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THE FUTURE OF FRAMING

April 2013

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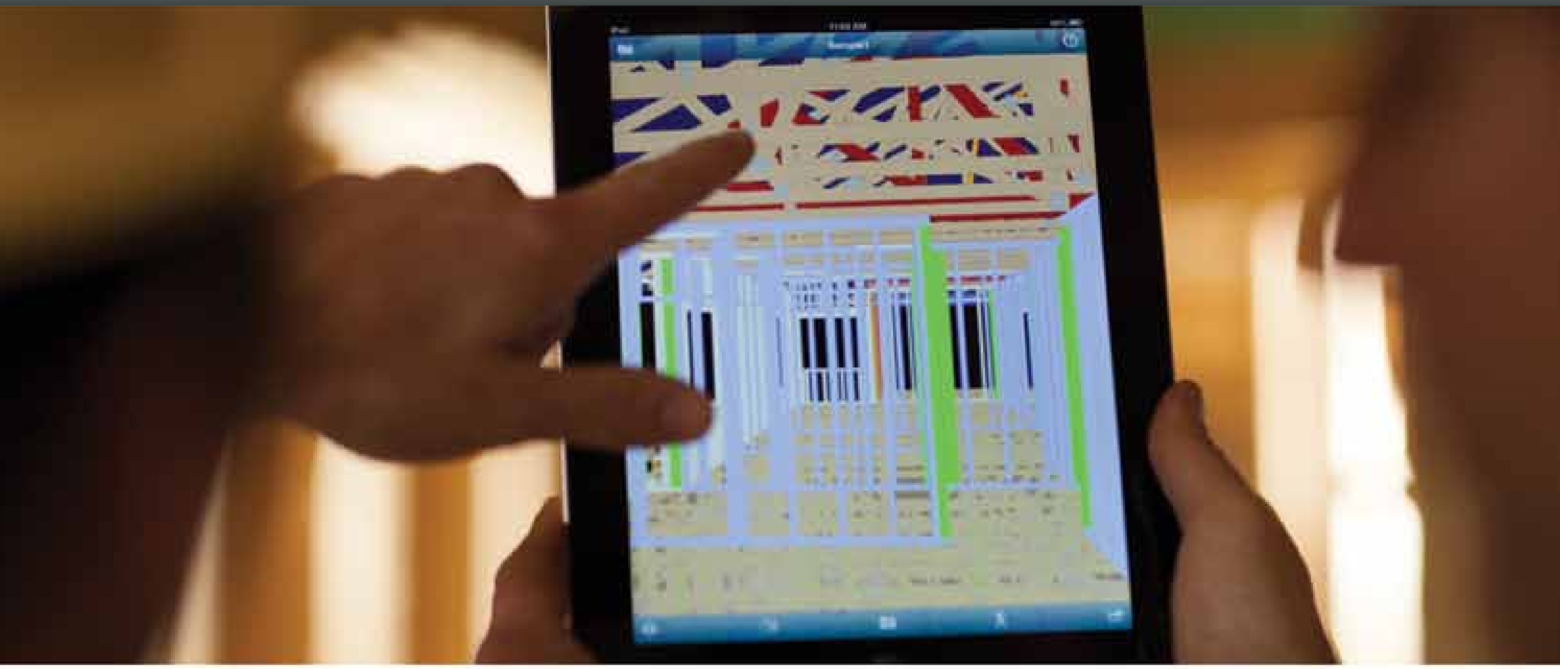

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contents

The mission of *Structural Building Components Magazine (SBC)* is to increase the knowledge of and to promote the common interests of those engaged in manufacturing and distributing structural building components. Further, *SBC* strives to ensure growth, continuity and increased professionalism in our industry, and to be the information conduit by staying abreast of leading-edge issues. *SBC's* editorial focus is geared toward the entire structural building component industry, which includes the membership of the Structural Building Components Association (SBCA). The opinions expressed in *SBC* are those of the authors and those quoted, and are not necessarily the opinions of Truss Publications or SBCA.

SBCA

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Our supplier members provide services and expertise that can help you improve your business and your bottom line. This year, ***SBC Magazine*** will profile several aspects of the component manufacturing industry and highlight the supplier companies that serve those business segments.

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editor's message

by Scott Ward

Quality Is Job One…As Well As Jobs Two, Three, Four…

A reputation for quality is something your truss plant can't afford to be without.

No matter how much time goes by, there are certain things about this industry that it pays to revisit. In the November 1999 issue of ***Woodwords Magazine*** (this publication's predecessor), I wrote a column entitled, "Why Use WTCA QC? Reason #5: Cost Savings." As the production supervisor of my family's business, I oversaw the implementation of this program in our plant, pushed us to be one of the first In-Plant WTCA QC-certified plants in the country, and was blown away by the results.

Truth is, I still am blown away. More than 13 years after I wrote that story, I find myself reflecting on all the work we have put into implementing the program and the dramatic, positive effect it has on our manufacturing process. With regards to quality control, our industry has a lot at stake. We put in a good amount of time and capital toward ensuring our truss designs meet our customers' needs in a structurally accurate, efficient and cost-effective manner. It's all a waste though, if the product we ultimately ship to the jobsite has no quality control applied. Our bottom lines are tight enough as it is, without having to deal with customer call-backs, rebuilding or repairing trusses, or raw material waste.

While it is easy to identify why QC is important at a conversational level, it's just as easy to lose track of it in the manufacturing process when you are consumed by everything that goes into getting products out the door and meeting customer demands. Successfully managing a truss plant is hard work. The needs of our customers are constantly changing, and balancing the costs of overhead and volatile raw material prices is enough to make you tear your hair out (fortunately, I don't have any).

With all that other stuff to worry about, I didn't want to worry about how to do proper QC in the plant back in 1999, and I still don't want to worry about it today. Fortunately, the In-Plant WTCA QC program helps us monitor quality, while providing an easy-to-use truss manufacturing data management system. In order to evaluate quality, you really need good data. The QC program helps us with that, but you also need employee commitment and good training.

As far as data is concerned, the program requires regular inspection of trusses and data entry into the software program, and our production guys are checked hourly for percentages and periodically for QC purposes. We then analyze that data to spot trends so we can target the aspects of our manufacturing that may impact quality. In other words, we can make a well-informed decision to change a production procedure or arrange additional training opportunities in a timely manner, which increases our chance to maintain and improve the quality of our products.

