



# American Institute of Timber Construction

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## AITC 403-2005

### STANDARD FOR END JOINTS FOR USE IN LAMINATION REPAIR

Adopted as Recommendations, October 28, 2005

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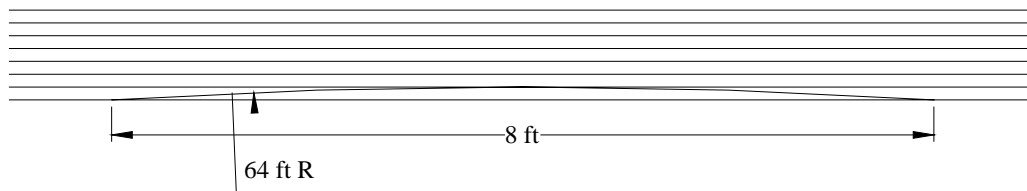
#### 403.1. SCOPE

This Standard covers procedures to be used for in-plant structural repair of laminations in glued laminated timber members. The repair procedures include the use of qualified structural end joints to join the required repair section(s) to the existing member. Repairs are made to single laminations using end joints produced through the lamination thickness with "radius scarfs" (64 ft minimum radius as described in Figure 403-1), or with straight scarfs or any other configuration that can be appropriately qualified. This repair procedure is used as an alternate to replacement of an entire lamination. In addition to end joint qualification tension test requirements, the repair procedures are verified for adequacy through the use of full scale beam tests as described in 403.2.8.

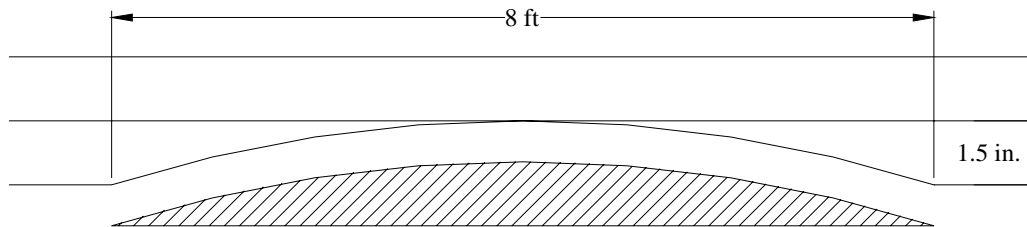
#### 403.2. GENERAL REQUIREMENTS

**403.2.1** End joints to be used in lamination repair procedures must be qualified specifically for this purpose through the use of AITC Test T 119 modified as follows:

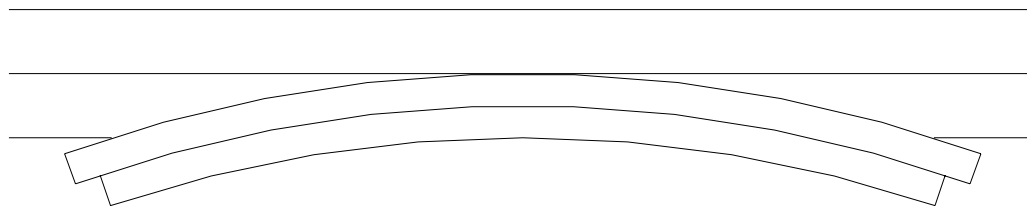
- (a) Twenty end joint specimens (full size) shall be prepared using simulated repair procedures to the face(s) of straight glued laminated timber members. These specimens shall be tested in tension with no requirement for correlation with daily test methods.
- (b) The specimen length between grips may be adjusted to accommodate the repair joint dimensions.
- (c) Lumber for the end joint test specimens shall meet the grade and specific gravity requirements specified, and shall be selected so that the maximum slope of grain in the lamination resulting from the repair process is no greater than 1:16.
- (d) Grip spacing may be extended to a maximum of 6 ft.
- (e) Strength and wood failure requirements are applicable.



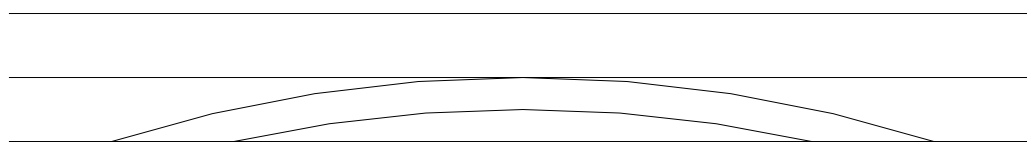
(a) 8 ft repair on 64 ft radius.



(b) STEP 1: The defective area is cut away by a planer on a 64 ft radius.



(c) STEP 2: Repair laminations are bonded into place (two  $\frac{3}{4}$  in. laminations shown).



