DAY 3

WEDNESDAY | SEPT 13 | 2023

FABTECH

NORTH AMERICA'S LARGEST METAL FORMING, FABRICATING, WELDING AND FINISHING EVENT

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SHOW DAILY

THE OFFICIAL FABTECH PUBLICATION

TODAY'S EVENTS

Keynote: Digital Leadership: The 5 Simple Habits of Digital Leaders
8:30 AM – 9:30 AM
Lakeside Center Ballroom

Exploring Welding Apprenticeships and Talent Development
10:30 AM – 11:30 AM
Lakeside Center Ballroom

LEADERSHIP EXCHANGE
Advancing Robotics in the Fabrication Metal Industry
12:30 PM – 1:30 PM
Lakeside Center Ballroom

Breaking Boundaries: Empowering Women in Welding
3:00 PM – 4:30 PM
Lakeside Center Ballroom

Top Tips from Successful Women in Manufacturing

Tuesday's Woman of FABTECH Panel, "How Did I Get Here? My Pathway to Manufacturing," laid out the career pathways of leading lights of the manufacturing and fabrication industries. Panelists included: Teresa Beach-Shelow, Owner, Superior Joining Technologies Inc.; Amanda Reel, Training Engineer, TRUMPF Inc.; Marhya Osheaski, Vice President Sales, IFS Coatings; Lisa M. Habe, President and Chairman of the Board, Interlake Industries Inc.; and Karen Gilgenbach, Zone Vice President, Matheson.

MODERATOR: Theresa Beach-Shelow
Superior Joining Technologies Inc.

Amanda Reel
TRUMPF Inc.

Lisa Habe
Interlake Industries Inc.

Karen Gilgenbach
Matheson

Marhya Osheaski
IFS Coatings

Representing a variety of manufacturing roles within the primary FABTECH industries, they shared in-depth personal career stories. They passed on their unique experiences, what led them to manufacturing and the many challenges they faced as well as numerous successes, tips and suggestions on how to encourage more women to enter our growing industry.

For those of you who missed it, here are some of the highlights:

Gender Imbalance

Many industries suffer from gender imbalance however, it is particularly prominent in manufacturing. While the number of women enrolled in STEM (Science, Technology, Engineering, and Math) academic programs is on the rise, they remain far outnumbered by their male counterparts. This translates to an underrepresentation of women in STEM-related and manufacturing careers.

According to research from online career platform Zippia, women in the U.S. make up roughly 28% of the technology and STEM workforce. These numbers haven't changed that much over the last 25 years. So, what is to be done beyond drawing attention to the divergence? The women of FABTECH each support efforts to promote more female fabricators, engineers and manufacturing professionals.

Take the case of Lisa Habe of Interlake Industries. As the leader of one of Ohio's leading stamping services, she provides comprehensive metal stamping including engineering, and design, fabrication, subassembly and finishing of runs from one to 250,000 components. The company owns and builds all its own dies, with the main industries it serves being electrical, aerospace and tooling.

"We are primarily a short-to-medium run (nonautomotive) metal stamper," said Habe. "We also own a deburring company and most recently we acquired a long-run metal stamper."

How did she find her way into the industry. Her father began the business way back in 1957. But she initially had no intention of joining several siblings in working in the family company.

"I was heading down a very different career path and working my way up the management ladder at a large corporation… until my father knocked on my door," said Habe.

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September 11-14, 2023 / Booths A2104 and B15001

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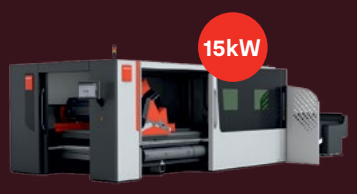

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CCAI Finishing Academy Adds New Courses to Its Online Education Portfolio

The Chemical Coaters Association International's (CCAI) successful Finishing Academy continues to answer the demand for a higher level of education in the finishing industry. With the addition of the System Design and Pretreatment online courses, there are now four different subject matters available.

Education is a primary focus for CCAI. With an ongoing and expansive need for skilled employees in the world of industrial finishing, many hours over the past few years have been invested in developing programs and materials to create the CCAI Finishing Academy. The Academy aims to provide education and training for those who are currently employed in industrial finishing, as well as those who are new to the industry.

In Fall 2021, the CCAI Finishing Academy launched its online training program with two courses, one focused on powder coating and the other on liquid coating and equipment. Led by instructors with extensive industrial finishing experience, the seven-week, self-paced courses include weekly assignments, regular quizzes, and a final project.

Since their debut, the powder and liquid courses have been held for a combined total of ten times, receiving rave reviews and often selling out. With the success of the initial subject matters, the program has expanded, adding a System Design course in January of this year and a Pretreatment course debuting in October.