Fortunately, we've now been doing the In-Plant WTCA QC program long enough that our employees have bought in to the concept. They've embraced it so well that they now repair their own mistakes (admittedly, part of their motivation is that they know it will catch up with them later). Having this system in place allows us to put most of our efforts into the most important aspect of quality control: training.

Training new employees is something we struggle with on a daily basis. We show videos, use SBCA's In-Plant Basic Training and train on the job, but there are still large hurdles to overcome. Sometimes it's a language barrier, sometimes it's bad technique (i.e., guys beating up plates with their hammers), other times

Continued on page 6

at a glance

- Scott Ward first implemented In-Plant WTCA QC in 1998 and has more than a decade of experience with the program.
- He reflects on the benefits he first saw when implementing the QC program and how QC helps differentiate his business based on the unique quality of their production.
- The In-Plant WTCA QC program's biggest impact for Ward's company has been training employees and reducing customer product issues and related costs.

Editor's Message • Continued from page 5

it's learning proper crowning of wood and placement of plates. All of these topics are a subject to address at a later date, but it's important to recognize that having a good QC program helps you identify more effectively where to target your training efforts.

In this issue, Mike Cassidy, Executive Director of the Truss Plate Institute (TPI), begins a series of articles outlining their approach to third-party quality control audits. That program is one of the best ways that TPI supports our industry, and it is something I encourage all component manufacturers to learn more about, if you aren't already relying on it.

Something I pointed out in my 1999 article still rings true with me as I write this, "You need to think about whether there is a price too high to pay to either maintain or improve your company's reputation in your market. Remember that, in the long run, a reputation for quality is something your truss plant can't afford to be without." Our industry has only become more competitive since then, making the sentiment all the more true today. SBC

SBC Magazine encourages the participation of its readers in developing content for future issues. Do you have an article idea for a future issue or a topic that you would like to see covered? Email your thoughts and ideas to editor@sbcmag.info.

BCMC Throughout the Year — SBCA Annual Workshop & Conference

Keep BCMC alive throughout the year with the SBCA Annual Workshop & Conference. On the second Tuesday of every month at 2 pm ET/1 pm CT/12 pm MT/11 am PT, the Workshop will feature the great speakers and sessions from BCMC 2012 and lead into BCMC 2013. Mark your calendar and join us online with SBC Connection.

- April 9 – Your Litigation Playbook w/ SBCA Legal Counsel Kent Pagel
- May 14 – Efficient Design Techniques: Less is More

For more details, visit sbcindustry.com/workshop.php. SBC

exec's message

by Kirk Grundahl, SBCA Executive Director

CMs & Suppliers—Your Growth Supports Their Growth

When is the last time your lumber supplier took an active role in your business initiatives?

A Few CM-Focused Lumber Companies

- Anthony Forest Products
- Beadles Lumber Co
- Boise
- Canfor
- CLW Inc.
- Deltic Timber Corp.
- H.W. Culp Lumber Co.
- Interfor
- International Beams, Inc.
- Lamco Forest Products
- LebCorp, Inc.
- Nordic Engineered Wood
- Resolute Forest Products
- Rex Lumber
- Robbins Manufacturing
- Scotch & Gulf Lumber, LLC
- Shuqualak Lumber Company
- Simpson Lumber
- Tolko Marketing and Sales Ltd.
- Travis Lumber
- Vaagen Brothers Lumber, Inc.
- West Fraser, Inc.
- Westervelt Lumber
- Weyerhaeuser

at a glance

❑ A key SBC industry value proposition is to sell a value-added product by providing unique engineering and supply-chain management solutions to customers.

❑ SBCA members should have passion for and speak with a united voice in advocating for supplier and supplier association initiatives that positively support the SBC industry.

In my last message, I concluded by saying, "If you are a smaller [component manufacturer] CM, I know choosing [to embrace engineering, building design, intellectual property development and engineering innovation] is a time and cost challenge. However, when you think about it, your highly capitalized suppliers should be willing to help, given that you provide a source of profit to them—your success is important to their success."

Given all the money you have spent on lumber since the start of your business, have you ever asked yourself, "When is the last time my lumber supplier supported my business initiatives to help me differentiate and increase our opportunity for mutual success?"

Unfortunately, the value-added products our industry manufactures are sold using a different business model from the commodity-based business model that is used in the sale of lumber. Economically speaking, the lumber business model follows the commodity marketplace, where highs and lows are based on anticipated and/or expected future outcomes. Add to this the constant variability between lumber supply and demand, and it begins to make sense why the price of lumber is constantly on the move. This often makes raw material input costs quite uncertain. In a fixed customer contract that can last between one week and nine months, this uncertainty can cause CMs to get caught between a rock and a hard place. Consider this:

- To get a development loan, a homebuilder has to get a permit. The permit is based on a pretty well-defined set of plans and specifications that can be shown to comply with the local building code. From this set of plans, they can estimate the cost and then get an appropriate amount of money from the bank to build the structure. Typically, this approach establishes a relatively fixed budget to complete all the tasks, with minor modifications. A 50 percent increase in lumber cost, resulting in a 25 percent decrease in profit margin, is unlikely to be passed on to the builder who is working on a fixed budget with a fixed bid for the structural components.
- So in today's short-supply, rising-demand lumber market, the CM takes on the aforementioned budget risk. In a situation like this, the CM had better hope his balance sheet is strong, given the opportunity to raise the price of the components is not good, and can never be as quick as the supply-demand equation adjusts raw material prices in the commodity marketplace.
- Simply put, can you adjust your structural component prices as fast as the commodity market adjusts its prices? Obviously, at 50 percent of one's cost, this will have a big profitability impact.

There are other commodity market and supply chain issues that can pop up with direct effects on a CM's business model. These may include, but certainly are not limited to:

- Terms and conditions of sale and taking on-time payment discounts. Are the terms favorable to your business or that of your supplier? Does your customer expect you to be their bank?
- Product shipments are not always timely. If you bought your raw material at a very low price, and the market has risen so that more profits can be made by shipping the product in a timelier manner to other buyers, is it surprising if your shipments are delayed?

- In a falling lumber market, are you typically able to maintain your structural building component business model or does your buyer expect a discount?

There are certainly more examples of being caught in the profit squeeze between your builder customer and your lumber supplier. We would love to hear about and compile additional business model effecting circumstances to use for intelligence sharing in the future.

