



Research Report

International Building Code/International Residential Code Inspection & Quality Assurance Requirements for Metal Plate Connected Wood Trusses

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Structural Building Components Association (SBCA)

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This research report is based on practical scientific research (literature review, testing, analysis, etc.), with the goal of supporting strategic needs for code and standards development and market expansion. This research report complies with the following sections of the building code:

- [IBC Section 104.11.1](#) and [Section 1703.4.2](#) – "**Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved sources*."
- [IBC Section 202](#) – "**APPROVED SOURCE.** An independent person, firm or corporation, *approved* by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

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Introduction:

There is confusion within the building construction industry with regard to the requirements for inspections and quality assurance of trusses. While the building codes and the referenced standards address these requirements, they can be difficult to understand in that there are a number of terms that may be unfamiliar to most people. Additionally, there are several layers of inspection requirements in the code which are located in varying sections of the code. This can make understanding how the requirements apply to a specific product difficult to understand. Also, some confusion stems from an interpretation of how in-plant manufacturing quality control (QC) relates to fabricator approval ([IBC Section 1704.2.5](#)) and the third party inspection process. This report will focus on the inspection and quality assurance requirements for Metal Plate Connected Wood Trusses (MPCWT) as defined in the building codes and their referenced standard, ANSI/TPI 1.

The Structural Building Components Association (SBCA) has developed this Research Report to provide a clear perspective on truss plant quality assurance and third party inspections as they relate to the requirements developed by the International Code Council (ICC) within the *International Building Code (IBC)* and the *International Residential Code (IRC)*. The same perspective outlined in this Research Report should be applied when discussing how all structural building component third party inspections relate to Chapter 17 special inspection requirements. The analysis is based on the 2012¹ and 2015 editions of the *IBC* and *IRC* as well as the referenced industry design standard *ANSI/TPI 1*².

Definitions³:

BUILDING:

Any structure used or intended for supporting or sheltering any use or occupancy.

BUILDING CODE:

As it applies to a Building, any set of standards set forth and enforced by a Jurisdiction for the protection of public safety.

BUILDING OFFICIAL:

Officer or other designated authority charged with the administration and enforcement of the Building Code, or a duly authorized representative.

BUILDING PERMIT:

Certificate of permission issued by a Jurisdiction to an Owner to construct, enlarge, or alter a Building.

CONSTRUCTION DOCUMENTS:

Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a Building Permit.

JURISDICTION:

Governmental unit that has adopted this code under due legislative authority.

REGISTERED DESIGN PROFESSIONAL (RDP):

An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

SPECIAL INSPECTION:

Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with this code and the approved construction documents.

STRUCTURAL ELEMENT:

Single structural member (other than a Truss) that is specified in the Construction Documents.

¹ All code references herein are to the 2015 editions of the IBC and IRC. Unless otherwise noted, 2012 sections are the same as the referenced 2015 code sections.

² *TPI 1* is the National Design Standard for Metal Plate Connected Wood Trusses and has been adopted as a referenced standard in Chapter 35 of the 2012 and 2015 editions of the *IBC* and *IRC*. The *TPI 1-2007* is referenced in the 2012 editions and *TPI 1-2014* is referenced in the 2015 editions.

³ Definitions taken from *IBC 2015*, *ANSI/TPI 1-2014* Chapter 2, adopted by reference in *IBC 2015* (See IBC 102.4, 2303.4, 2306.1, Chapter 35), or the *Metal Plate Connected Wood Truss Handbook* published by SBCA.

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STRUCTURAL OBSERVATION:

The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents.

TRUSS:

Individual metal-plate-connected wood component manufactured for the construction of a Building.

TRUSS MANUFACTURER:

Person engaged in the fabrication of Trusses.

Discussion:

Code requirements as they relate to MPCWT inspections and quality assurance are basically found in three locations.

