04–with%20_errata_incorporated.pdf)

GLUED LAMINATED TIMBER COLUMNS AND BEAM-COLUMNS

Structural glued laminated timbers are commonly used to resist axial loads, such as may occur in columns, trusses, struts, and ties. These members may resist axial loads alone, or they may support flexural (bending) loads in addition to the axial loads. The flexural component occurs as a result of transverse loads and/or eccentric axial loads. This course will present requirements for the analysis of columns, beam–columns, tension members, and tension members with bending loads. It is recommended that the student prepare for this course by reviewing the material presented in *Glued Laminated Timber Fundamentals* and *Glued Laminated Timber Design Values, Adjustment Factors, and Beam Design*.

Centrically-Loaded Columns

Compression members are typically referred to as *columns*. Centrically–loaded columns must be proportioned to resist failure by crushing, buckling, or a combination of both. In addition to its material properties, the capacity of a column is dependent on its cross–sectional geometry and its *effective length*.

Short, thick columns are able to support high compressive loads, only failing when the compressive strength of the material is exceeded, crushing the column. Long, slender columns will buckle under compressive loads producing stresses well below the crushing strength of the material. Columns of intermediate length fail due to a combination of crushing and buckling, resulting in a lower capacity than would be predicted by either pure crushing or pure buckling (Figure 1). The column stability factor, C_P, accounts for each of these possibilities.

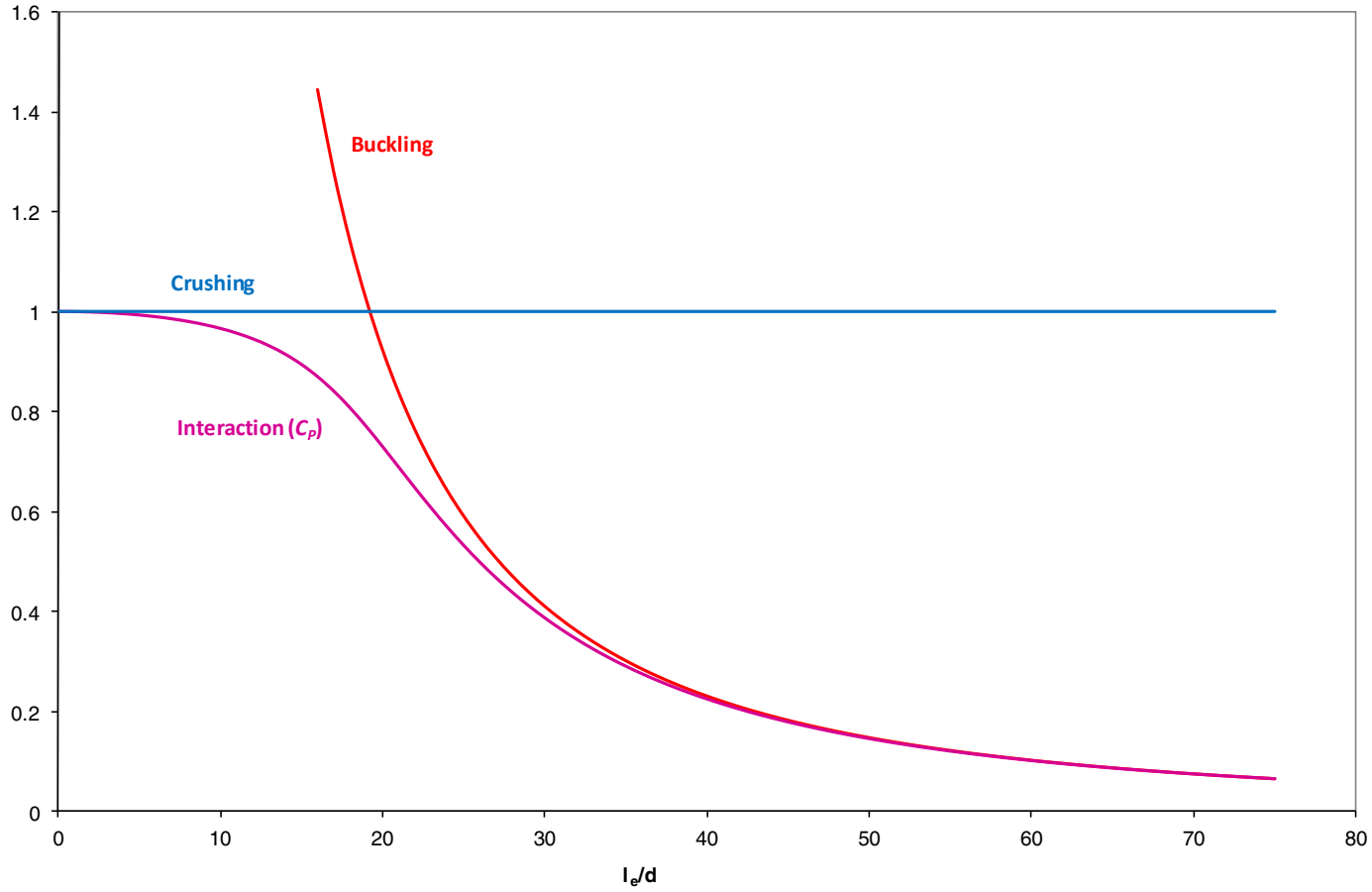

Figure 1. Column behavior. ($F_c^* = 2000$ psi and $E'_{min} = 0.9$ million psi).

Centrically loaded columns must be proportioned so that:

$$\frac{P}{A_g} \le F_c' = F_c C_D C_M C_t C_P$$

and:

$$\frac{P}{A_n} \le F_c^* = F_c C_D C_M C_t$$

where: P = centric axial compres
A_g = gro

The first crit ckling. The second criterion mus s at connections. In addition, the g construction, when it must not exce

Buckling

Buckling can b **ease of an existing** load under whic **ncreased.**" [2] Because bucklir t be prevented by limiting loads or

An ordinary yard t an axial load of several pounds w ghtly under the load, a small incre rdstick and vertical displacem ding moment on the column which

Column buckling i oss–section **about the buckling** **le about either** bending axis. The re likely to buckle. The colum ness can be increased by reducing the length depth of the section in the direction of interest. Increasing g axis is a less efficient way to increase stiffness.