I know there are lumber manufacturing industry visionaries who are interested in championing our industry's needs. Just a few examples of lumber companies that have recently shown strong support of CMs are listed in the side bar on page 8. They all have owners/leadership who understand the importance of listening to and supporting their component manufacturer customers and providing differentiated services (i.e., favorable terms and conditions of sale, protecting customer profit margins from the highs and lows of the commodity market, adjusting their grading to meet customer quality needs, etc.).

I am certain that there are more companies who likewise wish to partner in some way with their customers and can be added to this list. If you work with a lumber manufacturer who has worked hard to support your business, please let us know how and what they have done so that we can grow and support these types of actions and help to foster partnerships dedicated to changing the structural building component model for the better.

Here's another way to think of it. Take a moment and quantify the amount of money you spend each year with your various suppliers (lumber; engineered wood; fasteners, connectors and related steel products; truss plates; engineering and business management software; or other large-ticket items). Look closely at the suppliers you have spent the most money with and compare that cost to the suppliers who have supported your growth the most. Since your growth supports their growth, shouldn't those two lists be nearly identical?

I believe the time is right for our entire industry to passionately advocate for greater supplier support in the mission to help you differentiate your business and set both you and your supplier apart. All of our industry's suppliers benefit from being engaged with their buying customers in planning for mutual success. This has the potential to change the profitability equation for you and your business teammates in materially beneficial ways. A change in thinking and passion would, by definition, have supply-chain and industry-wide benefits.

A final thought—SBCA members should ask themselves, "Which of our suppliers and supplier associations have done the best job of helping our collective industry grow by supporting industry-wide SBCA/component manufacturing initiatives?" This should be a passion of all SBCA members speaking with a loud and united voice. **SBC**

SBCA recently re-drafted its raw material design policy. See page 16.

technical Q&A

by Daniel Lawless &
Dan Hawk, E.I.T

BCSI Guidelines for Continuous Lateral Restraint & Diagonal Bracing of Metal Plate Connected Wood Trusses

Understand the potential for future BCSI optimization using SBCRI truss assembly test data.

Wood trusses have slender members loaded with high compression forces; therefore, temporary and permanent truss member continuous lateral restraint (CLR) and diagonal bracing is critical to preventing premature failure by buckling of the top/bottom chords and/or web members. Truss member CLR and diagonal bracing is typically installed according to the recommendations provided in *Building Component Safety Information (BCSI): Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses,* produced jointly by SBCA and TPI.

Question

I've heard that industry testing of BCSI has been conducted at the SBC Research Institute (SBCRI). What kinds of tests have been performed and how will they affect BCSI CLR and diagonal bracing recommendations?

Answer

BCSI was created to provide industry recommended methods and procedures for installing CLR and diagonal bracing that are comprehensive and result in safe construction practices. It uses a prescriptive approach to CLR and diagonal bracing for trusses up to 60' in length and up to 80' in length when CLR and diagonal bracing is designed and inspected by a Building Designer [registered design professional (RDP)] per ANSI/TPI 1 Chapter 2 and the International Building Code (IBC). The International Residential Code (IRC) adopts these provisions by reference to ANSI/TPI 1 and BCSI.

Both BCSI and ANSI/TPI 1 were developed by leading representatives of the truss design and manufacturing industry, based on engineering mechanics theory and their collective experience. BCSI is intended as a guide and does not and should not supersede a Building Designer's CLR and diagonal bracing specifications. Due to its prescriptive approach and range of possible truss configurations, some BCSI provisions may be more stringent than a CLR and diagonal bracing plan generated by a qualified Building Designer based on job-specific structural analysis. To improve the prescriptive CLR and diagonal bracing methods of BCSI, the unique testing capabilities of SBCRI have been used to better understand the true distribution of load through CLR and diagonal bracing members in an assembly.

BCSI Lateral Restraint & Diagonal Bracing Tests

SBCRI conducted tests on an assembly of five 39' common trusses (see Figure 1) under 33 different CLR and diagonal bracing conditions. The assembly was first tested with CLR and diagonal bracing applied according to BCSI guidelines, to establish baseline performance. Different elements of the CLR and diagonal bracing system were then removed, and the assembly was re-tested to determine how the forces in the CLR and diagonal bracing changed, and if the assembly experienced buckling failure.

In all tests, load was applied to the bottom chord of the end truss, representing the loads applied by three construction workers standing at the quarter points of the truss. The load was increased linearly up to a maximum of 420 pounds (2.1 x 200 lb man-load). Load reactions were measured at the bearings of the five trusses and

at a glance

- SBCRI conducted tests on an assembly of five 39' common trusses under 33 different lateral restraint and diagonal bracing conditions.
- The test data and Finite Element Model (FEM) results will ultimately be used to revise the BCSI guidelines to result in easier and more economical installation of lateral restraint and diagonal bracing methods and a safer jobsite.
- Additional information on SBCRI testing can be found at sbcri.info.

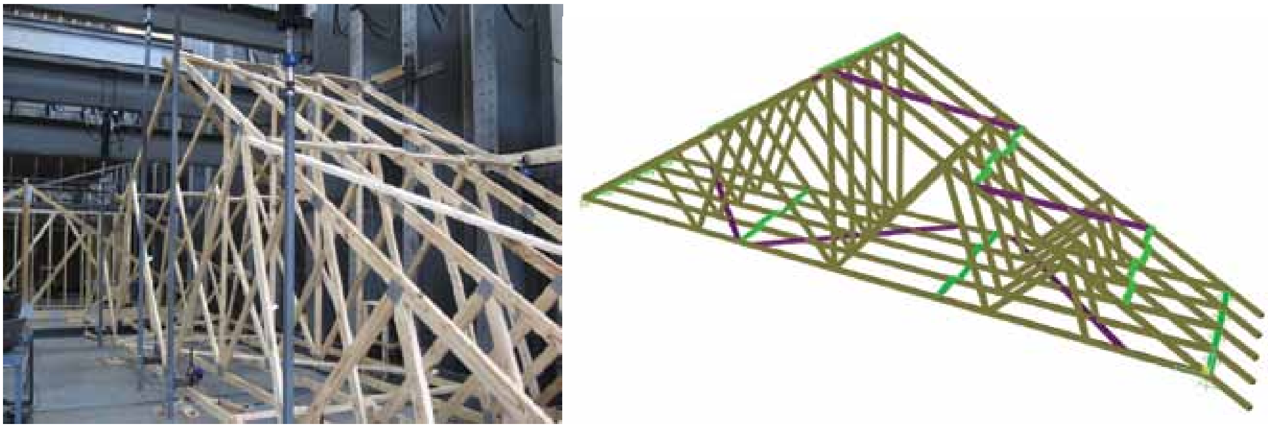

Figure 1. Truss Assembly (left) and 3D Finite Element Model (FEM) of Truss Assembly (right).

at the horizontal ground CLR and diagonal bracing locations. This reaction information determined the path the load followed from its point of application to the assembly supports.

