Glued Laminated Timber Connection Design Overview

An Online Continuing Education Course for Engineers

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An AITC Continuing Education Course

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Introduction

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 two–hour course is designed to familiarize the student with good detailing practice for connections in structural glued laminated timber (glulam). In addition, reference design values and adjustment factors for typical fasteners used in glulam connections will be discussed. While the focus of this course is structural glued laminated timber, the principles taught are applicable to solid sawn lumber and other engineered wood products, as well.

This course builds on the knowledge obtained from the previous course *Glued Laminated Timber Fundamentals*. It is recommended that the student prepare for this course by reviewing the material presented in the earlier course.

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. Differentiate between good and poor connection details.
2. Identify common fasteners used to connect glulam members to other structural components.
3. Determine fastener design values for loads applied at an angle to grain.
4. Determine appropriate adjustment factors for fastener design.
5. Calculate the group action factor for a row of fasteners.

Recommended Texts

1. National Design Specification (NDS). AF&PA. 2012.
2. Timber Construction Manual. AITC. 2012.
3. AITC 104–2003. Typical Construction Details. AITC. (http://www.aitc–glulam.org/shopcart/Pdf/aitc_104_2003.pdf)

Glulam Connection Design Overview

1. Introduction

Connections between structural elements are an integral part of any structure. Connections involving structural glued laminated timber (glulam) members generally incorporate one or more fasteners, may also incorporate bearing, and may or may not utilize metal side plates. With the exception of specially designed moment splices, connections in timber are generally not expected to transfer moments between members.

This course provides an overview of connection design, including connection detailing principles, fastener types, reference design values, and adjustment factors. It is recommended that the student prepare for this course by reviewing the material presented in *Glulam Basics*. This course will provide a foundation for subsequent courses.

2. Connection Types

A variety of fasteners can be used to connect glulam members to each other or to other structure. The simplest type of connection is a bolted connection. Bolted connections are relatively easy to design and very effective and should be used when possible. Other fasteners, such as split rings, shear plates, or timber rivets, require special tooling and so other methods must be used. The most common fasteners used in glulam connections are bolts, lag screws, nails and screws. Split rings, shear plates, and timber rivets provide another option for glulam connections, but require special tooling that is not always readily available. Fasteners should not only be of adequate strength, but rather should be of the same strength as the glulam members they connect.

Regardless of the fastener type, connections must be designed to resist all anticipated loads. In addition to resisting the applied loads, connections must accommodate wood shrinkage. Special attention must also be taken in moist or wet environments to avoid the development of excessive tension perpendicular-to-grain stresses. Wood has relatively low strength in tension perpendicular to the grain. Connections that have demonstrated good performance in the past are usually the best guide. This course presents recommended details and identifies details that should be avoided.

2.1 Accommodating Wood Shrinkage

Understanding wood shrinkage is critical to proper detailing of connections. Glulam members, which are typically manufactured from kiln-dried lumber, are used in dry conditions and will shrink as they dry to the moisture content that is a reasonable estimate of indoor equilibrium moisture content for the majority of the country. The average moisture content of structural glued laminated timber members can be as high as 15% at the time of manufacturing. Based on the rule of thumb discussed in *Glued Laminated Timber Fundamentals* (5% drop in MC = 1% shrinkage), a structural glued laminated timber member would be expected to shrink by 1% as it dries in service. This shrinkage must be accommodated in the connection detailing to ensure that tension perpendicular-to-grain stresses are not induced in the member. Tension strength perpendicular to the grain in wood is very small and can practically be considered as zero for most design purposes.

Shrinkage generally does not cause problems by itself, however, relative shrinkage between connected parts can result in splitting in the timber members at the connection. Care must be taken in detailing connections so that