STRUCTURAL BUILDING COMPONENTS MAGAZINE

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Considering Quality — A Brief History of the QC Standard Change by Stan Sias

QUALITY…Something special about an object that makes it what it is.
QUALITY…The essential attribute or characteristic.
QUALITY…The grade of Excellence.

What does the word quality mean to you? Is quality a subjective opinion or a quantifiable science? What should it mean to structural building component manufacturers, or better yet, what does it mean to our industry?

There seems to be some confusion as to why the ANSI/TPI 1-1995 needed to be revised, how the need came about, and the process that led to the writing of the new standard. With these questions clearly in mind, the WTCA QC Committee and Board discussed this topic at their last meeting.

The following motion was approved by the WTCA QC Committee and subsequently approved by the WTCA Board of Directors at the July 2002 Open Quarterly Meeting in Salt Lake City:

> Motion to create a position statement to be signed by the Chairs of TPI-TAC, WTCA Engineering and Technology, and WTCA QC Committees surrounding the history and issues behind the need for rewriting the Quality Standard.

CLICK ON IMAGE FOR LARGER VIEW

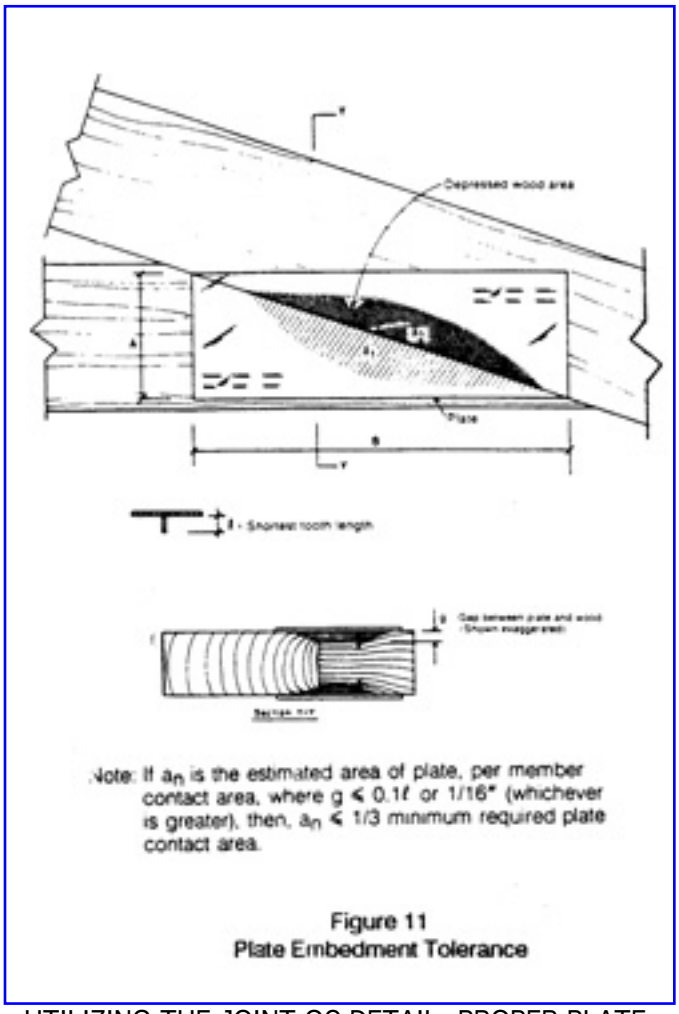


Figure 11
Plate Embedment Tolerance

UTILIZING THE JOINT QC DETAIL, PROPER PLATE PLACEMENT UNDER THE PPM INSPECTION METHOD IS QUICK TO CHECK.

That Position Statement is printed below.

PART OF THE HISTORY

Back in 1988 there was a committee formed within WTCA to take a serious look at quality in the manufacturing process. Bob Ward, Rip Rogers, Koss Kinser, Merle Nett, Don Hershey and other industry veterans were part of that group. Their efforts were driven by the many complaints

from component manufacturing members that the then current standard, QST-88, was hard to comply with.

When Bob Ward was Chair of the Quality Committee around "BCMC-time" in 1990, he was asked by the National Forest Products Association (now AF&PA) to improve the way the truss industry was undertaking quality control. The implication in this discussion was that if the truss industry did not undertake this work, someone else was likely to do so. Ward explained that WTCA was in fact studying that exact issue, and had been for nearly two years, at both the committee and Board levels. The discussion stayed any further action at that time by NFPA.