In addition, the lateral force in one of the top chord CLRs was measured by replacing the lumber with a threaded rod that contained a load cell (see Figure 2). By measuring the force in the CLR at this location, comparisons could be made to the lateral restraint requirements calculated using the current design procedures (such as the "2 percent rule"). Current design procedures, including the "2 percent rule," are generally a conservative assessment of lateral forces that result in good performance but may present unnecessary challenges for framers (see the article, "System Stability in Wood Truss Assemblies during Construction" in the Sept/Oct 2007 issue of ***SBC Magazine***).

Figure 2. Load cell measuring force in top chord CLB (upper left), load cell measuring horizontal load in ground brace (lower left), and load cell measuring vertical reaction at end of truss (right).

The lateral deflections of all CLR points and the quarter-point vertical deflections of the loaded truss bottom chord were recorded as well. The load and displacement measurements for the different CLR and diagonal bracing configurations can then be used to calibrate and verify the results of computer models of the truss assembly.

Finite Element Modeling

The results of the CLR and diagonal bracing tests are being used to validate a Finite Element Model (FEM) of the truss assembly (see Figure 1). Once the model is fully calibrated and verified, FEM will be used to predict the actual forces in the truss members and CLR and diagonal bracing components. Knowing the actual forces of the truss and CLR and diagonal bracing members under load will determine if the members are susceptible to buckling and the amount of lateral restraint needed to prevent buckling. The reactions produced by FEM will be compared to the measured reactions to ensure that the model is accurately distributing forces throughout the assembly. In addition, the non-linear modeling capabilities of FEM will be used to predict when and where buckling failures occur. The predicted buckling load and buckled shape will be compared to the buckling load and shape observed during tests to verify that the model produces accurate results (see Figure 3).

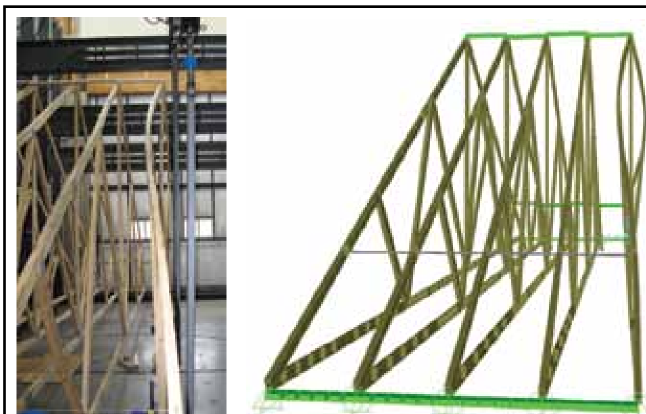

Figure 3. Comparison of the buckled shape predicted by the FEM to the actual buckled shape observed in testing.

All of the information gathered from the 33 tests conducted by SBCRI and FEM can be used to evaluate current design truss CLR and diagonal bracing methods. Once validation of the model is completed, FEM can analyze other truss configurations and assemblies. These models will determine the critical

Continued on page 14

Non-Linear Finite Element Analysis

To determine if a structure will buckle, a finite element program can use a non-linear analysis that accounts for large displacements. Most structures are analyzed for member and connection resistance assuming that the displacement/rotation of the structural members and/or connections is small. This member resistance analysis can use the initial un-deformed geometry of the structure, which makes solving for the forces in the system simpler and is usually quite accurate.

However, using the undeformed (undeflected) shape of the structure does not check for buckling of compression members, since this involves large displacements (like the 1" displacement assumed for the generation of the 2 percent rule). To determine if a structure will buckle, an analysis must use the deformed shape of the structure. An example of a non-linear analysis involving large deformations is shown in Figure 4. Under large deformations, the truss has a different geometry, which implies that it will have a different stiffness response to the vertical load.

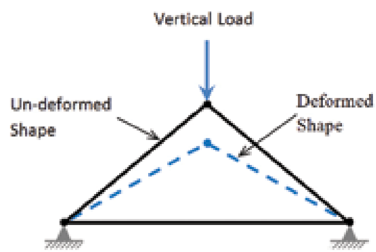

Figure 4: Simple Truss with a Vertical Load

For a non-linear analysis, a finite element program accounts for the large displacements by conducting an iterative solution. The geometry of the structure changes over time, with each step of the analysis using the deformed shape calculated in the previous step. Using this method, buckling failures can be determined. The type of non-linearity resulting from large displacements is called geometric non-linearity and is only one form of non-linearity that can be considered by finite element programs.

SBCRI is undertaking this work to provide better truss system buckling behavior analysis. A non-linear finite element resistance program and model are being calibrated to the test data. This model will define and refine the required temporary and permanent lateral restraint and diagonal bracing required to efficiently resist the applied gravity-load-inducing and wind-load-inducing lateral loads. The goal is to provide a generally accepted engineering CLR and diagonal bracing solution that is more accurate and framer friendly.

SBCA Member Support Services: Industry Code Compliance Technical Evaluation Reports

The SBC Research Institute (SBCRI) has launched a new website, sbcri.info, which features Technical Evaluation Reports (TERs) created for SBCA. Available at sbcri.info/sbca, SBCA TERs address issues related to the code-compliant use of structural building components, including findings from industry testing of braced walls. SBCRI has also begun sending out an electronic newsletter, which covers an analysis of industry-focused testing conducted at SBCRI and summarizes TERs that may be of interest to manufacturers.

If you have a code or professional engineering issue that comes up repeatedly, it's likely that other component manufacturers have encountered the same issue in their markets. A TER can be created for SBCA, which manufacturers can include in jobsite packages or send out as needed, and the issue can be resolved through this marketplace educational vehicle.

