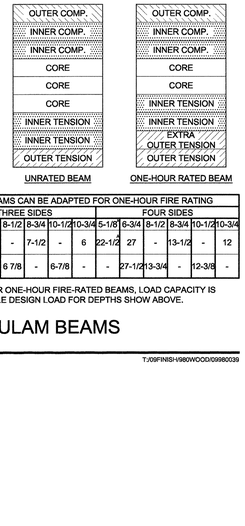
WHEN A ONE-HOUR RATING IS REQUIRED FOR A GLULAM BEAM, ONE ADDITIONAL TENSION LAMINATION WILL REPLACE A CORE LAMINATION AND THE GLULAM IS TO BE MARKED "FIRE-RATED ONE-HOUR" BY THE MANUFACTURE. FOR A BALANCED BEAM LAYUP, AN ADDITIONAL TENSION LAMINATION IS TO BE ADDED TO BOTH OUTER ZONES.



MINIMUM DEPTH AT WHICH GLULAM BEAMS CAN BE ADAPTED FOR ONE-HOUR FIRE RATING											
FIRE EXPOSURE	THREE SIDES					FOUR SIDES					
BEAM WIDTH (IN.)	5-1/8	6-3/4	8-1/2	8-3/4	10-1/2	10-3/4	5-1/8	6-3/4	8-1/2	8-3/4	10-1/2	10-3/4
MINIMUM DEPTH (IN.): 1-1/2" THICK LAMINATIONS	12[A]	13-1/2	-	7-1/2	-	6	22-1/2	27	-	13-1/2	-	12
MINIMUM DEPTH (IN.): 1-3/8" THICK LAMINATIONS	-	13-3/8	6 7/8	-	6-7/8	-	-	27-1/2	13-3/4	-	12-3/8	-

A. WHEN A 5-1/8" WIDE GLULAM IS USED FOR ONE-HOUR FIRE-RATED BEAMS, LOAD CAPACITY IS REDUCED TO ABOUT 50% OF THE ALLOWABLE DESIGN LOAD FOR DEPTHS SHOW ABOVE.

FIRE-RATED GLULAM BEAMS
(1 HR RATING)

SCALE: 1"=1'-0"

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Fire-Resistive Construction

Fire resistance is the length of time a structural member can support its load before collapsing. The goal of fire-resistive construction is to provide adequate fire resistance for occupants to evacuate the building safely.

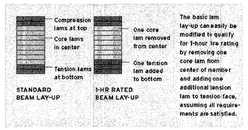
The standard test for measuring fire resistance is the American Society for Testing and Materials (ASTM) Test Method E-119. Ratings of assemblies (including beams, walls and floors) are determined by test procedures that approximate actual fire conditions.

The results of ASTM fire tests for building assemblies, sponsored jointly by the American Forest & Paper Association and the American Institute of Timber Construction (AITC), enable designers to calculate specific fire ratings for glulam members. Calculations are based on a consideration of member size, degree of fire exposure, and loads on the member.

Additionally, fire-resistance ratings for glulam beams require lay-up modifications. For example, a simple span glulam beam having a cross section of 6 3/4" x 13 1/2" and exposed to fire on three sides can be sized for a one-hour fire rating. To qualify for this rating, an inner or core lamination is removed from the beam at the time of manufacture and replaced by adding an additional tension lamination to the bottom of the beam as shown in the figure above.

For additional information related to calculating a fire rating for heavy timber members, please refer to AITC Technical Note No.7 *Calculation of Fire Resistance of Glued Laminated Timbers* (www.aitc-glulam.org) and to AF&PA Technical Report 10 *Calculating the Fire Resistance of Exposed Wood Members* (www.awc.org).

ADAPTING STANDARD BEAM LAY-UP TO MEET ONE-HOUR FIRE RESISTANCE



ABOVE (middle): Typical glulam beam exposed in finishes during standard ASTM E-119 fire test.

ABOVE (bottom): Typical glulam beam following fire testing; the outer surface of the beam has charred while the inner areas remain unburned. The charred outer material acts as an insulator during fire, reducing the rate at which the inner material will burn.

Glulam Product Guide 20

DESIGNING FOR FIRE RESISTANCE

Fire Performance of Wood Construction

The truly fireproof building does not exist. In nearly all buildings, the contents are flammable and are the critical factor in a fire. The smoke and heat generated by the burning contents can cause extensive damage and loss of life long before the structural components of the building are affected.