Upon continuing study, QST-89 was found to be a very subjective quality standard and that true compliance was hard to assess and could vary significantly from one QC inspector to the next. Also, there was a provision in the standard, Appendix P, that stated:

> **610** All trusses shall have fully embedded connector plates at every joint. The bottom surface of the connector plates shall be in firm contact with the wood surfaces. The embedment tolerance shall not exceed a gap of less than or equal to 10% of the tooth length, or 1/16 inch, whichever is greater, for less than or equal to 1/3 of the minimum required plate contact area, for each member as shown in Figures 10 & 11. [See Fig. 11 above.] However, no less than 2/3 of the minimum required plate contact area for each member shall be in firm contact with the wood. Tooth length is measured from the tip of the tooth to the nearest face of the plate from which it is formed. If a metal connector plate has more than one length of teeth, the shortest tooth length shall be used. The plate embedment tolerance as shown in Figure 10 & 11 is a maximum tolerance as it pertains to the 10% rule; it shall not be used in combination with any other manufacturing characteristics. Embedment gap is measured through the slot opening from the underside of the plate to the wood surface with a dial caliper, depth gage or equivalent measuring device.

The component manufacturers knew that this was nearly impossible to do, in any truss manufacturing operation, all the time. Provisions were needed to eliminate the subjectivity AND allow for manufacturing nuances, including lumber characteristics, which are not always perfect.

As time moved along, WTCA began to look even more seriously at the quality issues. A group led by Merle Nett, Don Hershey, Bob Ward, Gary Sweatt and Pat McGuire suggested testing be done in the plant to determine how to better deal with plate embedment issues, which was the primary area of concern at that time. The findings in this initial study led to the creation of new plating/embedment criteria on a per-tooth basis (the 1/32" plate embedment gap allowance and tooth count) that replaced the previous requirement for "fully embedded plates at every joint."

A change to the entire quality standard was made for the ANSI/TPI 1-1995 standard that yielded a quantifiable (non-subjective) approach to quality that the industry never had before. The goal then was to have a quality standard that could produce data to be used as a management information system. The WTCA Quality Committee and TPI TAC worked very hard to arrive at this type of standard. Once we had a standardized data acquisition methodology, then we began to assess actual in-plant performance, through the use of the WTCA QC database program.

The development of a QC database computer program led to an understanding of truss manufacturing quality control that the industry never had before. The concerns and desires that truss manufacturers had were:

- With litigation increasing, there was often a focus on truss quality issues. There was a strong desire within the truss industry to have a standard that was as attainable as possible within the manufacturing environment.
- The validity of a truss design was tied to the minimum level of quality established by the current quality standard (i.e. QST-89, ANSI/TPI 1-1995 chapter 4).
- The time involved in the compliance process via the tooth-counting method was burdensome in the fast-paced manufacturing facility.
- The goal had to be to create a quality standard where compliance could be easily, quantifiably and consistently assessed so that the manufactured truss would perform as the truss designer and truss design anticipated. The entire manufacturing and QC process is driven by the truss design process.

THE NEXT WORKING GROUP

The February 15 and 16, 2001 working group meeting that included Professor Steve Cramer, P.E. and Bert Hall of the University of Wisconsin-Madison; Steve Cabler, P.E. of MiTek; Dave Brakeman, P.E. of Alpine; Dave Gromala, P.E. of Weyerhaeuser; Kelly Gutting and Charlie Goehring of TPI; and Ryan Dexter and Kirk Grundahl, P.E. of WTCA, was tasked with taking all of the test data that WTCA had developed from its tests completed in June 2000 and January 2001, digesting it and proposing a direction that our industry should take with QC. Once done the group was responsible for submitting a draft QC standard proposal to the project committee working on the rewrite of ANSI/TPI 1-1995.

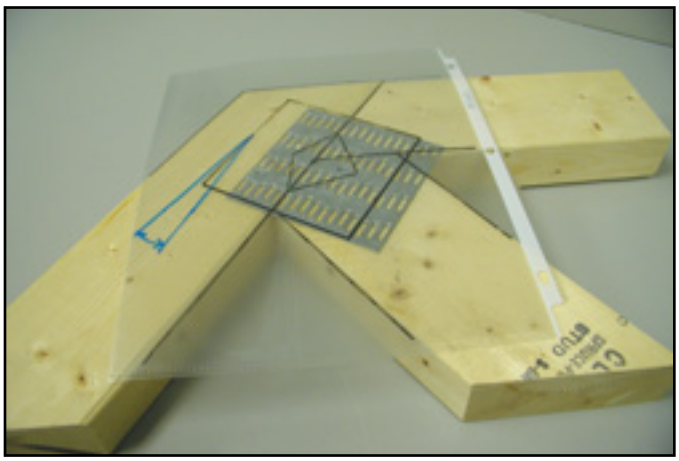
THE CHANGE: HOW IS IT GOING TO WORK?