Technical Q&A

Continued from page 11

CLR and diagonal bracing components, which will allow for optimization of their design. Using a system-based design method to determine the stability of the truss assembly will likely result in a reduction, perhaps significantly, of the CLR and diagonal bracing forces currently expected when designing members individually. The test data and FEM results will ultimately help revise BCSI guidelines to result in more economical restraint and CLR and diagonal bracing methods.

Concluding Thoughts

This work is being undertaken because, more often than not, framers do not follow BCSI guidelines. Some framers find BCSI too time-consuming and difficult, and they generally believe it is overkill. It's important for BCSI to provide an answer, through engineering analysis, testing and generally accepted engineering principles, that solves framers' concerns and provides solutions that make framers say, "Now that bracing process makes sense to me!" If done well, temporary CLR and diagonal bracing will become permanent CLR and diagonal bracing, which is installed just once, versus being installed, taken off, and permanent CLR and diagonal bracing installed separately. If this process is simple for framers to deploy, safe truss installation will improve. Everyone can embrace concepts that make installation easier and safer, and in the process, prevent a serious injury or save a life. SBC

For more information on temporary and permanent lateral restraint and diagonal bracing of trusses, see the BCSI book (sbcindustry.com/bcsi.php) and B-Series Summary Sheets (sbcindustry.com/bcsi.php#bseries).

Design Values Matter

Make Sure You Fully Understand Why

by Sean D. Shields, Kent Pagel & Kirk Grundahl, P.E.

It really isn't overly dramatic to say that the structural building components industry lives and dies by accurate raw material design values. However, for many years, this industry has more or less taken design values for granted because it was assumed that the wood products and steel industries stood behind the design values ascribed to their products without exception. Also, it had been so long since lumber design values had been revised dramatically, upwards or downwards, that the 2012-2013 Southern Pine (SP) design value devaluation caught virtually everyone in the industry off guard.

This high-profile action, combined with data obtained through recent full-scale testing conducted at the SBC Research Institute (SBCRI) on braced wall panels, brought into sharp focus for the SBCA Executive Committee and SBCA Board of Directors the need for an industry policy articulating exactly why raw material design values are so important to the products this industry manufactures. To gain an understanding of why this policy (sbcmag.info/dvp) is needed, what it communicates to the marketplace, and, ultimately, what it promises about the future, let's break the policy down into its basic elements.

Design Values = Load Resistance

No matter the species, component manufacturers (CMs) purchase and rely on the accuracy and reliability of many different lumber design properties, including: bending (Fb); shear parallel to grain (Fv), compression perpendicular to grain (Fc⊥), compression parallel to grain (Fc), tension parallel to grain (Ft), and modulus of elasticity (E and Emin). Depending on the type of structural load resisting component (roof, floor or roof truss) and a lumber member's location in that component (top chord, bottom chord, or web), one or more of these design values are critical to the structural performance of that component and will control the ability of the lumber member to resist anticipated loads.

As the policy articulates in its initial paragraphs, CMs don't simply purchase lumber; they actually purchase the design values attributed to that lumber. Those design values, in the case of SP, are determined by the Southern Pine Inspection Bureau (SPIB) and then approved by the American Lumber Standards Committee (ALSC).

During the component design process, technicians working for CMs utilize component design software that assumes reliability of lumber design values, which have been input into the American Wood Council National Design Standard's (NDS) engineering mechanics-based resistance equations.

NDS standardized engineering equations assume that the resistance to applied loads is equal to or greater than the applied load, along with a typical factor of safety, such as two. The concept that the load divided by the lumber's load resisting properties is less than or equal to 1.0 implies that the engineering properties for lumber are accurate and reliable. In other words, it is difficult, within the mathematics of engineering, to have 1.0 really be equal to 1.0 plus or minus 30 percent. If design values are low by 30 percent for any reason, the expected factor of safety is also not going to meet end-use expectations. Based on this, the factor of safety could now be 1.5 versus 2.0.

These same engineering mathematics fundamentals apply to component design software, however, in a more complicated manner because the math used in design software is based on a more sophisticated matrix method or finite element engineering analysis. These equations also assume that lumber properties accurately represent resistance. The real difference is that there is less chance for human error when software-based engineering math is used, as opposed to the "hand calc" engineering math used through the NDS.

Naturally, the engineering math used to determine accurate raw material properties extends to all building materials used to provide structural resistance, whether they are connector-plates, wood structural panels (e.g. OSB, plywood, etc.), LVL, I-joists, hangers or fasteners.

For CMs to effectively meet customer needs and build market share, innovation and

Given that our industry is in the component design and engineering business, which is closely related to the building design business, accurate and reliable engineering is central to every CM's future success.

optimization of engineering resistance must have suppliers who stand behind their raw material design values as accurate and reliable. Whether it is visually-graded lumber, truss plate steel, or a machinery safety bar, it is necessary to put in place the quality control systems needed to assure this reliability.

Regular Testing of Raw Materials

Since accurate and reliable raw material design values are so critical to the components manufacturing industry, it is vital that raw material producers conduct regular testing of their resource to verify those values. An example of this need for regular lumber testing is found in Appendix A of Supplement 13 to the SPIB Grading Rules, 2002 Edition, approved by ALSC in January, 2013:

> Wood is a natural product subject to variations in geography, climate, specific site characteristics, silvacultural practices, and harvesting decisions. Its strength properties are not only anisotropic (vary by principal axis) but also can vary with proximity to the center of the tree. These characteristics complicate the assignment of individual pieces into design value groups based on the visual appearance.

Wood, being organic, is subject to variability. Fortunately, this isn't news to anyone. Lumber testing procedures for all North American species were recently reviewed by ALSC to ensure that testing programs are regularly conducted in a manner that ensures the design values ascribed to visually-graded lumber is a representation of the entire current population of trees harvested. As SPIB also states in Appendix A, "there is great variability present in design values assigned through visual grading means."

Alternatively, machine graded lumber (MSR/MEL) is tested and graded by a machine, which assesses the actual strength properties during the production process of each piece of lumber. Whether it's by directly measuring the stiffness of the lumber or its density, MSR/MEL has the advantage of providing more accurate and reliable lumber design values. Further, the quality assurance process for MSR/MEL lumber ensures that every single piece of MSR/MEL lumber has been assessed and can be used in engineering equations with assurance that these equations will produce reliable resistance. That assurance allows CMs the flexibility to be more confident in the creative and innovative techniques that their truss designers use to meet customer needs.

Regular Testing of the Building Code

Raw material design values are not the only thing that needs to be tested and verified on a regular basis. As the SBCA design value policy points out, there are building-code adopted wood product prescriptive applications that should be tested and verified as well.