The primary objective in any fire-rated construction is protection of human life. The combination of a variety of products and construction methods can slow flame spread and make a building fire-safe. In addition to the structural materials used, the variables involved in creating a fire-safe environment include the use of sprinkler systems, gypsum wallboard, acoustical tiles and separation walls. Sprinkler systems may be used to increase allowable floor areas for most occupancies and in some instances, sprinklers may be substituted for one-hour fire-resistive construction in certain sections of a building. Building codes vary widely, so it is important to review the codes for the geographic area in which the building is being constructed to determine fire safety requirements.

Glulam Performance in Fire

Glulam performs very well in the intense heat of a fire, where temperatures can achieve 1,650° F or higher. Unprotected steel members typically buckle and twist in such high temperatures, causing catastrophic collapse of both the roof and supporting walls.

Wood ignites at about 450-500° F, but charring may begin as low as 300° F. Wood typically chars at a rate of 1/40 inch per minute. Thus, after 30 minutes of fire exposure, only the outer 3/4 inch of the glulam will be damaged. It is important to note that the adhesives used in the manufacture of a glulam beam burn at about the same rate as the wood and do not affect the overall fire performance of the member. The char that develops insulates the glulam member and, hence, raises the temperatures it can withstand. Most of the cross section of a large glulam will remain intact when exposed to fire, and the member will continue to support load.

Thus, depending on the severity of the fire and after a structural re-analysis by a qualified design professional, it is often possible to salvage the glulam members by merely removing the fire-damaged material and refinishing the surface of the member.

One-hour Fire Resistance

To assure a safe structure in the event of a fire, authorities base fire and building code requirements on research and testing, as well as fire histories. Based on these and other considerations, the model building codes, including the International Building Code (IBC), classify Heavy Timber as a specific type of construction and set minimum sizes for roof and floor beams to assure fire performance.

Procedures are also available to determine the minimum glulam size for projects in which one-hour fire resistance of components is required. Tables 4 and 5 on page 21 illustrate this principle for glulam timber. Additional details are provided in EWS Y245, *Calculating Fire Resistance of Glulam Beams and Columns.*

A structural member's fire resistance is measured by the time it can support its design load during a fire. An exposed beam or column sized for a minimum one-hour fire resistance will support a design load for at least one hour during standard fire test conditions which simulate an actual fire. The IBC provide a methodology for calculating the minimum size of glulam to provide a one-hour fire rating under given design conditions. An alternate procedure is given in Chapter 16 of the 2005 *National Design Specifications.*

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Glulam Product Guide 21

TABLE 4

MINIMUM DEPTHS AT WHICH 6-3/4" AND 8-3/4" WIDE BEAMS CAN BE ADAPTED FOR ONE-HOUR FIRE RATINGS

Beam Width (in.)	Depth 3 Sides Exposed (in.)	Depth 4 Sides Exposed (in.)
6-3/4	13-1/2	27
8-3/4	7-1/2	13-1/2

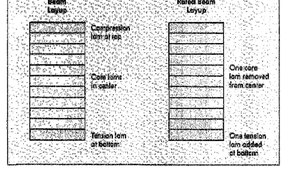
TABLE 5

MINIMUM DEPTHS AT WHICH 8-3/4" AND 10-3/4" COLUMN WIDTHS QUALIFY FOR ONE-HOUR RATING FOR GIVEN l/d

l/d Criteria	Column Width (in.)	Depth 3 Sides Exposed (in.)	Depth 4 Sides Exposed (in.)
l/d > 11	10-3/4	10-1/2	13-1/2
l/d ≤ 11	8-3/4	7-1/2	12
	10-3/4	7-1/2	10-1/2

FIGURE 6

SIMPLE SPAN UNBALANCED LAYUP



It is important to note that to qualify for a one-hour fire rating for a glulam member, it is necessary to replace one core lamination with one tension lamination, as illustrated by Figure 5.

As with all other structural framing, specifications of members designed to have one-hour fire resistance should be carefully checked by a professional engineer or architect to assure compliance with all local building codes.

Fire Treatments

While pressure impregnated fire retardant chemicals are often used to reduce flame spread of some wood products, they are not recommended for use with glulam. If a fire retardant treatment is used, it is the responsibility of the design professional to determine the effects of the treatment on the strength of the glulam by consulting the manufacturer of the fire retardant treatment. Another option for reducing flame spread is to apply an intumescent paint to the surface of the glulam, which does not affect the structural integrity of the member.

For more information on fire-rated construction systems and one-hour rated glulam, refer to the APA Fire-Rated Systems guide, Form W305.