All the courses are based on CCAI's technical manuals and offer thorough training on each topic. Participants gain critical knowledge to help improve their finishing operations.

"The overwhelmingly positive response to CCAI's courses is indicative of the industry's need for continued education programs delivered in diverse learning formats. So far, more than 165 finishing professionals have benefitted from the in-depth material designed to provide professional development through this flexible and efficient approach," states CCAI Executive Director, Anne Goyer.

NEW – Pretreatment Online Course

This course covers surface cleaning and conversion coating methods used in effective industrial finishing operations. The information included is a summation of known technology and process issues that affect the cleaning and pretreatment process. It will prove useful to the beginner as well as the experienced industrial finisher and can be used for training and reference.

NEW – System Design Online Course

The most common types of industrial finishing processes including powder, liquid, autodeposition, and electrodeposition are covered in this course. Students will learn the basics of designing a new system, determining the best coating process based on the substrate, volume, size, and performance requirements. Students will also gain knowledge to support an existing finishing operation and make recommendations for process improvements.

Powder Coating Online Course

This course addresses all aspects of the powder coating process including formulation, manufacturing of powder coatings, powder coating materials, material handling, surface preparation, application equipment and systems, curing technology, as well as quality, maintenance, troubleshooting and overall costs for operating a powder coating line.

Liquid Coating & Equipment Online Course

This course covers all aspects of the liquid coating process including material handling, hanging methods, surface preparation and curing. Students will learn about the benefits and various types of liquid coatings, including formulating and testing. The course will also cover the operational costing of a liquid coating system, health and safety, and maintenance and troubleshooting of liquid coating equipment.

To learn more about the CCAI Finishing Academy online courses, please visit www.ccaiweb.com/academy to view complete course details and to register. Space is limited and you may only enroll in one online course at a time. ■

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Leadership Exchange — Building the Future Workforce

With the nature of work changing so fast, workforce transformation is more vital than ever. It takes the right people with the right skillsets to ensure that advanced manufacturing and innovation can support technological competitiveness and drive product and process improvements. But major challenges lie ahead. The manufacturing industry has a massive skills gap at a time when the workforce continues to shrink.

Tuesday's Leadership Exchange panel, therefore, couldn't have come at a better time. A distinguished group of industry executives discussed ways and means of building the future workforce. The panelists included:

- Moderator: Jeannine Kunz, Chief Workforce Development Officer, SME
- *Connie King, Director Workforce Development, PMA
- Edward C. Dernulc, Director – Foundation, FMA
- Monica Pfarr, Executive Director, AWS Foundation
- Lara Threet, Program Coordinator & Instructor, Industrial Technology, Mississippi State University

They shared some key take-ways industry leaders can develop to secure future opportunities in areas such as getting involved earlier in the educational pipeline, learning to embrace change, how to attract more attractive career pathways and investing in unskilled workers via training and career development.

Start Early

Edward C. Dernulc, Director — Foundation, FMA, believes the number one problem facing the manufacturing industry is the lack of skilled and trained human resources. There are just not enough people to meet the needs of manufacturers.

"I can find a banker, attorney or accountant on every corner, but I cannot find anyone who knows how to weld or a good plumber or electrician," he said. "We have a skills trade gap of approximately 2.2 million open jobs and very little pipeline to fill those slots"

During the panel, he offered tips such as being as flexible and collaborative as possible. That includes partnering with the local community colleges and trade schools for a strong human resource pipeline.

"The more you are willing to work with schools, the better your opportunity will be to get trained, competent hires," said Dernulc.

In addition, he urges industry executives to think outside of the box. That might entail working with social services groups for less technical skills needed. Just because a person has Downs Syndrome or autism doesn't mean that person cannot be a great employee. In Dernulc's experience it often turns out to be the opposite.

"Young adults with unique abilities can change the culture of your organization," he said.

Another tip: get in front of kids early. After about 17, he believes there are too many outside influences that affect a person's decisions. Guidance counselors, parents, peer pressure, a favorite uncle and others will get involved in influencing career decisions.

"Expose the kids to the manufacturing industry at an early age so they realize the career pathway and opportunities it provides," said Dernulc. "We offer great careers to kids who want to work with their hands and 'under the hood'."

Learn to Embrace Change

Lara Threet, Program Coordinator & Instructor, Industrial Technology at Mississippi State University, engaged the FABTECH crowd about the importance of dealing with change, especially technological change.

"Companies barely get new technology implemented and employees trained before it changes again," she said. "Most people are resistant to change, and we are now changing more and more frequently."

"Thus, there needs to be a shift in thinking at all levels about change implementation in the company as well as a new strategic plan for technology upgrades. The winning approach is to actively and publicly embrace change," she added.

"Being a leader who welcomes change and encourages everyone at all levels to welcome change will help enormously in shaping the future workforce," said Threet.

