NATIONAL QUALITY STANDARD FOR METAL PLATE CONNECTED WOOD TRUSSES

Rev. June 4, 2013

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Reference Publications

- Truss Plate Institute of Canada (TPIC), Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses
- National Lumber Grade Authority (NLGA), Standard Grading Rules/Special Product Standards
- FPInnovations, Truss Fabricator Guidelines on the Use of Fingerjoined Lumber in Metal Plate Connected Trusses

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1. GENERAL

1.1. Scope

This standard is a quality standard for the manufacturing of metal-plate-connected wood trusses and shall be used in conjunction with an in-plant quality assurance program. It is intended to provide the basic quality requirements to enable truss plants to demonstrate conformance with industry standards.

1.2. Alternative Materials

Where alternative material is used, additional requirements such as found in Annex A, "Truss Fabricator Guidelines on the Use of Fingerjoined Lumber in Metal Plate Connected Wood Trusses" shall also apply.

2. IN-PLANT QUALIFICATION PROGRAM

2.1. Plant Quality Assurance Manual

Each qualified truss plant shall have a plant quality assurance manual complying with this standard and approved by the Regional Association[1]. It shall contain documentation of quality control procedures which include the requirements for initial plant qualification and for ongoing quality control.

2.2. Manufacturing Tolerances

Manufacturing tolerances shall be in accordance with TPIC "Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses", Appendix G, and this standard.

2.3. In-Plant Inspections

A minimum inspection of three trusses per operational set-up location per shift, per week shall be completed and duly recorded. Trusses sampled for inspection shall be as-finished off the production line or preferably from yard storage. They shall, as much as practicable, be the type representative of the range of production. Inspections shall follow a format that includes the manufacturing and material variances prescribed in TPIC Appendix G, and this standard.

2.4. Non-Conforming Inspections

Trusses that do not meet minimum allowances for material defects and variances in workmanship shall be documented with follow-up repair, rework or replacement as instructed and documented by the truss designer.

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[1] The term "Regional Association" means an entity representing one or more light metal plate connected wood truss plants and possibly associated industries within a given geographical region.

2.5. Outside Party Audits

Audits shall be conducted at a minimum frequency of two times per year unless the plant is inactive for a period of at least 6 months. They shall be random and unannounced and reasonably distributed during the year. These audits are intended to verify the plant's ongoing conformance with this standard and Regional Association requirements. They are to be conducted by qualified individuals approved by the Regional Association.

2.6. Documentation

The plant shall maintain all records of in-house inspections including outside party audits for a minimum of 5 years. The Regional Association shall maintain a current list of qualified plants that can be made available to interested parties.

3. TRUSS DESIGN DRAWINGS

3.1. Design Procedures

All trusses shall be designed in accordance with TPIC procedures.

3.2. Minimum Information

Minimum information shall be in accordance with TPIC "Minimum Information on Truss Design Drawings", Appendix H.

4. MATERIALS

4.1. Lumber

All trusses shall be manufactured using dimension lumber graded and stamped according to NLGA Rules including applicable NLGA Special Products Standards.

4.2. Metal Connector Plates

All metal connector plates shall be in accordance with TPIC Appendix G. Substitute (larger) sizes are acceptable provided the plate is the same type, gauge and orientation as the plate being specified. No dimension can be less, and the tooth count in each joint member shall equal or exceed the original requirement. Plates shall not project past truss profiles or internal boundaries where clear space is required by the design specifications i.e. duct chases in floor trusses, room space in attic trusses.

5. HANDLING AND STORAGE

5.1. Lumber and plates

Lumber and plates shall be stored in a way to protect against the elements.

5.2. Fabrication

Any damage to trusses during fabrication and handling relevant to Section 1.2, Alternative Materials shall be recorded and made available to the Regional Association.

5.3. Finished Trusses

Trusses shall be handled and stored in a way to prevent damage (excessive bending, overstressing joints and lumber). They shall be protected from excessive moisture including excessive ground contact.

6. TRUSS SUBMITTAL PACKAGE

6.1. Design Drawings

The truss submittal package shall contain individual truss design drawings, including requirements for web bracing, or otherwise in accordance with the Authority Having Jurisdiction.