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FIRE-RATED GLULAM BEAMS
(ONE-HOUR RATING)

SCALE: NTS

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SECTION 714
FIRE-RESISTANCE RATING OF
STRUCTURAL MEMBERS

714.1 Requirements. The fire-resistance rating of structural members and assemblies shall comply with the requirements for the type of construction and shall not be less than the rating required for the fire-resistance-rated assemblies supported. Exception: Fire barriers, fire partitions and smoke barriers
as provided in Sections 706.5, 708.4 and 709.4, respectively.

714.2 Protection of structural members. Protection of columns, girders, trusses, beams, lintels or other structural members that are required to have a fire-resistance rating shall comply with this section.

714.2.1 Individual protection. Columns, girders, trusses, beams, lintels or other structural members that are required
to have a fire-resistance rating and that support more than two floors or one floor and roof, or support a load-bearing wall or a nonload-bearing wall more than two stories high, shall be individually protected on all sides for the full length with materials having the required fire-resistance rating. Other structural members required to have a fire-resistance rating shall be protected by individual encasement, by a membrane or ceiling protection as specified in Section 711, or by a combination of both. Columns shall also comply
with Section 714.2.2.

714.2.1.1 Membrane protection. King studs and boundary elements that are integral elements in load-bearing walls of light-framed construction shall be permitted to have required fire-resistance ratings provided by the membrane protection provided for the load-bearing wall.

714.2.2 Column protection above ceilings. Where columns require a fire-resistance rating, the entire column,
including its connections to beams or girders, shall be protected. Where the column extends through a ceiling, fire resistance of the column shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column.

714.2.3 Truss protection. The required thickness and construction of fire-resistance-rated assemblies enclosing
trusses shall be based on the results of full-scale tests or combinations of tests on truss components or on approved calculations based on such tests that satisfactorily demonstrate that the assembly has the required fire resistance.
714.2.4 Attachments to structural members. The edges of lugs, brackets, rivets and bolt heads attached to structural members shall be permitted to extend to within 1 inch (25 mm) of the surface of the fire protection.

714.2.5 Reinforcing. Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement except that stirrups and spiral reinforcement ties are permitted to project not more than 0.5-inch (12.7 mm) into the protection.

714.3 Embedments and enclosures. Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.

714.4 Impact protection. Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 5 feet (1524 mm) from the finished floor.

714.5 Exterior structural members. Load-bearing structural members located within the exteriorwalls or on the outside of a building or structure shall be provided with the highest fire-resistance rating as determined in accordance with the following:
1. As required by Table 601 for the type of building element based on the type of construction of the building;
2. As required by Table 601 for exterior bearing walls based on the type of construction; and
3. As required by Table 602 for exterior walls based on the fire separation distance.

714.6 Bottom flange protection. Fire protection is not required at the bottom flange of lintels, shelf angles and plates, spanning not more than 6 feet (1829 mm) whether part of the structural frame or not, and from the bottom flange of lintels, shelf angles and plates not part of the structural frame, regardless of span.

714.7 Seismic isolation systems. Fire-resistance ratings for the isolation system shall meet the fire-resistance rating required for the columns, walls or other structural elements in which the isolation system is installed in accordance with Table 601. Isolation systems required to have a fire-resistance rating shall be protected with approved materials or construction assemblies designed to provide the same degree of fire resistance
as the structural element in which it is installed when tested in accordance with ASTM E 119 (see Section 703.2).
Such isolation system protection applied to isolator units shall be capable of retarding the transfer of heat to the isolator unit in such a manner that the required gravity load-carrying capacity of the isolator unit will not be impaired after exposure to the standard time-temperature curve fire test prescribed in ASTM E 119 for a duration not less than that required for the fire-resistance rating of the structure element in which it is installed. Such isolation system protection applied to isolator units shall be suitably designed and securely installed so as not to dislodge, loosen, sustain damage or otherwise impair its ability to accommodate the seismic movements for which the isolator unit is designed and to maintain its integrity for the purpose of
providing the required fire-resistance protection.

INFORMATION ON FIRE RATING GLB'S OBTAINED THROUGH LAM-WOOD SYSTEMS, INC.

CORE 2ND FLOOR FRAMING (BEAM PROTECTION)

SCALE: 1/8"=1'-0"

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BEAM PROTECTION SPECIFICATIONS

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DATE 8/28/2015

REVISED DATE

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save:9/10/2015 10:46 AM jasonm job:8/28/2015 10:35 AM keithsm file:c:\users\jason\me-aa\docs\arch\ab\ab1\ab1 2nd floor framing beam protection.dwg A8.9d