- Chapter 1 of the *IRC* and *IBC*
- Chapter 17 of the *IBC*
- *ANSI TPI 1*- Design Standard for the Manufacture of Metal Plate Connected Wood Trusses, Chapters 2 and 3

Chapter 1 of the *IBC* and *IRC* provide the general provisions for submission of construction documents, approval of the documents by the building official and general building inspection requirements.

Chapter 17 of the *IBC* deals with Special Inspections. Where required, special inspections are inspections that are completed in addition to the inspections required by Chapter 1. These are generally inspections that require a certain level of expertise in a specific field of knowledge that the building official may not have. The special inspections are performed by approved agencies. The special inspectors may or may not be registered design professionals but they are competent to perform the inspections based on their expertise in the area of consideration.

In addition to the special inspection requirements of Chapter 17, structural observations are also required in some cases. These structural observations are required to be completed by registered design professionals and are generally reserved for structural observation of the building system resisting high seismic and high wind forces.

ANSI TPI 1 is a standard referenced by the building codes to address requirements for the design and manufacture of MPCWT including requirements for inspection and quality assurance of the manufactured products.

IBC/IRC Chapter 1- Administration of the code

The Building Official (authority having Jurisdiction) receives submittal documents from the building Owner or his authorized representative. These documents show to the building official how the intended construction complies with the building code. Where required by the statutes of the local jurisdiction, submittal documents are prepared by a Registered Design Professional (RDP).

IBC 107.1 Submittal Documents. Submittal documents consisting of construction documents, statement of special inspections, geotechnical report and other data shall be submitted in two or more sets with each permit application. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the building official is authorized to require additional construction documents to be prepared by a registered design professional.

IRC R106.1 Submittal documents. Submittal documents consisting of construction documents, and other data shall be submitted in two or more sets with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the building official is authorized to require additional construction documents to be prepared by a registered design professional

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The Building Official is responsible for all the required inspections of Buildings or this role can be delegated to approved agencies or individuals. Ultimately, the Building Official or their delegate is responsible for inspecting the structural framing for each Building which includes the Trusses, as stated below:

IBC 104.4 Inspections. The building official shall make all of the required inspections, or the building official shall have the authority to accept reports of inspection by approved agencies or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such approved agency or by the responsible individual. The building official is authorized to engage such expert opinion as deemed necessary to report upon unusual technical issues that arise, subject to the approval of the appointing authority.

IRC R104.4 Inspections. The building official shall make the required inspections, or the building official shall have the authority to accept reports of inspection by approved agencies or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such approved agency or by the responsible individual. The building official is authorized to engage such expert opinion as deemed necessary to report upon unusual technical issues that arise, subject to the approval of the appointing authority.

The entire inspection process for metal plate connected wood trusses is outlined in *IBC* Section 110 and *IRC* Section 109 where it is stated that framing inspections are to be performed by the Building Official. If the Trusses are manufactured in a manufacturing facility with a third party quality control process in accordance with *TPI 1*, the inspection process is performed by an approved inspection agency at the manufacturing plant.

IBC Inspection Requirements

IBC 110.1 General. Construction or work for which a permit is required shall be subject to inspection by the building official and such construction or work shall remain accessible and exposed for inspection purposes until approved. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the owner or the owner's authorized agent to cause the work to remain accessible and exposed for inspection purposes. Neither the building official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material required to allow inspection...

IBC 110.3 Required inspections. The building official, upon notification, shall make the inspections set forth in Sections 110.3.1 through 110.3.10...

IBC 110.3.4 Frame inspection. Framing inspections shall be made after the roof deck or sheathing, all framing, fireblocking and bracing are in place and pipes, chimneys and vents to be concealed are complete and the rough electrical, plumbing, heating wires, pipes and ducts are approved.

IBC 110.3.9 Special inspections. For special inspections, see Chapter 17.

IBC 110.4 Inspection agencies. The building official is authorized to accept reports of approved inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability.

IRC Inspection Requirements

IRC R109.1 Types of inspections. For onsite construction, from time to time the building official, upon notification from the permit holder or his agent, shall make or cause to be made any necessary inspections and shall either approve that portion of the construction as completed or shall notify the permit holder or his or her agent wherein the same fails to comply with this code.