But change requires buy-in from all levels. Not only does top leadership need to accept the change, team and line leaders need to be proponents, too.

To succeed in building a culture that embraces change, however, the mindset needs to be one of lifelong learning, not just classroom education prior to employment.

"Learning at work is just as important," said Threet. "Don't be afraid to take on a new task or to learn something new. It makes you an invaluable resource to your company."

Create Attractive Career Pathways

During the panel, Monica Pfarr, Executive Director at the AWS Foundation, addressed how changing demographics and the graying of the workforce are shrinking the available labor pool in the U.S. The solution for the manufacturing industry is to provide attractive career pathways with opportunities for growth, promote diversity and inclusion, and foster a culture of continuous learning to attract and retain talent, she believes. Additionally, she stressed the need for the industry to embrace technologies such as implementing robotics and automation to enhance productivity and augment the skilled talent pool.

"Other strategies that manufacturers can implement to address the skill shortage include registered apprenticeships, collaboration with educational institutions, and promotion of the industry," she added.

Investing in Unskilled Workers

Connie King, Workforce Development Director at the Precision Metalforming Association (PMA) is all about training and career

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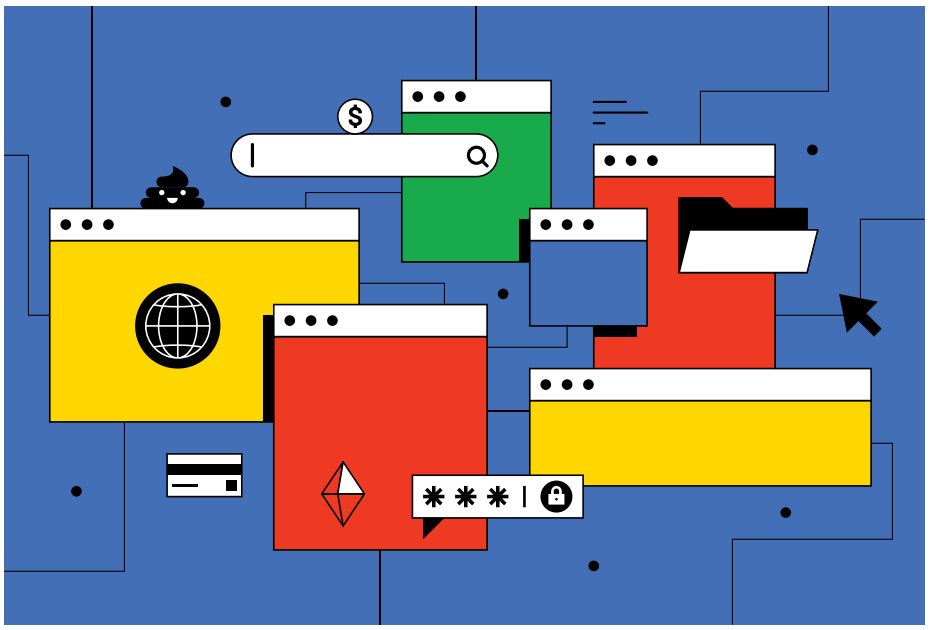
Maximize Value with Digital Advertising

by Caleb Chamberlain, Published in the June 2023 issue of *The Fabricator®*

"Half the money I spend on advertising is wasted; the trouble is, I don't know which half." Ever heard that before? The quote comes from John Wanamaker, a U.S. businessman who worked in the late 1800s and early 1900s.

Digital advertising can be rough, but it still provides a unique connection to potential customers. The trick often comes down to understanding how much to spend, and where. This isn't the year 1900. In 2023, you should expect to understand not only which campaigns work, but how much you should spend on them to meet your business goals. To make efficient use of digital advertising, you need to answer the following key questions:

1. **What are your growth and profitability goals?**
2. **What are your customers worth?**
3. **How do acquisitions scale with increased ad spend for each marketing channel?**



Getting Measurable Results

A digital advertising strategy should be tuned for your business. Are you highly liquid and aiming for rapid growth to please investors? If so, you can afford to spend more without seeing an immediate return, earning higher revenue at the short-term expense of lower contribution margin. Are you a bootstrapped company where cash is king? Your advertising dollars will need to produce positive cash flow in the short term, possibly at the expense of lower year-over-year growth. The ideal campaign depends on your company's financial position and growth goals.

This analysis should translate into a specific statement about how and when your ads should bring value back into your business. You might want a return on your investment in one month or one year. You might have a specific goal, such as acquiring three new contracts per month.

Immediate profitability is a great goal, but it can be difficult in a crowded ad space. Putting a timeline on profitability allows for higher immediate spend, with repeat customers generating more value long term. And a fixed ad budget can be allocated across many different advertising channels (think social media, search engines, YouTube, etc.). The distribution of that fixed budget will be affected by which platforms are most effective over the target time range.