7. REPAIR AND REPRESSING

7.1. Repair Specifications

When any installed (i.e. embedded) connector plate does not meet plating requirements the truss designer shall do one of the following:

(a) Specify the repair removing the plate
(b) Specify the repair leaving the plate in place, or
(c) Review and approve the plate "as is".

7.2. Lumber Condition

When a connector plate is installed in a connection area of lumber that contains tooth holes (wood otherwise not damaged) from a previously installed plate, connector plate teeth shall be considered 50% effective at the location where they cover the tooth holes.

7.3. Plate Removal

Connector plate teeth installed into lumber which has been damaged (i.e. wood removed, or excessive splits) by the installation/removal of a previous connector plate shall be considered ineffective in the damaged areas.

7.4. Repressing

Connector plates may be repressed during manufacture to improve plate embedment.

8. TRUSS MARKING

8.1. Plant Qualification Marking

Appropriate truss marking (stamps, tags) should be used to provide evidence of plant qualification to standards.

8.2. Special marking

Bearing locations other than truss heels, and locations of point loads shall be identified with stamps, tags or other appropriate marking on each truss, or with the drawings that accompany the truss shipment. Bottom chord bearing parallel chord truss shall be clearly marked to avoid inverted installation.

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ANNEX A

TRUSS FABRICATOR GUIDELINES ON THE USE OF FINGERJOINTED LUMBER IN THE METAL PLATE CONNECTED TRUSSES

Rev. February 29, 2012

1 General

Fingerjoined (FJ) lumber provide truss fabricators with long lengths of lumber that may provide opportunities for truss fabricators to optimize their production process and realize savings by, for example, reducing inventory levels or minimizing waste. FPInnovations and representatives from the truss and lumber industry have been looking at developing fingerjoined lumber as a viable option for the metal plate connected wood truss industry.[1]

The key steps of the initiative include:

1. Understanding how fingerjoined lumber would behave in truss applications;
2. Revision to and taking steps to gain code recognition in Canada and the US of the National Lumber Grades Authority (NLGA) fingerjoined machine graded lumber standard, SPS 4[2]; and
3. Developing lumber and truss handling guidelines to help ensure that the fingerjoined lumber and trusses made with fingerjoined lumber perform as expected.

2 Intent

These guidelines were judged necessary because acceptable lumber and truss handling in the truss fabrication industry have developed over time and, more importantly, from experience gained from handling non-fingerjoined lumber. These guidelines are meant to provide practical information on fingerjoined lumber product produced to the NLGA SPS 4 that will help prevent poor product performance either in the plant or in the field.

It is assumed that truss fabricators have in-plant quality assurance procedures that can be adapted to implement these guidelines, and that these guidelines will be used in conjunction with the other truss industry guidelines on truss handling.[3] It is anticipated that feedback from the truss industry on acceptable alternative practices would develop from these guidelines and implemented as appropriate.

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[1] This initiative was funded by Natural Resources Canada through its "Value to Wood" program and its contributions to the FPInnovations national research program; by the Alberta Science and Research Authority; and by FPInnovations industry members, and the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, New Brunswick, and Newfoundland and Labrador. Additional funding, guidance and support to the project were provided by truss fabricators across Canada, the provincial Wood Truss Associations, and the Canadian Wood Truss Association.

[2] The 2011 edition of the SPS 4 is available for purchase from the NLGA (www.nlga.org).

[3] These guidelines shall complement and are not meant to supersede procedures recommended by the authority having jurisdiction or the engineer of record.

3 Scope

These guidelines will focus on the following areas:

- Fingerjoined lumber order inspection
- Fingerjoined lumber storage
- Fingerjoined lumber handling
- Fingerjoined lumber cutting
- Truss assembly and fabrication
- Truss handling in-plant
- Truss storage in-plant
- Truss shipment
- Truss storage on-site
- Truss erection
- Other considerations

It is recognized that some of these areas, such as truss on site storage and truss erection, is beyond the responsibility of the truss fabricator. However, knowledge and application of these practices by all in the distribution chain is encouraged to ensure the successful market acceptance of fingerjoined lumber in truss applications.