IRC R109.1.4 Frame and masonry inspection. Inspection of framing and masonry construction shall be made after the roof, masonry, all framing, firestopping, draftstopping and bracing are in place and after the plumbing, mechanical and electrical rough inspections are approved.

IRC R109.2 Inspection agencies. The building official is authorized to accept reports of approved agencies, provided such agencies satisfy the requirements as to qualifications and reliability.

Chapter 17- Special Inspections and Structural Observations

As stated above in *IBC* Section 107.1, submittal documents shall include a statement of special inspections. [Chapter 17](#) of

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the *IBC* defines when special inspections are required and what items are included in the special inspection provisions. Where the submittal documents require special inspections as stated on the statement of special inspections, they would be subject to [Chapter 17](#) of the *IBC*.

Based on the information contained in this Research Report, trusses should not be listed as requiring special inspections with the exception of Metal Plate Connected Wood Trusses spanning 60 feet or greater. Buildings with trusses spanning 60 feet or greater require special inspection of the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing per *IBC* Section 1705.5.2.

1705.5.2 Metal-plate-connected wood trusses spanning 60 feet or greater. Where a truss clear span is 60 feet (18 288 mm) or greater, the special inspector shall verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

Structural observations are generally intended to be applied to special occupancies and circumstances that fall under critical seismic and wind conditions where the application of any Structural Element is deemed critical from a life safety perspective.

IBC 1704.6 Structural observations⁴. Where required by the provisions of Section 1704.6.1 or 1704.6.2, the owner or the owner's authorized agent shall employ a registered design professional to perform structural observations. Structural observation does not include or waive responsibility for the inspections in Section 110 or the special inspections in Section 1705 or other sections of this code.

Prior to the commencement of observations, the structural observer shall submit to the building official a written statement identifying the frequency and extent of structural observations.

At the conclusion of the work included in the permit, the structural observer shall submit to the building official a written statement that the site visits have been made and identify any reported deficiencies that, to the best of the structural observer's knowledge, have not been resolved.

IBC 1704.6.1 Structural observations for seismic resistance⁵. Structural observations shall be provided for those structures assigned to Seismic Design Category D, E or F, where one or more of the following conditions exist:

1. The structure is classified as *Risk Category III* or *IV*.
2. The height of the structure is greater than 75 feet (22,860 mm) above the base as defined in ASCE 7.
3. The structure is assigned to *Seismic Design Category E*, is classified as *Risk Category I* or *II*, and is greater than two stories above grade plane.
4. When so designated by the registered design professional responsible for the structural design.
5. When such observation is specifically required by the building official.

IBC 1704.6.2 Structural observations for wind requirements⁶. Structural observations shall be provided for those structures sited where V_{asd} as determined in accordance with Section 1609.3.1 exceeds 110 mph (49 m/s), where one or more of the following conditions exist:

1. The structure is classified as *Risk Category III* or *IV*.
2. The building height is greater than 75 feet (22 860mm).
3. When so designated by the registered design professional responsible for the structural design.
4. When such observation is specifically required by the building official.

IBC Section 1705 provides additional special inspections as it lists all the inspections required for structural steel and concrete applications under the critical seismic and wind conditions defined in Section 1704. There are no special inspections required for metal plate connected wood trusses or structural building components in Section 1704. There is, however, an exemption for conventional light-frame construction, which is the majority of construction that metal plate connected wood trusses and other structural building components are deployed in.

⁴ 2012 *IBC* Section 1704.5

⁵ 2012 *IBC* Section 1704.5.1

⁶ 2012 *IBC* Section 1704.5.2

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IBC 1704.2 Special inspections. Where application is made to the building official for construction as described in Section 105, the owner or the owner's authorized agent, other than the contractor, shall employ one or more approved agencies to perform inspections and tests during construction on the types of work specified in Section 1705 and identify the approved agencies to the building official. These special inspections and tests are in addition to the inspections by the building official that are identified in Section 110.