Marketing strategies change with the advertising platform and how its audience uses it. Trade publications (like the one you're reading now, either print or online) have curated circulations full of longtime readers. People know and respect the publication's brand.

Online platforms like Google don't have that kind of relationship with their users. Someone who clicks on an ad is usually hunting for something specific, now. If they don't find what they want quickly, they click away and move on. Marketing strategies need to take this behavior into account.

Considering all this, what follows is a sampling of OSH Cut's digital advertising strategy — specifically, a single campaign on Google Ads.

What Are Your Customers Worth?

It's hard to overstate how important this is. You can't know how much to spend on advertising if you don't know what your customers are worth.

For example, **Figure 1** shows an example of OSH Cut's customer value model. This kind of modeling works best for "sticky" customers who keep coming back and ordering again. That's common in manufacturing, which is great. It's far more difficult to advertise efficiently if your customers order once and never again. Even so, some customers will order only once, and those should also be included in the average lifetime value model.

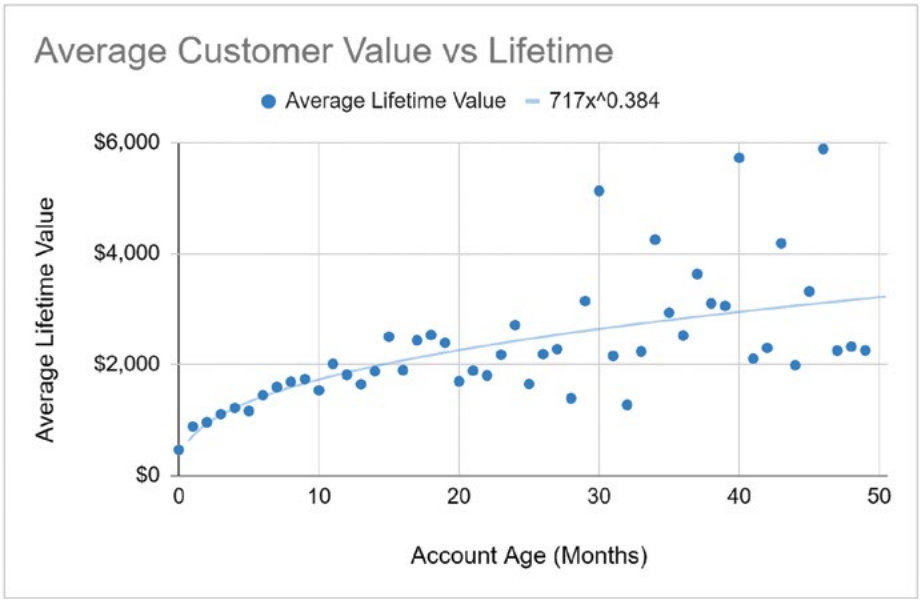


FIGURE 1 Average customer lifetime value versus the account age in months. Data has been skewed and obfuscated, but it illustrates how customer value can be modeled over time.

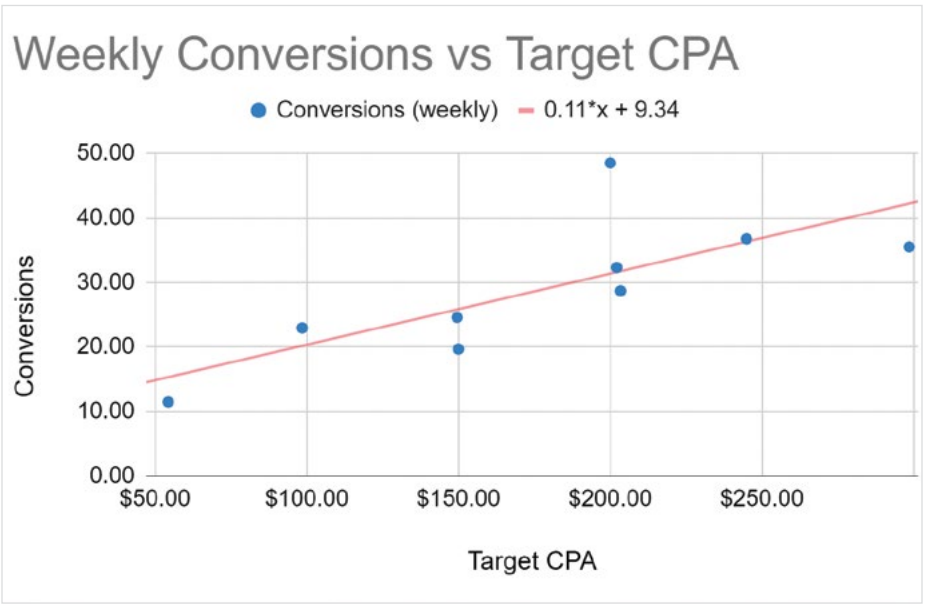


FIGURE 2 Weekly conversions vs. target CPA in a Google ad campaign.