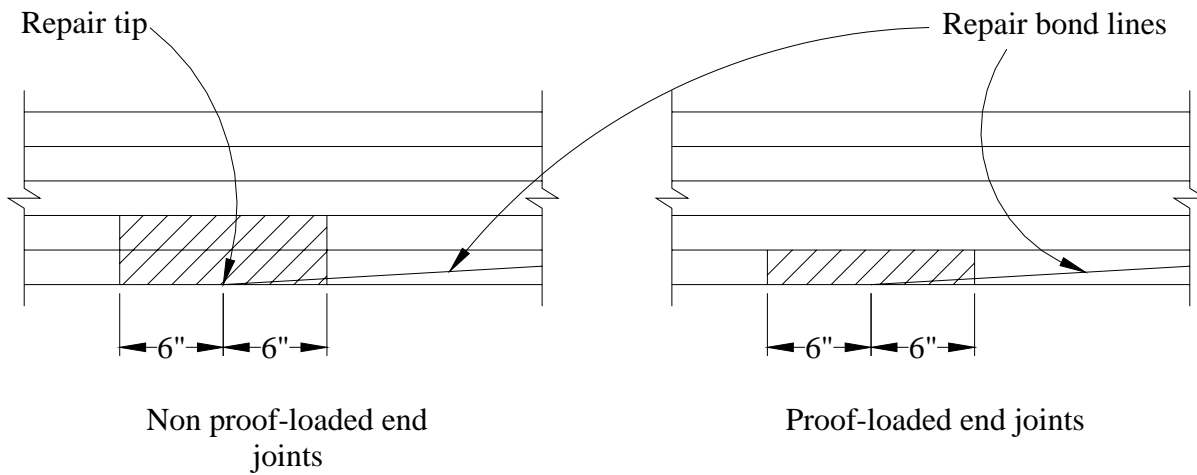
(d) STEP 3: The face side is surfaced smooth after the adhesive has cured.

**Figure 403-1.** *Tension lamination repair procedure. Vertical scale of drawings (b), (c), and (d) is magnified 5:1.*

**403.2.2** Repair procedures shall be qualified as an extension of routine plant production methods and, as such, they must be reproducible in the plant.

**403.2.3** Repairs are limited to single lamination depths in the outer laminations. If, for any reason, interior laminations are to be repaired by an end joint repair procedure, the outer laminations must first be removed.

**403.2.4** End joint spacing requirements apply only to the repair joint tip area, as illustrated in Figure 403-2, for any repair joint length that is 24 in. or longer. These end joint spacing requirements also apply to laminations which have been proof loaded.



**Figure 403-2.** End joint spacing requirements. End joints are not permitted in hatched areas.

**403.2.5** Basic daily test requirements are fulfilled by using either AITC Test T107 or full size tension test AITC Test T119 with specimens prepared by procedures modified for this purpose as specified in 403.4.

**403.2.6** When a repair is made to a member containing proof loaded laminations, it shall not be marked as containing proof loaded end joints.

**403.2.7** The number of repairs that may be performed in a single lamination is restricted only by end joint spacing requirements.

**403.2.8** Each system of end joint repair used by the industry, except for the qualified plane scarf joints, shall be verified through the use of full scale beam tests as shown in 403.5. Once these beam tests have been completed, they will apply to any plant that uses the same system provided all qualification and daily quality control tests included herein are performed and the system meets the requirements.

### **403.3. REPAIR PROCEDURES**

Approval of repair procedures at individual laminating plants shall include qualification of the end joint configuration to be used for the lamination repair process, and qualification of the specific production procedures to be used.

**403.3.1 Radius Scarf End Joint Used For Repair.** This process involves use of 64 ft. radius scarf joints to insert one or more repair sections along the length of an outer lamination in a glulam member. A single repair results in a constant radius glue line surface that extends through the lamination width, and extends approximately 8 ft. along the lamination length. The repair surface becomes tangential at the first

glue line in from the face of the member. Each repair that begins and ends at the face is considered completely from the repair joint to the end of the member or to another single radius scarf along the glue line between the outside 2 laminations. The curved surface of the radius scarf on the lamination being repaired must be a knife planed surface produced from a fixed guide or template.