Exceptions:

1. Special inspections and tests are not required for construction of a minor nature or as warranted by conditions in the jurisdiction as approved by the building official.
2. Unless otherwise required by the building official, special inspections and tests are not required for Group U occupancies that are accessory to a residential occupancy including, but not limited to, those listed in Section 312.1.
3. Special inspections and tests are not required for portions of structures designed and constructed in accordance with the cold-formed steel light-frame construction provisions of Section 2211.7 or the conventional light-frame construction provisions of Section 2308.
4. The contractor is permitted to employ the approved agencies where the contractor is also the owner.

ANSI/TPI 1, which is the design and quality control standard that is used by the structural building components industry with respect to truss manufacturing, includes quality control provisions that are upheld under the supervision of a third party quality control agency. The third party QC process that many Truss Manufacturer's employ is done at the manufacturing facility and, per *IBC* Section 1704.2.5.1, takes the place of any special inspection requirements.

IBC 1704.2.5.1 Fabricator approval⁷. Special inspections during fabrication are not required where the work is done on the premises of a fabricator registered and approved to perform such work without special inspection. Approval shall be based upon review of the fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved agency. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the owner or the owner's authorized agent for submittal to the building official as stated in Section 1704.5 stating that the work was performed in accordance with the approved construction documents.

The following language of the *IBC* defines Fabricated Item:

FABRICATED ITEM. Structural, load-bearing or lateral load-resisting members of assemblies consisting of materials assembled prior to installation in a building or structure, or subjected to operations such as heat treatment, thermal cutting, cold working or reforming after manufacture and prior to installation in a building or structure. Materials produced in accordance with standards referenced by this code, such as rolled structural steel shapes, steel reinforcing bars, *masonry units* and *wood structural panels*, or in accordance with a referenced standard that provides requirements for quality control done under the supervision of a third-party quality control agency, are not "fabricated items."

ANSI TPI 1- MPCWT Inspections and quality assurance

The *IBC* and *IRC* use reference codes and standards to provide specific information that would be impossible to fully include in the Building Code without making it unwieldy. The Building Codes reference ANSI-based consensus codes and standards for all material interests, trusses included. The following is the implementing language in the *IBC* and *IRC* for the use of the referenced standard, *ANSI/TPI 1*.

IBC 102.4 & IRC R102.4 Referenced codes and standards. The codes and standards referenced in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.4.1 (R102.4.1) and 102.4.2 (R102.4.2).

Chapter 35 of the *IBC* and Chapter 44 of the *IRC* provide a list of the standards referenced by these sections. *ANSI TPI 1* is the referenced standard for MPCWT.

The 2015 edition of the *IBC* and *IRC* include the following language regarding the use of Trusses:

2015 IBC 2303.4 Trusses. Wood trusses shall comply with Sections 2303.4.1 through 2303.4.7.

2015 IBC 2303.4.6 TPI 1 specifications. In addition to Sections 2303.4.1 through 2303.4.5, the design, manufacture and quality assurance of metal-plate-connected wood trusses shall be in accordance with TPI 1. Job-site inspections shall be in accordance with Section 110.4, as applicable.

⁷ 2012 IBC Section 1704.2.5.2

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2015 IRC R502.11.1 Design. Wood trusses shall be designed in accordance with approved engineering practice. The design and manufacture of metal plate connected wood trusses shall comply with ANSI/TPI 1. The truss design drawings shall be prepared by a registered professional where required by the statutes of the jurisdiction in which the project is to be constructed in accordance with Section R106.1.

2015 IRC R802.10.2 Design. Wood trusses shall be designed in accordance with accepted engineering practice. The design and manufacture of metal-plate-connected wood trusses shall comply with ANSI/TPI 1. The truss design drawings shall be prepared by a registered professional where required by the statutes of the jurisdiction in which the project is to be constructed in accordance with Section R106.1.