It is not disputed that the model building code is a set of "ICC-consensus-based" provisions. (ICC is not an ANSI or ASTM consensus standards development process.) However, when these requirements provide prescriptive design guidelines and values based on outdated test data, problems arise. Historical test data were based on test assembly boundary conditions that do not reflect real building performance.

For example, historical test data uses a steel beam to apply lateral load across the top of a wall assembly. This steel beam is supposed to represent floor or roof framing. This steel beam boundary condition test result is used to establish code-based resistance to lateral load design values. By definition, these design values will be much different than what a real structure experiences.

When this testing and design value development information is not transparently understood, it is difficult, if not impossible, to make engineering judgments with respect to actual resistance. In addition, only a handful of engineers in the U.S. really know the substance behind the judgments made in the development of the building code language, which everyone otherwise has assumed is correct.

Engineering should be straightforward and easy to understand: apply a load and provide enough resistance to safely transfer that load to the ground. Recent empirical test results show that code-adopted prescriptive design values are not accurate. This information should be easy to understand and well known so that engineering load resistance judgments can be made based on real resistance and all the factors that may have been applied to that resistance to make the code based tables work.

From 2009 through 2012, Qualtim, Inc. conducted (with more testing ongoing) 470+ ASTM E564/ASTM E2126 full-building tests, associated data analysis and finite element modeling to help understand true building braced wall panel performance. The results conclusively demonstrate that the IRC's prescriptive 3/8", 7/16" and 15/32" wood structural panel design values are overstated by a factor of 1.8 for both walls without interior gypsum wallboard applied and those with interior wallboard.

This is a significant inaccuracy because fundamental shear wall design values, as defined in the building code, are overstated within the building code. The building code then becomes law, as municipalities adopt the code, and the 1.8 code implied design value factor is not explicitly defined. In the case of braced wall panels, this places the engineered designs that CMs undertake at a distinct competitive disadvantage where products other than OSB and plywood are used because no one knows that a code-implied design value factor of 1.8 has been applied to the code-based structural resistance provided.

When these code-adopted factors are not transparent or well understood by the engineering or building code community, engineered designs become devalued in the marketplace because they are viewed to be more expensive. Therefore, specifiers and construction product purchasers default instead to the prescriptive, building code approved alternative.

SBCA's design value policy argues that greater transparency is necessary to provide a fair playing field for making good performance-based engineering decisions and accurate building code approval judgments. As the policy states, "it is in in the

Continued on page 18

Design Values Matter

Continued from page 17

best interests of both the construction industry at large, as well as the truss and component manufacturing industry in particular, that engineering, and thus construction, be entirely based on tested and accurate raw material load resistance data." This approach will not only ensure reliable building performance and more accurate factors of safety, it will also allow for greater innovation through the use of accurate and empirical-data formulated judgments.

Comply with State-of-the-Art

One of the most difficult aspects of raw material design value changes is the impact it has on prescriptively engineered conventional light frame construction, or stick-framing, when compared to the engineering that goes into truss design. For instance, when the new SP design value changes go into effect June 1, 2013, all engineered truss designs that are sealed by a professional engineer have to use the new SP design values, unless the Building Designer authorizes that a specific set of lumber design values can be used for the specific project. From a reliability, knowledge and liability perspective, CMs have no choice but to use the new design values to calculate everything from maximum spans to panel lengths to joint locations and plate sizes. Doing otherwise would introduce arbitrary engineering and construction defect liability exposure.

Likewise, building owners and contractors who use prescriptively engineered conventional framing are required to use the new design values by the SP effective date assigned by ALSC. Unfortunately, by either ignorance, oversight or neglect, they may not choose to use the effective SP design values. Many local framers may simply continue to build as they have done in the past, despite the fact that the SP span tables, adopted into the building code, have dramatically changed on the SPIB effective date. In some instances the local building inspector may not know of the changes either, and the unsuspecting local framer is effectively allowed to not follow the SP effective date state of the art. This is yet another example of not knowing, oversight or neglect.

Older span tables using outdated design values are still readily available and will be cause for confusion. If a local framer unknowingly picks up an old floor joist span table, and compares this span table to a corresponding span table for floor trusses (which use SP effective date design values), joists appear to be both stronger and able to span further than trusses and this may result in joists being a less expensive floor system. This apples-to-oranges comparison is possible again because of the SP effective date oversight process.

For either a local framer or building inspector to know of the design value changes and the absolute need to comply with the SP effective date state of the art, yet ignore the change and construct using old design values is an example of neglect, perhaps gross neglect. It is further neglect for either an industry resource or trade association to advise the marketplace that the use of old design values is appropriate as long as a building inspector chooses not to enforce the change. This "only change if you get caught" mindset is dangerous and constitutes a blatant disregard of the testing behind the lumber design value changes, engineering principles, the SP effective date "state-of-the-art" standard, and good old-fashioned common sense.

To ensure a more level playing field for the components industry, SBCA's policy advocates that all manufacturers, sellers, specifiers, purchasers and users should be held to the same SP effective date "state-of-the-art" standard, regardless of the actual enforcement mechanism.

Striving for a Reliable Field

This new SBCA policy draws into sharp focus the many challenges facing the structural building component industry with regard to raw materials and other construction products. There are several facets of this issue that have the consequence of reducing the value of engineering. This clearly creates less incentive for CMs to innovate based on using their engineering skills to the full extent possible. This also allows competitive advantages to be inequitably built into the marketplace by codifying them into the law of the land (building codes).

Striving to understand and appreciate these impacts, and then actively participating in SBCA's efforts to address them in the marketplace, may be one of the most important activities you can do as a CM. Deeper knowledge will help you craft business strategies that will place your business in a better position to compete with prescriptively engineered conventional construction (stick framing).

Given that our industry is in the component design and engineering business, which is closely related to the building design business, accurate and reliable engineering is central to every CM's future success. A key SBCA mission is for engineering services to have ever-increasing value to the markets we serve. SBC

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Quality Control Your Destiny

by Mike Cassidy, Executive Director of TPI, & Sean D. Shields

Quality. It's the word you want each and every one of your customers to attribute to your products. It's a word that implies reliability, a characteristic that builds trust and respect. It's also a concept that points to superior craftsmanship that differentiates you from your competitors. What you may not immediately attribute to the word is how it represents significant cost savings to you through less waste, fewer customer call-backs and greater production efficiency.