4 Fingerjoined Lumber Inspection

In addition to the normal inspection of lumber, the following should also be checked:

- In Canada, the grade stamp for fingerjoined machine stress rated lumber should say “NLGA SPS 4”. Lumber with a grade stamp indicating “NLGA SPS 1” will only be visually graded and is permitted if approved by the design engineer of record.

- Under no circumstances should the grade stamp say “NLGA SPS 3” or “Vertical Use Only”. Check the package label as well as the grade stamp.

- If the trusses are NOT to be used under “dry service conditions”[4], the fingerjoined lumber SHOULD NOT say “Dry Use Only”. In applications that are not deemed to be “dry service” the fingerjoints will need to be bonded with an adhesive that is suitable for exterior or wet service.[5] Furthermore, the fingerjoined lumber may need to be preservative treated.

[4] “Dry service” is defined as conditions where the average moisture content over a period of a year averages approximately 15% and does not exceed 19%. These are generally found in indoor and protected environments. Unusual environments, such as indoor swimming pools where humidity levels are consistently high, are deemed to be “wet service” environments.

[5] Under NLGA SPS 4, lumber not marked “Dry Use Only” are required to be bonded with an adhesive that meets either CSA O112.9, *Evaluation of adhesives for structural wood products (exterior exposure)*, or CSA O112.7, *Resorcinol and Phenol-Resorcinol Resin Adhesives for Wood (Room- andIntermediate-Temperature Curing).* The references to these standards only specify the moisture resistance performance level of the adhesive. Additional requirements, such as wood treatments, may be specified.

- All NLGA fingerjoined lumber will include the Heat Resistant Adhesive (HRA) designation. This indicates that the product has been bonded with an adhesive that has been assessed in accordance with ASTM standard practice D 7374[6] as enforced by the Canadian Lumber Standard Accreditation Board (CLSAB) or in the US by the American Lumber Standard Committee (ALSC).

- Unless specified, fingerjoined lumber specifications do not require that the product be dressed or planed after joining. Therefore, the pieces may be offset slightly on either side of the joint[7]. The NLGA SPS 4 limits the amount of offset to 1/16" inch on the narrow and wide faces at the time of manufacture. If joint offsets are common in the shipment, even if they are less than 1/16", additional truss plated joint inspections may be required to ensure that truss plates are properly embedded.[8]

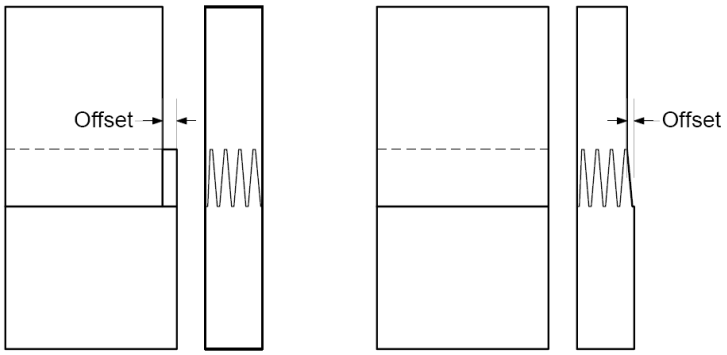

Figure 1 Horizontal joint with an offset on the edge (left) and on the wide face (right)

5 Lumber Storage

- All kiln-dried,glued-,or otherwise dried lumber should be kept as dry as possible, especially before it is cut or assembled into trusses.

[6] ASTM D 7374, *Practice for Evaluating Temperature Performance of Adhesives Used in End-Joined Lumber*. This practice evaluates the elevated temperature performance of a structural adhesive using a load bearing wall assembly exposed to a standard fire specified in ASTM Test Methods E 119. Adhesives meeting D 7374 have also been found to meet a comparable standard, ASTM D 7247, *Standard Test Method for Evaluating the Shear Strength of Adhesive Bonds in Laminated Wood Products at Elevated Temperatures*. Copies of these standards are available for purchase from the American Society for Testing and Materials (www.ASTM.org).