ANSI/TPI 1 in-plant inspection process was clarified in the 2014 edition and is referenced by the 2015 editions of both the IBC and IRC as follows:

ANSI/TPI 1-2014 Sections 2.3.6.11 In-Plant Truss Inspections. Truss inspections, as required by the Jurisdiction, shall be performed at the manufacturer's facility using the manufacturer's In-Plant Quality Assurance Program monitored by an inspection agency approved by the Jurisdiction, and shall satisfy any Quality Control/quality assurance requirements for the Trusses, and shall satisfy any designated in-plant special inspection requirements for the Trusses.

ANSI/TPI 1-2014 Chapter 3 (Quality Criteria for the Manufacture of Metal-Plate-Connected Wood Trusses) implements the in-plant quality control process as follows:

ANSI/TPI 1-2014 Section 3.1 GENERAL

3.1.1 Scope Chapter 3 of this Standard is the quality standard for the manufacturing processes of metal-plate-connected wood Trusses, and shall be used in conjunction with a manufacturing quality assurance procedure and a Truss design. These provisions shall be included in the In-Plant Quality Assurance Program of each Truss Manufacturer.

3.1.2 Requirements Metal-plate-connected wood Trusses shall meet the minimum manufacturing quality requirements specified in Chapter 3 of this Standard, so that design assumptions are met.

3.1.3 Documentation Truss Manufacturers and inspection agencies shall establish methods that document the application of these quality assurance procedures throughout the manufacturing process. The Truss Manufacturer's methods shall be subject to periodic audit for compliance with the requirements of this Standard by an approved inspection agency per Section R110 Inspections of the *International Residential Code* / Section 110 Inspections of the *International Building Code*, where required by local authorities having Jurisdiction, or other means.

3.2 IN-PLANT QUALITY ASSURANCE

3.2.1 In-Plant Quality Control Manual An in-plant quality control manual shall be maintained for each truss manufacturing facility, which will include the requirements for daily quality control and any audits that will be performed. At a minimum, the in-plant quality control manual shall contain:

- (a) Either a production flowchart or a description of the manufacturing process;
- (b) Manufacturer's organizational chart, a description of the duties and Responsibilities assigned to key positions in the quality program;
- (c) Quality control procedures, including sampling criteria and how manufacturing processes are monitored to ensure that the product is consistently manufactured within the allowable tolerances; and
- (d) A document retention policy.

3.2.2 Inspection Frequency At a minimum, three Trusses per week per operational set-up location per shift as outlined in the in-plant quality control manual shall be inspected and recorded for in-plant audits.

3.2.3 Inspection Sampling A random representative sampling of Trusses shall be chosen for inspection, either off the production line after all pressing operations are completed, or from finished goods storage.

3.2.4 Inspection Procedure. For Trusses chosen for inspection, the joint inspection procedures of Section 3.7 shall be used.

ANSI/TPI 1 standards further support the *IBC* and *IRC* referenced codes establishing that "special inspections" are not needed for Trusses and the third party QC process, as outlined above, takes the place of any special inspection requirements.

Conclusion:

- The traditional third party inspection process that the structural building components industry has used for the last 50 years continues to satisfy both the *IBC* and *IRC* requirements.
- The code language and industry third party inspection standards highlight metal plate connected wood trusses explicitly comply with the *IBC* and *IRC* requirements for supplying structural building components to the building construction marketplace without falling into the special inspection requirements
- Truss manufacturing falls outside the definition of “Fabricated Item” for which Chapter 17 applies, and rather, must conform to *ANSI/TPI 1*, which is a Chapter 35 listed design and quality control standard used by the structural building components industry with respect to Truss manufacturing.
- *ANSI/TPI 1* has followed the *IBC* and *IRC* requirements for third party inspections, thus requiring Truss Manufacturers to have third party inspection agencies regularly audit and inspect their manufacturing process in order to evaluate their compliance with *ANSI/TPI 1*. There is no requirement to have an on-site “special inspection” of the Trusses.