Once you have the data, you can fit an equation to the average lifetime value at any period of time. A power series can be used to model the value in Figure 1:

$$ltv = 717 \times m^{0.384}$$

where ltv is the lifetime value and m is the number of months since the customer was acquired. If you don't know how to fit an equation to data, don't worry. Spreadsheet software like Google Sheets or Microsoft Excel can do most of the heavy lifting for you.

Building a customer value model like this shines a spotlight on what you can spend. If you want to break even on ads in six months, your average customer is worth $1,426 in that time, and your gross margin is 40%, then it's probably worth spending up to $571 to acquire each new customer. That doesn't necessarily mean you should spend that much. Perhaps you can meet your growth objectives while spending less.

Once you have a solid customer value model, you can use it to sanity-check your marketing efforts, both globally and per campaign. You can divide your total ad spend by the number of acquisitions in a period, and if it's above your acquisition cost target ($571, in the example above) then you are spending too much. If it's below your target, you can spend more, hopefully acquiring more new customers in the process.

Measuring Performance

The real magic happens when you pair your customer value model with advertising channel models. This can be tricky because circumstances change, sometimes very quickly. If you pay for ads on platforms like Google, the amount you spend and the number of acquisitions you obtain can change overnight if another competitor starts (or stops) bidding on the same keywords. Add fluctuating demand to the mix and it can be hard to know exactly what will happen when you change strategies.

Even so, the best campaigns do lend themselves well to analysis. If you have no idea whether your ads are working, it might be worth shifting to an advertising channel or campaign that is better-behaved.

Figure 2 shows an example of how the number of weekly conversions might scale with target cost per acquisition, or CPA. In Google Ads, you can configure a "target CPA" and let Google automatically bid on ad placements. If you are willing to spend more to acquire a customer, your ads will show more often and in more favorable positions in search results. That produces more conversions, but (of course) at higher cost. Note that there is often a lag between when ads are viewed and when conversions happen. That can and should be modeled as well.

As your ad spend increases, you'll start to hit a point of diminishing returns, where spending more has a smaller impact. Measuring and understanding that behavior allows you to understand what your ad budget should be to meet growth and profitability goals. From the data in Figure 2, we can relate conversion count to CPA using the following equation:

$$con = 0.11 \times cpa + 9.34$$

where con is the number of conversions, and cpa is the target CPA. This equation will be different in every campaign and may or may not be a simple affine equation. Because the total campaign cost is simply the number of conversions multiplied by the CPA, the projected weekly cost of the ad campaign in this example becomes:

$$cost = 0.11 \times cpa^2 + 9.34 \times cpa$$

Tying It All Together

If you know how much your average customer is worth after any number of months, and you know how many conversions you'll get at a target CPA and at what cost, you can combine all three to determine your projected contribution margin (gross profits less ad costs) attributable to an ad campaign. If we let CM represent the contribution margin, then we end up with the following:

$$CM = ltv \times con - cost$$

The utility of this equation becomes apparent if you plot it with respect to CPA. **Figure 3** shows a peak at which target CPA results in

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The Role of the CWI or SCWI in Fracture Critical Applications

When identified in contract documents, the requirements for inspection and testing of fracture critical materials and welds may be significantly different from standard procedures and production welds typically encountered by the Certified Welding Inspector (CWI) or Senior Certified Welding Inspector (SCWI).

A fracture critical member (FCM) is defined within the American Association of State Highway and Transportation Officials (AASHTO)/AWS D1.5M/D1.5:2020, Bridge Welding Code, section 12. AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members, sub- section 12.2, Definitions, states, "12.2.2 Fracture Critical Member (FCM). AASHTO LRFD Bridge Design Specifications define an FCM as a steel primary member or portion thereof subject to tension whose failure would probably cause a portion of or the entire bridge to collapse."

For many certified inspectors, bridge welding was not a part of their original career choice, and they prefer to work with standard structural fabrication and erection described in AWS D1.1/D1.1M:2020, Structural Welding Code — Steel, or other industry standards for piping, equipment, or tanks. However, recent initiatives by the U.S. Congress to improve the nation's infrastructure have placed inspectors from different industries in positions where they need to become familiar with the codes and other standards relating to bridges.

This article is intended to identify and discuss the topics related to fracture critical materials and welds during the quality and inspection procedure development phase, as follows:

The source and rationale for fracture critical materials and welds

- How does the inspector know that a procedure, materials, and welds are fracture critical?
- What codes and standards are used to govern fracture critical?
- What is the FCP?
- What is the relationship between the inspector and the engineer of record? Special testing requirements for welding procedure specifications (WPSs) used to produce fracture critical welds
- Are prequalified welding procedure specifications (PWPSs) allowed for fracture critical welds?
- What welding processes are allowed?
- What materials are allowed?
- What special considerations are there for filler metals or base metals?
- What is the reference for removal (location) of supplemental Charpy V-Notch (CVN) test specimens?