[7] Most fingerjoining operations will be using segments of lumber that have already been surfaced and dried. There will be slight variations in cross-section dimensions. The segment-to- segment differences are generally due to differential shrinkage and thus will depend on their initial moisture content, moisture content at the time of joining, and the growth ring orientation in the cross-section. Unless a segment is undersized and improperly surfaced, the offset will likely appear in the width direction. In a horizontal joint profile (where the finger appears on the narrow face), the offsets will normally all be on one narrow face as the opposite narrow face will be held against a flat surface during the fingerjoining process (Figure 1).

[8] Production should be inspected and documented to see if this is warranted.

- If wetted beyond just "surface wetting"[9], glued lumber should be allowed to dry before handling. Otherwise, additional supports beyond that specified in the Lumber Handling Section of these guidelines should be provided to reduce handling stresses.

- NLGA SPS 4 requires that the fingerjoined lumber be bonded with a structural adhesive that has qualified to at least the CSA O112.10[10] standard. While a high degree of moisture resistance is built into the adhesive specification, good lumber storage practices should be followed to prevent staining and dimensional stability issues. This means keeping the lumber wrapped or equivalently protected, on dunnage to avoid ground contact, and also rotating inventory.

6 Lumber Handling

Lumber breakage generally occurs during the initial lumber handling when lengths are long and there is a need to transfer pieces from a bundle.[11] It appears to be common to have one person use a single roller stand to move lumber from one pile or station to another by pivoting the lumber against the roller stand. This places considerable bending stresses on the lumber at and near the pivot point.

While fingerjoined lumber can be provided in standard dimension lumber lengths up to about 18 ft., it will most likely be provided in longer lengths.

- Lumber handling procedures and equipment should not permit fingerjoined lumber to repeatedly overhang more than 16 ft. from a support while in a flat-wise position. Such conditions may cause failure of a fingerjoint located at or close to the edge of the support.[12,13, 14]

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[9] An example of this condition is when water is allowed to pool on the surface of a horizontal piece of lumber for extended periods of time. Under these conditions, the wood moisture content below the surface will likely exceed 20% even though the surface is dry.

[10] Adhesives meeting the requirements of CSA O112.10 are rated for "limited moisture exposure". Although the specification requires that the adhesive show a high degree of resistance to degradation when exposed to moisture, the adhesive is only required to resist design load levels under dry conditions. An extensive commentary is provided with the CSA O112.10 standard. The latest edition of the CSA O112.10 standard is available for purchase from the Canadian Standards Association (enter keyword search CSA O112.10 at http://shop.csa.ca)

[11] This is based on interviews with six truss fabricators in 2010 by FPInnovations Industry Advisors in the provinces of BC, Alberta, Saskatchewan, and Quebec.

[12] Because the applied stress is a function of the lumber weight, this rule applies to all widths of lumber. The "relative" likelihood of failure is based on a theoretical assessment comparing a fingerjoint failure versus failure of non-fingerjoined lumber under the same loading conditions. Due to the number of assumptions required to make such an assessment, this is only an estimate of the relative frequency. The absolute failure rate, which likely less accurate, is on the order of 1 in 1000 pieces when the lumber is about 16 to 18 ft. long.

[13] The average fingerjoint spacing is closely related to likelihood that a joint will fall in the zone of high bending stresses during handling. Therefore, fingerjoined lumber with more joints may be more susceptible. The SPS 4 standard compensates somewhat for this by requiring that product with close fingerjoint spacing be subjected to proportionately more testing (e.g. 2 to 3 times more fingerjoint tests when the joints are spaced at 2 ft. versus spaced at 8 ft.). Furthermore, all SPS 4 (and SPS 1) fingerjoints are tension proof tested (i.e. weak joints are culled by testing every joint to a stress level that is slightly above the published design value).

7 Lumber Cutting

No issues are anticipated in the cutting of fingerjoined lumber. However, if longer lengths are anticipated, the same issues as that for lumber handling apply.

Where the fingerjoint spacing is close, the following should be noted:

- Some adhesives may be harder than others, which might lead to more wear on saws.
- Occasionally when sawing through a fingerjoint, the portions of the outer finger may separate from the joint. This does not necessarily indicate an inferior joint and is not considered by SPS 4 to be a joint offset.[15] However, this should be treated like a joint offset as it may affect the effective embedment of any truss plate pressed into the joint.[16]The effect of this on the required plate embedment should be considered.