Briefly, the key change in the approach from the existing ANSI/TPI 1-1995 quality standard is the creation of a new inspection procedure called the Plate Placement Method (PPM) of inspection. This procedure has at its core the creation of a plate placement tolerance polygon that is printed onto a template, which is called the Joint QC Detail. All truss design software providers will program into their software the ability to provide this detail, quickly and easily.

The PPM joint inspection process is far simpler than that required by the current ANSI/TPI 1-1995 Standard. Now, not all joints on a truss will need to be inspected. Our testing determined that there were some joints that were unlikely to influence truss failure if they were anywhere close to being properly plated. The testing further suggested that all joints with a Joint Stress Index (JSI) of 0.80 when using the PPM should be inspected, and all joints with a JSI of 0.65 when using the TCM inspection process (the Tooth Count Method, or TCM process, is described below). The difference is to ensure that the same joints will be inspected for each method. The JSI is the largest ratio of applied design force to allowable design force, a concept similar to the commonly used Combined Stress Index (CSI) used for wood members. The JSI values will be printed on the inspector's truss design drawing.

WHAT HAS CHANGED FROM THE EXISTING ANSI/TPI QUALITY STANDARD?

Following is a summary of the critical changes that have been made to the existing ANSI/TPI Quality Standard. All of the changes have been arrived at through the consensus process, which includes the involvement of the TPI Technical Advisory Committee (TAC), UW-Madison, WTCA and TPI staffs, the TPI Project Committee and public comment.



UTILIZING THE JOINT QC DETAIL, PROPER PLATE PLACEMENT UNDER THE PPM INSPECTION METHOD IS QUICK TO CHECK.

- As described above, a new method of inspection has been created called the Plate Placement Method (PPM). This is a graphical approach that shows positioning tolerances calculated by the truss designer for any particular joint of a truss selected for truss inspection (see photo). The testing undertaken by WTCA showed that monitoring plate placement is the fastest way of controlling truss joint quality.
- Testing showed that to enhance the speed of the inspection process over the requirement of counting teeth in the existing ANSI/TPI Quality Standard, the new plate placement method of inspection requires that a factor of 0.8 be multiplied by the plate's lateral resistance (tooth holding) design values. This means that plate sizes may increase to account for the ability to quickly assess lumber characteristics (e. g. loose knots, holes, wane, flattened teeth, etc.) in the plate area. The PPM method will require that each joint is subject to a visual inspection to ensure lumber characteristics take no more than 20 percent of the plate contact area for each member connected.
- In special circumstances, a more detailed and time-consuming QC process called the Tooth Count Method (TCM) will be required and, as its name implies, requires the counting of teeth. The TCM, however, is an improved version of the QC methods that are currently found in the ANSI/TPI Quality Standard.
- We have simplified the plate rotation tolerances from the existing ANSI/TPI Quality Standard. The new standard uses a plate rotation tolerance of ±10 degrees. This rotation limit will be placed on the Joint QC Detail.
- We have simplified the gap tolerances from the existing ANSI/TPI Quality Standard. Wood-member to wood-member gap requirements are now:
  • 1/8" for all joints except floor truss chord splices.
  • 1/16" maximum gap for floor truss chord splices.
  • These gap tolerances apply to all points of member to member contact as shown on the truss design drawing. This also covers the use of round-cut webs (e.g. Turbo-webs) and square-cut webs.
- As discussed above, only joints with a Joint Stress Index (JSI) of 0.80 when using the PPM (and a JSI of 0.65 when using the TCM) need to be inspected. However, truss manufacturers should note that these inspection criteria pertain only to the minimum joint inspection requirements for the audit that verifies in-plant QC processes. These inspection guidelines do not suggest that the in-plant QC process can ignore joints without high stress levels. The in-plant QC

process must still be in place to monitor overall quality issues.
- For internal plant auditing purposes, the group defined that, at a minimum, three trusses per week, per set-up location, per shift shall be inspected and recorded.

So there you have it. We have tried to write a standard that balances the needs and desires of the component manufacturer, and the CM's in-plant QC inspector(s), with the expectations of the Truss Design Engineers. Together we believe we've come closer to that end. Re-read the final paragraph of the Position Statement. There is a spirit of cooperation that exists between WTCA and TPI members, their working committees and staffs. The industry depends on these groups to evaluate all the data before them, undertake research as needed to improve our understanding of the issue at hand and then make the decisions necessary to advance our industry's progress on the path of obtaining greater product acceptance. The work done with this standard is a very positive step in a forward direction. Thanks to all who were involved.