Personnel qualification and certification required for fracture critical applications

- What are the personnel requirements within the governing documents?
- Are specific CWI/SCWI endorsements required for fracture critical?

The inspector should note that the relevant section in D1.5M/D1.5 regarding the special requirements for FCM is section 12, AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members. This approach to identifying fracture critical members and weldments focuses on the requirement for an FCP, which will be used whenever the engineer of record identifies structural members as fracture critical. Bridge structures that do not contain fracture critical members rely on the content of all sections of D1.5M/D1.5, except section 12.

In addition to AWS D1.5M/D1.5, standards such as AASHTO's Manual for Bridge Evaluation (MBE), National Bridge Inspection Standards (NBIS), the Federal Highway Administration (FHWA) manuals, and AASHTO Bridge Design Specifications (LRFD) all have information the inspector will need when going into a bridge project where the engineer has identified a FCM. Furthermore, any company wishing to perform construction or fabrication of bridges with FCMs must be certified under the American Institute of Steel Construction (AISC) Quality Certification Program, Category III, Major Steel Bridges with Fracture Critical Rating.

Identifying the Presence of FCMs

Identifying the presence of FCMs must begin during the prebid phase to alert all bidders of the need to include requirements contained in section 12 of D1.5M/D1.5. This addition to the scope of the project has a significant impact on the value of fabrication contracts. Additionally, the presence of FCMs and fracture critical welds requires that the list of contractors be restricted to those with specific experience in fabricating steel with FCMs, as defined by the engineer.

The FCP referenced earlier contains the requirements of section 12 of AASHTO/AWS D1.5M/D1.5 and those additional requirements specified by the engineer of record. The FCP is a document clearly spelling out for both production and quality personnel the requirements that will apply to that specific project and that have been reviewed and approved by the engineer. Because different engineers of record may supplement Section 12 differently, it should be expected that some differences will occur between projects. The inspector must be familiar with the requirements of the FCP as it applies to the project at hand.

FCMs require mill orders of base metals to be manufactured of killed carbon steel and fine-grain base metals normalized, quenched, and tempered as specified with accompanying CVN results at the temperature specified by the engineer, all of which must be included in the contract documents. These requirements are typically specified for orders for structural shapes large enough to consume an entire heat (ladle) at a steel mill, finished and tested to the buyer's specifications, and used to fill only that order. Finding small quantities or partial heats meeting these special requirements and documentation would be very difficult for purchasing and inspection, as noncritical structural shapes are rarely manufactured, tested, and accompanied by this level of documentation. Regardless of whether they're from a mill order or a smaller quantity, all base metal surfaces and edges must be inspected for discontinuities upon arrival at the fabricator or construction site.

Welding Processes and Consumables

According to subsection 12.5, Welding Processes, the following processes listed in 12.5.1 may be used to construct or repair FCMs: shielded metal arc welding (SMAW), submerged arc welding (SAW), flux cored arc welding (FCAW), and gas metal arc welding (GMAW) with metal cored electrodes. Conversely, in 12.5.2, Prohibited Processes and Procedure Restrictions, electroslag welding (ESW) and electrogas welding (EGW) are prohibited for welding FCMs. When GMAW is used (except as allowed in 12.5.1), qualification tests, procedure control, and nondestructive examination (NDE) shall be as specified by the engineer. Subsection 12.5.3, Preferred Processes and Procedures, further stipulates that the engineer may designate specific processes or process controls for specific bridge welds. All special provisions shall be specified in the contract documents. Other restrictions, if any, on the use of welding processes or procedures shall be described in the contract documents.

Prequalified Welding Procedures are allowed to be used for welds in FCMs but only for SMAW using E7016, E7018, E7018-1, and E8018-X electrodes, including those with the C alloy and M classification as well as the R supplemental designator. All other groove weld WPSs using approved welding processes

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Metal Fabricator Eliminates Pallet Wrapping Bottleneck with Automated Orbital Wrapper

Metal fabrication company Penn Sheet Metal, Allentown, Pennsylvania, has cut the time required to stretch wrap its pallet loads of architectural and roofing components and custom decorative building products from an average of 15 minutes per load to 60 seconds or less by replacing manual stretch-wrapping with the automated TAB Wrapper Tornado orbital wrapping machine. Releasing a bottleneck in the packaging department that threatened the company's stellar lead times, the TAB Wrapper Tornado automatically wraps stretch wrap 360 degrees around and under the pallet and load while it is raised on a forklift to create a secure, unitized load without banding or boxes. The orbital wrapper safely encases the full length of the fabricator's custom 10- and 16-foot long pallets required for many of the elongated metal parts.