8 Truss Fabrication

8.1 Over Embedment of Truss Plates

A truss plate is considered "over-pressed" or "over embedded" if the bottom edge of the plate breaks the surface fiber of the lumber (Figure 2). This is caused by applying too high a pressure or incorrectly setting the finishing roller positions. If over pressing is observed, the damage is likely occurring on both faces of the lumber.

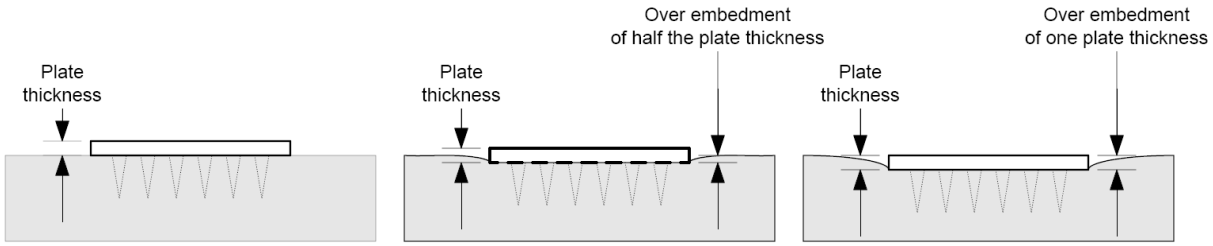

Figure 2 Over embedment of truss plates

- When pressing thick plates (18-gauge or thicker) ensure that the connector is not over embedded such that the edge of the plate breaks the fibers on the surface of the lumber. Pay particular attention when the edge of the connector plate coincides with the base (or tips) of the fingers.

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[14] These recommendations also apply to lumber with a high frequency of large strength reducing characteristics, such as knot or knot cluster. The difference is that with such lumber, the handling stresses resulting in breakage would be lower but at lower frequency because of the large variability in the strength reduction effects of knots. Fingerjoints, on the other hand, have higher capacities but possess lower variability in strength.

[15] Outer fingers are not able to apply the same levels of lateral pressure on the bond line and thus are sometimes poorly bonded. These occasional weak outer fingers are accounted for in the qualification and ongoing quality control tests of production.

[16] The amount missing will roughly be the length of the finger (which may be just slightly less than 1 inch, depending on where the saw cuts through the fingerjoint) and at most one half the finger pitch (tip-to-tip distance between adjacent fingers on one side of the joint).

- Because the damage will be difficult to repair short of replacing the member, it is recommended to periodically check pressure or finishing roller gap settings, especially when a mixture of connector plate gauges are used.

8.2 Under Embedment of Truss Plates

As part of the truss quality inspection program, there should be checks of insufficient truss plate embedment (teeth not fully embedded into the lumber) and appropriate corrections should be made. This is not unique to fingerjoined lumber but would be more frequent if the fingerjoined lumber contains joint offsets.

- Pay particular attention when using small connector plates in lumber that have joint offsets. Examples of these are integrated metal web/truss connectors for parallel chord trusses that are pressed into the narrow face of fingerjoined lumber joined using a horizontal profile. These components typically have small connector plates.

- Where small connector plates are used (such as in 4x2 gusset plated floor trusses, integrated metal web/connector plate parallel chord trusses), lumber that has been planed or sanded after joiningto minimize or remove the joint offset on the applicable face should be specified.[17]

8.3 Pre-Press

There is no indication of special issues arising from the pre-press stage of the manufacturing.[18]

- Recommendations from the **Lumber Handling** section apply in positioning truss members on the pre-press, particularly now that some chord splices may be eliminated.[19]

8.4 Finishing Press

There is no indication of special issues arising from the finishing press.[20]

- Recommendations from the **Lumber Handling** section apply in the transfer of trusses between stations, and in the unsupported length (in the lumber's weak direction) of trusses entering and leaving the finishing roller press.

- Depending on the lumber orientation required for the truss (lumber on flat or lumber on edge), joint offsets may cause plates to be either over embedded or under embedded. Joint offsets on the edge (see Figure 1) will be more problematic for trusses with embedded plates into the narrow face (e.g. parallel chord 3x or 4x trusses), than those trusses with embedded plates into

[17] Some fingerjoined lumber manufacturers may provide this step. However, the lumber may be slightly undersized, which may need to be taken into account in the design. Check with the truss designer.