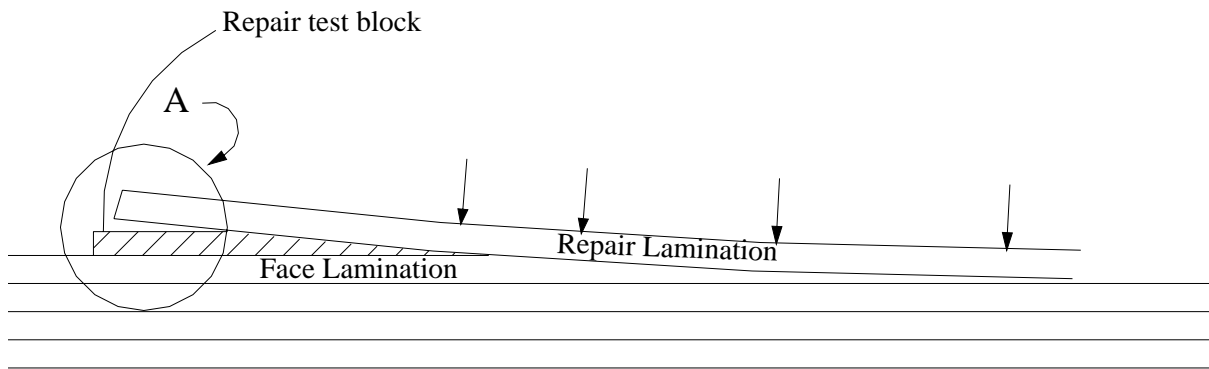
**403.3.1.1 Qualification Specimen Preparation.** Twenty end joint specimens shall be prepared from face laminations using repair procedures to be qualified. Repairs may be made to the face laminations of specially prepared beams (test beams) or they may be made to laminations that are temporarily attached mechanically to a backup beam.

#### **403.3.1.2 Specimen Preparation From Test Beams.**

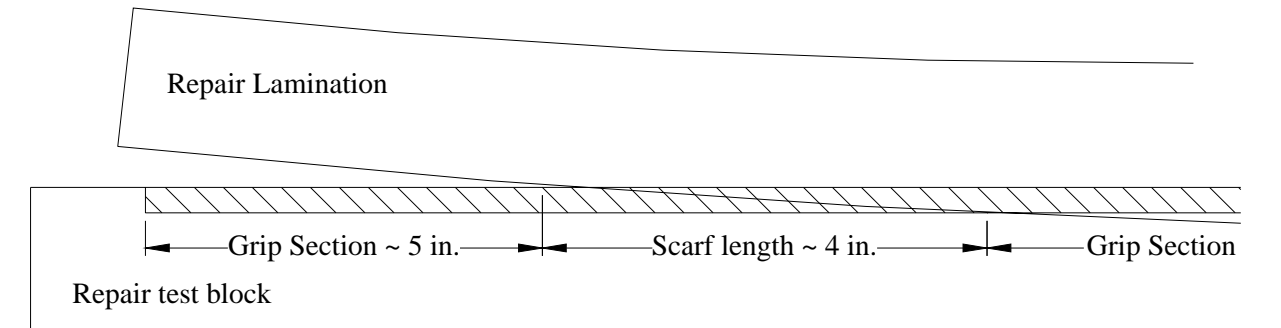
- (a) Ten beams (the length and depth of which may vary to accommodate specific repair procedures) are manufactured with tension grade laminations on the faces (see AITC 117-93 - MANUFACTURING for grade requirements). In some cases, it may be possible to use 5 beams with tension grade material on both outside faces for this step, or to make the beams long enough to allow for multiple repairs along the length of the members.
- (b) In order to provide sufficient machine grip length on each side of each end joint specimen, a single radius scarf may be used with the lamination extending approximately 5 ft. on each side of the joint.
- (c) Prior to performing the radius repair scarf cuts, test blocks are temporarily fixed to the beam face(s) as illustrated in Figure 403-3, to provide for the test specimens to be used for daily test procedures.
- (d) Radius scarf cuts are made to the face laminations using a fixed guide in conformance with the requirement that the repair procedure must be reproducible by the plant personnel.
- (e) The repair lamination is clamped into place following application of a qualified face bond adhesive. Clamp pressure and block spacing shall meet the requirements of ANSI/AITC A190.1.
- (f) Following an appropriate cure period, the face lamination(s) including the repair(s) are removed by sawing and tension test specimens for AITC Test T119 are prepared.

#### **403.3.1.2.1 Specimen Preparation Using Backup Beams.**

- (a) Procedures similar to those described in items (a) through (e) above may be used with the exception that the lamination to be repaired is temporarily mechanically fastened to any conveniently available straight beam.
- (b) With this procedure, only 1 joint may be used from each 8 ft. repair due to the 4 ft. grip length required on each side of the joint.