Speeding production while reducing the number of workers involved in the wrapping process from two or three to just one worker, the orbital wrapper saves an average of 2-1/2 hours per day or more than 78 full, eight-hour workdays per year, according to Mike Roeder, president of Penn Sheet Metal. "We were wasting so much time wrapping pallets by hand until I'd finally had enough," says Roeder. "Now we're getting a much better, more secure wrap every time, even on our longest skids and it wouldn't even be possible to wrap them by hand - I just love this machine!"

The orbital wrapping machine is designed and manufactured

by TAB Industries, Reading, Pennsylvania. TAB offers a range of automated and semi-automated orbital wrappers in several sizes to suit nearly any pallet wrapping requirements.

See the orbital wrapper at booth #A-5142; TAB Industries, LLC, 2525 N. 12th Street, Reading PA 19605; 610-921-0012; info@tabwrapper.com or see **www.tabwrapper.com.** ■

The Role of the CWI or SCWI in Fracture Critical Applications

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(SAW, FCAW, and GMAW) require testing — including CVN — to have been generated within a year of the start of production welding of FCMs.

Filler metals and fluxes used in FCMs, except for SMAW electrodes, are required to be tested and documented for diffusible hydrogen to meet optional designator H4, H8, or H16 (for ≤ 50 ksi – 345 MPa) or designator H4 or H8 (for ≥ 50 ksi – 345 MPa). Handling, storage, and drying of filler metals generally follow the manufacturer's recommendations; however, these may be modified by the engineer.

According to 6.1.3.2, Heat or Lot Testing, all welding consumables shall be heat or lot tested by the manufacturer to determine conformance with the applicable AWS A5.XX specification. The engineer must also be given certified copies of the test results. The heat and lot information shall be as defined in the latest edition of AWS A5.01, Welding and Brazing Consumables — Procurement of Filler Metals and Fluxes. The consumables shall also be tested by welding as specified in the appropriate AWS filler metal specifications. All tests required by AWS A5.01, Schedule J, shall be performed and reported. Also specified by 6.1.3.2, materials of the same specification, classification, brand, product trade name, and manufacturer (but not necessarily the same heat or lot) to be combined during production welding shall be used for heat and lot testing.

Additional consumable requirements are given in 6.1.3.1, Consumable Manufacturer Quality Assurance Program, which states: "Welding consumables shall be produced under continuing quality assurance programs audited and approved by one or more of the following agencies: (1) American Bureau of Shipping (ABS), (2) Lloyd's Register of Shipping, and (3) American Society of Mechanical Engineers (ASME)."

Examination and Quality

Quality functions are shared by the engineer and the contractor's or fabricator's inspector. The engineer is responsible for quality assurance (QA), and the inspector is responsible for quality control (QC). The engineer may contract for QA surveillance and audits; however, the final responsibility for the quality of the finished product rests with the contractor or fabricator. The FCP includes a designation for lead inspectors, who are required to have a minimum of three years of experience specifically in steel bridge construction or fabrication in addition to being a current or former AWS CWI, or an engineer or technician acceptable to the engineer of record (AWS D1.5M/D1.5, sections 8.1.3, Inspection Personnel Qualification, and 12.16.1.1, Inspectors). This lead inspector has the final determination for the acceptability of FCMs and welds associated with FCMs.

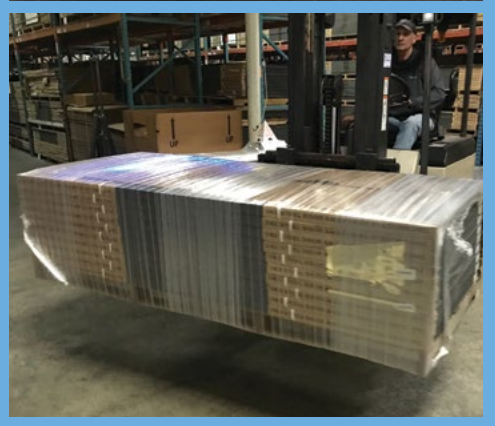
The lead inspector must ensure that any NDE technicians assigned to test FCMs are currently certified Level II or III in the appropriate method per the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1A. The engineer may accept alternative qualifications for NDE personnel that are deemed equivalent. One of the many unique requirements contained within section 8 of AWS D1.5M/D1.5 is that radiographic examination of welds in FCMs must use hole-type penetrameter (IQI) to capture the quality-level hole size specified in the contract. Wire-type IQI is not allowed for this application. This, and

continued on page 21

TAB Wrap It!

Booth #A-5142

At Monti, Inc.