Position Paper on the Industry QC Standard

INTRODUCTION

Chapter 3 of ANSI/TPI 1-2002, National Design Standard for Metal Plate Connected Wood Truss Construction, contains the new quality standard for the manufacture of metal plate connected wood trusses. ANSI/TPI 1-2002 is the latest edition in a long line of truss design standards from the Truss Plate Institute (TPI), starting with the first published design criteria in 1960, designated TPI-60, and followed thereafter with subsequent editions: TPI-62, TPI-65, TPI-66, TPI-68, TPI-70, TPI-74, TPI-78, TPI-85, and the current design standard, ANSI/TPI 1-1995. Chapter 3 of ANSI/TPI 1-2002 also succeeds a long history of standards that originated in 1970 as a stand-alone Quality Control Manual (QCM), with subsequent editions: QCM-73, QCM-74, QCM-77, QST-86, QST-88, and QST-89 (Appendix P, Addendum to TPI-85). It was finally incorporated into the current design standard as Chapter 4 in ANSI/TPI 1-1995.

DEVELOPMENT & SIGNIFICANCE OF THE NEW QUALITY STANDARD

At the February 25, 2000 Quality Control Committee meeting in Boise, ID, an analysis of expected to actual truss manufacturing quality control results was presented. That analysis created an initiative to modify and revise the appropriate quality control and joint design sections of the ANSI/TPI 1-1995 standard to produce a more efficient and effective process.

The development of improved truss quality control (QC) began at the May 5, 2000 Component Manufacturers Discussion Forum held in conjunction with the Wood Truss Council of America (WTCA) Open Quarterly Meeting in Herndon, VA. It was decided by the thirty-one component manufacturers at that meeting, based on the QC data at their disposal, that it was of the utmost importance for the industry to better understand truss quality and the resulting structural performance of the finished product. That group recommended, and the WTCA Board of Directors approved, allocating funds to proceed with testing full-scale trusses for the purpose of gathering information which could provide a benchmark to evaluate the existing industry quality

standard.

On February 15 and 16, 2001, a working group incorporating representatives from WTCA, TPI and the team that did the full scale truss testing, met with the task of reviewing the preliminary test data and findings from truss tests completed in June 2000 and January 2001. The group then proposed revisions to the QC standard for subsequent consideration and input by the ANSI/TPI 1 project committee and the public.

The QC test data indicated that a change in the QC standard was in fact, advisable and the overall goal identified by WTCA was to arrive at an in-plant QC program for truss manufacturers that:

- Is quick to do in a typical truss plant.
- Is easy to understand and implement by plant personnel.
- Provides us with the assurance that, even when we are doing QC quickly, the result will be the expected, code-mandated structural performance of the trusses that are produced.
- Keeps costs in line, yet recognizes that each of the three parameters above might cause the application of truss plates at a joint to be more conservative than a more intensive QC program would require.
- Keeps the in-plant QC inspector as its frame of reference, so that understandability and ease of implementation are assured.

Developing a structural quality standard that could be met by truss manufacturers with increased consistency and ease was equally important to TPI, in carrying out its mission of maintaining the wood truss industry on a sound engineering basis. It is recognized that the greatest assurance that a manufactured truss will perform as was originally intended by its design requires a combination of:

1) designs that account for some quality inaccuracies inherent to the manufacturing process, and
2) quality control protocols that work to consistently produce trusses in accordance with the truss designs.

Thus, the intent of the changes made to the quality standard was to improve the quality control process for truss manufacturers in recognition that maintaining overall quality of wood trusses is in the interest of public safety and welfare. Additionally, to better link quality control with truss design, a related change was made to the design standard such that the truss manufacturer can affect how much tolerance is built into the design. This change is in recognition that the truss manufacturer should appropriately choose the level of built-in quality tolerance based on individual manufacturing practices, quality assurance needs, and demonstrated conformance with minimum quality standards.

CONCLUSION

WTCA and TPI recognize the challenge in producing a QC standard that properly weighs the competing demands of efficient production and necessary structural quality. Chapter 3 of ANSI/ TPI 1-2002 reflects a concerted effort and cooperation by both organizations and the consensus

body to provide a QC approach that meets these demands. This effort marks a significant step forward with the quality standard, and the industry will continue to support research, development and testing of wood trusses to place itself on a sound engineering basis and improve the quality and efficiency of our products, for the purpose of obtaining greater product acceptance.

Signed by:

Dave Brakeman, Chairman, TPI-Technical Advisory Committee
Keith Kinser, Chairman, WTCA-Quality Control Committee
Don Groom, Chairman, WTCA-Engineering and Technology Committee

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