[18]This is based on interviews with six truss fabricators in 2010 by FPInnovations Industry Advisors in the provinces of BC, Alberta, Saskatchewan, and Quebec.

[19] The maximum lengths between chord splices may be limited by handling issues rather than the maximum lumber length available.

[20] This is based on interviews with six truss fabricators in 2010 by FPInnovations Industry Advisors in the provinces of BC, Alberta, Saskatchewan, and Quebec. However, there were suggestions that the fixed roller opening in a finishing press may subject the joint to high bending and shear stresses. This could not be confirmed. It is recommended that this be examined.

the wide face. It is recommended that the finishing press opening normally used for non-fingerjoined lumber be checked to confirm that it is appropriate for fingerjoined lumber.

9 Truss Handling In-Plant

During truss handling in the plant, the trusses are generally moved as individual trusses, which make them susceptible to damage in the same way as long lengths of lumber.

- Recommendations from the **Lumber Handling** section apply in the transfer of trusses between stations.

10 Truss Storage In-Plant or In-Yard

Standard truss storage procedures should generally be acceptable. Procedures should consider those issues discussed in the **Lumber Storage** (regarding moisture content) and **Lumber Handling** (regarding unsupported length in the weak direction).

11 Truss Shipment

Trusses will typically be bundled into units of multiple trusses for shipment. This places less stress on the trusses when they are lifted on or off a flatbed.[21]

- Banding damage to fingerjoined lumber can be assessed in the same manner as to non-fingerjoined lumber.[22]

12 Truss Storage On-site

Truss stored on site should follow practices that are similar to those recommended for **Lumber Storage** and **Truss Storage In-Plant**.

- Avoid storage such that there is a potential for continuous exposure to water without allowing surfaces to drain or periodically dry. Under these conditions, moisture will migrate into the wood causing the cross-sections on either side of the joint to swell and potentially at different rates.[23]

13 Truss Erection

During truss erection, the trusses are unbundled which makes them susceptible to damage. The document **Handling, Erection and Bracing of Wood Trusses**, and the video **Long Span Trusses: How to Handle, Erect and Brace** are also acceptable procedures for trusses made with fingerjoined lumber.[24]

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[21] Strapping procedures provided from the field reports appear to be adequate. Chords are strapped on either side of the panel points. Given that the panel lengths are typically not more than 8 ft or 2.5 ft apart for lumber on edge or flat, respectively, these procedures should provide adequate support to the lumber as the bundles are moved.

[22] Corner protectors should be used. While banding and truss plate over embedment may appear to cause the same type of damage, banding will only cause damage to one or two corners of a member, whereas over embedded truss plate placed at the base of a fingerjoint may cause damage across the full width or thickness of the lumber and on both faces.

[23] Even though the structure may not be watertight, trusses that have been erected and braced will allow water to drain from most surfaces.

[24] Documents and video available for download from the Truss Plate Institute of Canada (www.tpic.ca). The document and video are contributions to the wood truss industry from the Western Wood Truss Association of Alberta (www.wwta.ab.ca) and the Western Wood Truss Association of BC (www.wwtabc.com), respectively.

14 Other Considerations

Other considerations include response to claims of defective joints. All fingerjoined lumber manufactured to the NLGA SPS 4 will be grade marked. The grade mark provides assurance that the product was drawn from a process that is third-party inspected to be in conformance with the requirements of the standard.

In the event of a dispute on the quality of the lumber and/or fingerjoints, the NLGA SPS4 provides a mechanism for determining whether the product is or is not in compliance. The methods for sampling, testing and analysis of the test results are specified in the standard.

Plants should have a process for recording fingerjoint failures during handling so that patterns can be established and the procedure rectified.

16 References

Handling, Erection and Bracing of Wood Trusses, undated, Truss Plate Institute of Canada (PDF downloaded from http://www.tpic.ca/english/pdf/handling.pdf)

Long Span Trusses: How to Handle, Erect and Brace (video recording produced for WCB of BC), 2001, VancouverBC, Finalé Editworks.