Unfortunately, as you are acutely aware, quality does not occur automatically. It's attained through a constant commitment to monitoring and improving your production process and a dedication to implementing Quality Control (QC) throughout your operations. This article, the first of a three-part series, will look at the impact QC can have on your operations, explore how easy it is to implement, and look at the In-Plant WTCA QC program and the Truss Plate Institute's (TPI) Third-Party Inspection process.

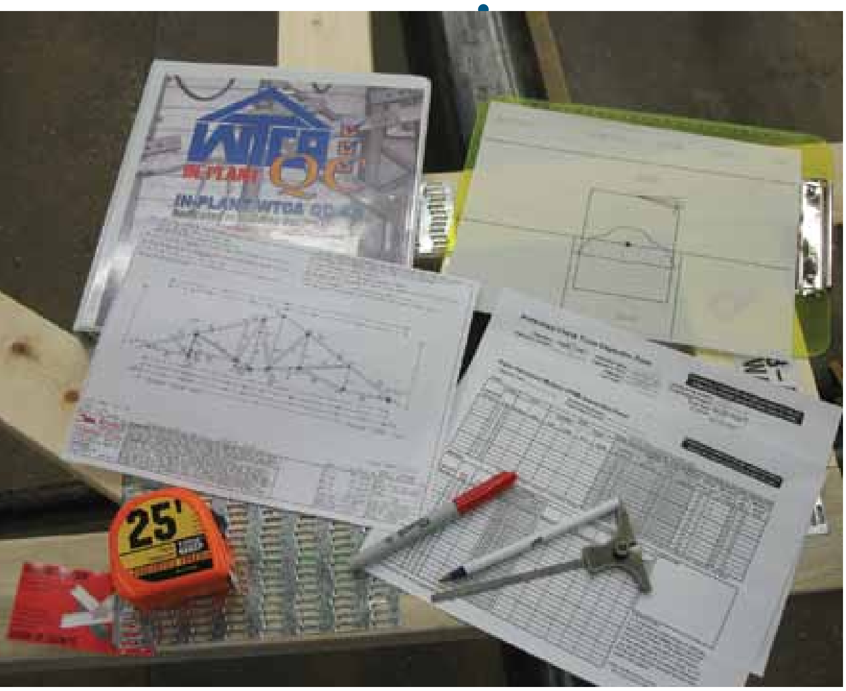
Quality Control

The purpose of a QC program is to help ensure you produce a consistent product where quality variation is well managed. Variation is a natural part of all manufacturing operations, so the important thing is to have a process in place that can show you on a regular basis whether that variation is acceptable or not. Your QC program should also provide tools to help you with targeted employee training, and provide an early warning for manufacturing machinery issues that could cause quality defects.

This information should help you make good decisions on whether big-picture or more targeted measures should be implemented to address a particular QC issue. For instance, monitoring and taking some plant-wide action with respect to knots in the plate area at the saw should speed up production table time because everyone on the table knows exactly what to do given the process that has been implemented in the plant.

2005 SBCA President Don Groom pointed out in his first **Editor's Message**, "When we take a job, we know that we owe our customers a quality product—it's simply good business. But while an effective QC program helps to keep our customers satisfied, it also reaches much farther than that, touching every segment of our businesses."

Implementing an effective QC program involves everyone, not just a supervisor or an inspector. QC is a part of everyone's job in the process. Here are examples of how each area of your plant participates in QC:



- Designers set the fabrication tolerances and optimize the design/lumber, while keeping in mind the ability of your assemblers to construct a particular design.
- Design departments can save costly re-dos and repairs downstream, which will be the topic of the third article in this series.
- Material receiving staff ensures that the material received is as specified (i.e., grade, moisture content, tolerable defects, etc.).
- Sawyers verify that the material flowing through the assembly line is the proper grade and free from unusable defects; they can even perform preliminary joint QC prior to sending the webs and chords to the production line.
- Assemblers double-check for good material in the plated area and replace lumber as needed; they also concentrate on accurately placing the plates and ensuring tight joints.
- Stackers verify that all plates are installed; visually check for any excessive member-to-member gaps, plate

- rotations over 10 degrees and plate embedment; and check for consistency in plate alignment between like trusses in a bundle.
- Drivers provide a final verification that the load being delivered is the proper one, the order is complete, and they ensure the product isn't damaged upon delivery.

That lengthy list drives home two good points: one, QC is truly part of everyone's job; and two, there are a lot of areas in the production process where poor QC can cause real headaches and threaten the cost-effectiveness of your operations.

"One of the biggest concerns component manufacturers have when they're deciding whether or not to implement an in-plant QC program is that it will be too time consuming. If an employee is doing inspections, he or she isn't building components," Groom pointed out in his message. "It's true, running a program will take some time that would otherwise be devoted to building components, but the benefits of a QC program far outweigh the lost time."

Two additional factors to consider in evaluating the benefits of having a QC process in place are: one, having a formal program can significantly reduce your liability and exposure to risk through the documentation and data you collect; and two, conducting in-plant QC inspections may be required for certain commercial projects through the building code. We will touch on both of these issues in greater depth in the next two articles in this series.

Not Difficult to Implement

Implementing an in-plant QC and third-party inspection program doesn't have to be difficult. You already make minor adjustments throughout any given day, with the goal of getting trusses out the door as fast and efficiently as you can. A QC program complements that process and, ultimately, lets you better focus on production by putting valuable management information in your hands to evaluate and identify opportunities for further processing and material through-put improvements, not to mention the potential savings in reduced call-backs and increased customer satisfaction.

The goal of a QC program is really to improve the education of plant personnel on what it takes to make a quality truss from a TPI 1 perspective. As you probably know, TPI 1 is the consensus-based standard that establishes minimum requirements for the design and construction of metal plate connected wood trusses. What you might not know is that TPI 1 also includes methods for establishing manufacturing quality where it states in Chapter 3, "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."

A good QC program focuses on incremental improvements in the manufacturing process, not a wholesale change overnight. Further, it assists in establishing benchmarks on which to compare inspection results and measure improvement. Like anything new, production may be affected while employees get used to it. However, the program isn't meant to diminish efficiency. In the end, its goal is to help you improve it.