(A) Specimen preparation from test block



Face lamination

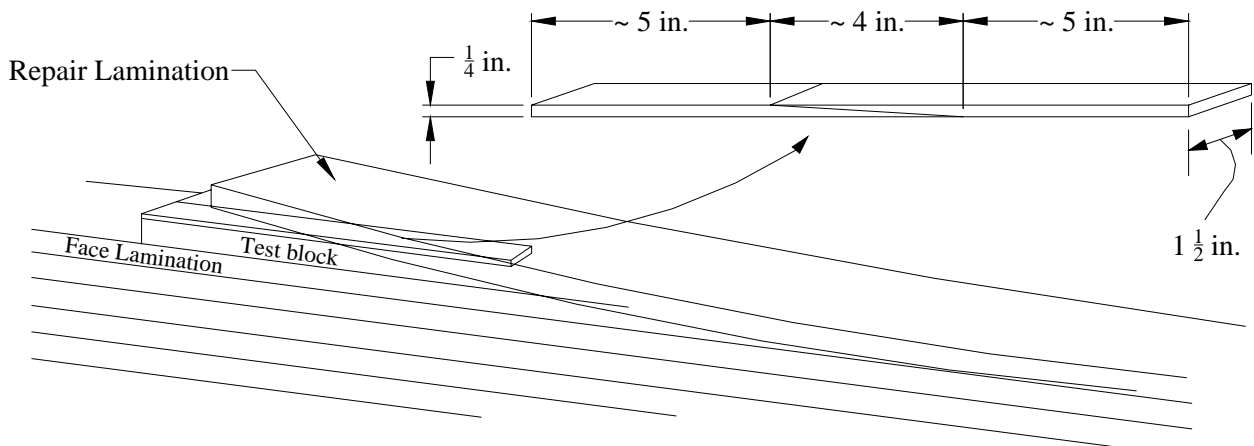


Figure 403-3. Preparation of test specimens for radius scarf repair procedures.

**403.3.2 Plane Scarf Joints Used for Repair.** A plane scarf joint may be used to repair a lamination provided the entire portion of the lamination from the repair to the closest end of the member is removed. The surface remaining after removal of the lamination shall meet the smoothness requirements of ANSI/AITC A190.1 for face joint bonding. The plane scarf used on the remaining portion of the lamination shall be cut by the use of guides or other methods that are reproducible in quality on a day-to-day basis. Beginning at the face, it shall slope away from center of the member.

#### **403.3.2.1 Preparation of Plane Scarf End Joints for Qualification Tests.**

**403.3.2.1.1 Specimens for AITC Test T119.** Twenty plane scarf end joints shall be prepared using the repair procedure to be qualified. The end joints are made by temporarily attaching a piece of lumber (specially graded for full size tension tests as described in AITC Test T119) to a backup beam by clamping. A sloping scarf is then cut in place on this piece of lumber using the same procedure used for repairs. A mating scarf end cut shall be made on another piece of the specially graded lumber. Glue is spread on the scarf cuts only, in the same manner used for repair. The piece of lumber is clamped in position in the same manner as the repairs are made. Wax paper (or plastic) should be placed between these pieces of lumber and the backup beam to prevent their sticking. After the end joints have cured, they are removed from the package and processed for testing by AITC Test T119. If the clamps used on the initial piece of lumber attached to the beam interfere with the cutting process, this piece can be glued to the backup beam and removed by sawing.

**403.3.2.1.2** The replacement lamination section is glued and clamped in place by procedures to be qualified. Clamp spacing and glue line pressure shall meet the requirements of ANSI/AITC A190.1.

**403.3.2.1.3** Subsequent to an appropriate cure period, the end joint specimens are removed from the face(s) of the test beam(s) and sized for testing in accordance with AITC Test T119.

**403.3.3 Other End Joint Types.** Any qualified joint configuration may be used as part of an approved repair procedure.

### **403.4. PREPARATION OF DAILY TEST SPECIMENS**

At the time of qualification, procedures to be used for preparation and testing of daily test specimens shall be demonstrated. One end joint sample shall be prepared for AITC Test T110 (when wet-use adhesives are used). An additional end joint sample shall be prepared for use with AITC Test T119. Modifications to specimen and test procedures that may be required to adapt AITC Test T119 for this purpose shall be included in the plant procedures manual.

### **403.5. REPAIRED BEAM TEST REQUIREMENTS**

End joint repair procedures must be verified for adequacy by supplemental full scale beam tests in addition to the tensile tests required in AITC Test T119. For these tests, the proposed repair procedures are applied to the faces of five 5 1/8 in. x 12 in. x 20 ft. glued laminated beams. The beams are then

tested in bending to failure. Full scale beam tests are required only for those end joint configurations not previously tested and approved by the AITC Inspection Bureau for the industry.

**403.5.1 Test Beam Preparation.** Repair procedures are applied to the face lamination such that at least one "end joint" is located directly opposite a load point in 3 beams, and centered at mid-span in 2 beams.

**403.5.2 Beam Test Procedures.** Test beams with "repaired" face laminations are tested in bending under 2 point loading in accordance with ASTM D 198.

**403.5.3 Beam Test Criteria.** The minimum acceptable beam test bending value shall be 2.1 times the tabular design stress in bending ( $F_{bxx}$ ) of the highest strength combination for which the repair is to be used. If the repair is intended to be used with combinations requiring a higher qualification stress level (QSL) than the tabular design value in bending ( $F_{bxx}$ ), any combination for which the higher QSL is required may be used in manufacturing the test beams.