In-Plant WTCA QC Program

If you're still skeptical about implementing a QC program in your plant, know that a lot of the hard work has already been done for you. SBCA worked with TPI and component manufacturers across the country in the late 1990s to develop a comprehensive QC program that helps manufacturers comply with the QC requirements of TPI 1 Chapter 3. Over the past two decades, hundreds of plants have implemented this program, providing significant input on how to alter and improve the program to make it as seamless and effective as possible.

At its core, the In-Plant WTCA QC program is a production management tool. Analyzing QC data and related information gathered from the shop floor to spot trends in your manufacturing are critical steps to strategically improving your quality. The adage, "garbage in equals garbage out," definitely applies here. The effectiveness of your QC efforts is directly tied to the data you collect and use to make your decisions.

Here's how it works. The In-Plant WTCA QC program outlines, through your plant QC manual, how and when to conduct QC inspections of various aspects of the production process. Management regularly checks the QC inspection records and notes any discrepancies and focuses on ways to improve processes or procedures based on the inspection feedback. Periodically, management will also walk the yard and perform a visual observation of trusses stored for shipment and run through a checklist to record any QC issues.

From observations made during the QC overview process, you can more accurately identify key areas where there is a need to improve education and training of staff, repair or adjust machinery, or address the quality of the material you receive (and possibly negotiate a different approach to your raw material buying with your suppliers based on your material quality findings). The In-Plant WTCA QC program allows you to collect all of the observations from inspections into one database so that you can make well-informed decisions on when and where to make adjustments. This data will also allow you to set goals and track incremental improvements over time.

Continued on page 22

parting shots

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Photo credit: Summit Credit Union and Mike Libby, Strang

Components play an integral role in the structural integrity of a building, but in this case, they're used purely for aesthetics. For the remodel of a Summit Credit Union's "Inspiration Branch," removable façades were built inside the lobby to represent financial and life goals dealing with travel, education and home ownership. This two-story façade shows part of a home, including a first-floor breakfast nook and a second-story child's bedroom with a roof that is framed with trusses. Much like a theatre set used in a play, the façade, including the trusses, can be moved without affecting the structure of the building.

The decision to use trusses in the dream house was intentional, says Peter Tan, of Strang, Inc., design architect on the project. "A cut-away view was the most effective way to simultaneously depict the breakfast nook and bedroom, as well as the interior and exterior of the house. Trusses are one of those easily recognizable iconic elements of a roof structure that, when exposed, effectively convey the idea that this is a cut-away view," Tan noted. "Someone imagining their dream house would expect to see a roof that is built of high-quality trusses that have been tested to perform to a predictable standard." SBC

Quality Control Your Destiny

Continued from page 21

Setting regular achievable goals not only makes the program more effective, the success helps build employee engagement and teamwork. In the end, you want to establish a QC culture that encourages ongoing awareness, participation and feedback so that processes truly improve. For example, you want your employees to know and embrace the fact that it's okay to find errors so they can be corrected. Without employee observations and feedback, errors don't get fixed, quality suffers, and the potential for unhappy customers and even future re-do costs, liability-related issues and lost customers become a possibility.

In the next article, we'll explore how some component manufacturers have implemented the In-Plant WTCA QC program in their plants and give some concrete examples of how this program has changed their operations (for one quick example, read Scott Ward's **Editor's Message** on page 5).

TPI Third-Party Inspections

Having an objective review of your QC efforts is vital to your success. A third-party QC inspection has many tangible benefits; it provides: an independent, critical eye on your operations (sometimes you can be too close to the problem to recognize it); a trained QC observer who knows exactly what to look for; and, the needed documentation to verify the quality of your product to your marketplace. Add to this the fact that a third-party inspection can either be a simple way to ease into the QC process by providing evaluation on basic TPI criteria, or it can be the culmination of your QC efforts because the In-Plant WTCA QC program requires a third-party inspection for certification, which will help you further differentiate your company and your product in the market.

TPI brings some unique benefits to its third-party inspection program. It's hard to argue that any other entity can have the same level of expertise as the organization that is responsible for TPI 1 and is the original truss industry association of plate suppliers and CMs. As steward of TPI 1, it also has the greatest depth of knowledge with regard to the inspection requirements contained in TPI 1 as referenced by the building code and, therefore, building code compliance.

In addition, TPI worked hand-in-hand with SBCA in developing the criteria used in the In-Plant WTCA QC program. TPI has an intrinsic interest in going beyond simple adherence to QC criteria by consulting with you to suggest potential areas of improvement to your QC process, and lead to greater production efficiency, higher quality and lower call back costs. Finally, utilizing the TPI third-party inspection process allows TPI to provide resources for other efforts to benefit the components industry, including industry-specific structural testing and standard development.

Conclusion

Whether it was Don Groom in 2005 or Scott Ward in 2013, both CMs recognize and tout the benefits of having a good QC program. Not only does it lead to spending less time and money on production, it leads to happy customers and a strong reputation in your market. There are several approaches to take, from starting with a third-party inspection process like TPI's, to adopting the In-Plant WTCA QC program and becoming certified through third-party inspections.

You are in the best position to make the choice as to what will work well for your operations. To help you in your decision-making process, next month, we will talk with some manufacturers who have already gone through it and give you their take on why they chose to do what they do and look at how it has benefited their operations. SBC

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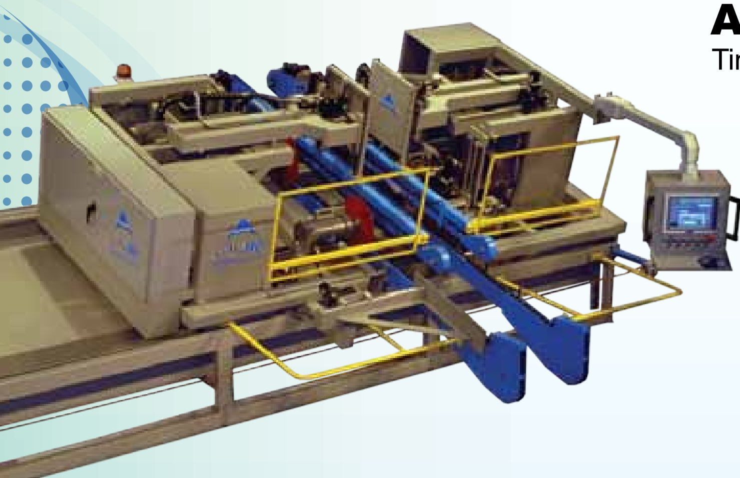

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