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EGB 6013 ARce
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AMADA is committed to treating the global environment with utmost respect by actively reducing CO_2 emissions, promoting waste reduction and reuse, and safeguarding biodiversity throughout all our processes. At FABTECH 2023, AMADA will showcase how fabricators can achieve unprecedented levels of automated productivity while placing a strong emphasis on environmental sustainability. Attendees will have the opportunity to witness the North American debut of two automated robotic bending systems equipped with Automatic Tool Changers. The event will also highlight the remarkable advantages of AMTES (Autonomous Mobile Transport Engineering System), enabling fully automated blank-to-bend processing and tracking. Additionally, demonstrations will feature new machines incorporating AMADA's latest generation 4ie control *(easy, efficient, environmentally-friendly, evolutionary)*.

EGB 1303 ARse
Robotic Bending System

North American DEBUT

EGB 1303 ARse Robotic Bending System — New electric press brake fully automated, including robotic part handling with auto tool change, to move from part to-part unattended.

North American DEBUT

EGB 6013 ARce Robotic Bending System — New high-speed fully automated electric brake used for small parts. Unattended robotic bending system with auto tool change.

EGB 6020 ATCe Press Brake — High-speed electric Auto-Tool-Change press brake for precise processing of high-mix, low-volume production parts.

REGIUS 3015 AJ (12kW) with Automation and Part Sorting — High-speed, 3-axis linear drive system combined with Variable Beam Control Technology and packed with features to support autonomous operation. Full automation combined with AMTES provides highly-efficient unattended processing, part sorting and tracking.

VENTIS 3015 AJ (6kW) Fiber Laser — Innovative beam control technology creates higher quality cutting by improving surface quality and reducing dross.

HRB 1003 ATC Press Brake w/ Automatic Tool Changer — U.S. manufactured press brake with Automatic Tool Changer, offers great cost-to-performance value. Uses HRB ATC tooling manufactured in the U.S.

BREVIS 1212 AJ (3kW) Compact Fiber Laser — Compact stand-alone 3kW Fiber laser for smaller parts up to 4' x 4'. Equipped with a Rotary Index.

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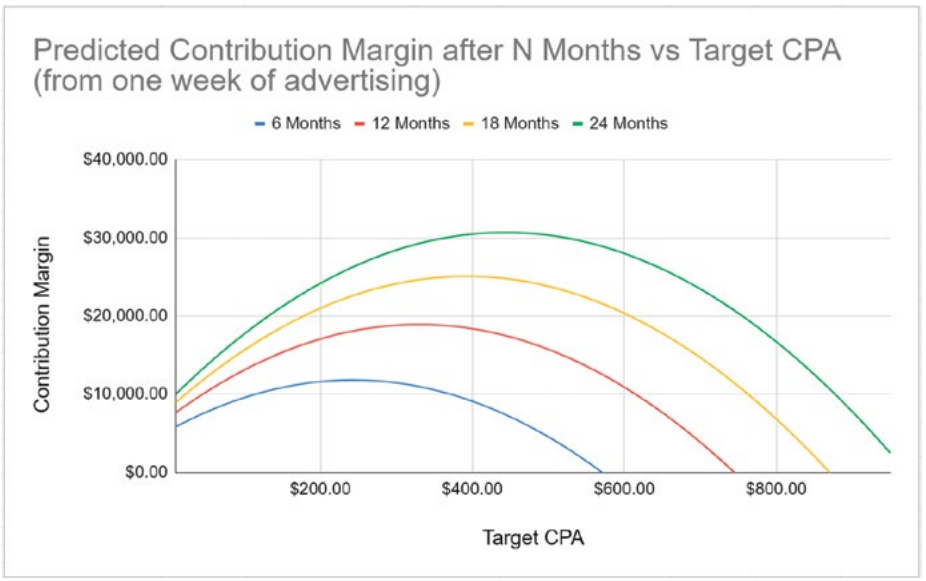

FIGURE 3 Tying an acquisition cost model to a customer value model allows contribution margin to be predicted based on a target CPA.

the highest predicted contribution margin attributable to a single week of ads. The longer you can wait to earn back ad spend with repeat volume, the more you can spend to acquire a customer. As a reminder, this example analysis is for a single campaign on Google Ads, and it reflects what the predicted outcome will be for a given target CPA setting in that campaign.

If the goal is to maximize profit in a period, you'd aim for a target CPA that hits the peak of the curve. In this example, if the goal is to be most profitable at six months, then the target CPA should be set to $243. On the higher end, if the goal is to be most profitable at 24 months, then the target should be set to $443.

On the other hand, if the goal is to grow as quickly as possible and break even on ad costs in a period (to result in even higher profits later), you'd set your target acquisition cost much higher, to where the gross profit curve crosses zero. If the goal is to break even at six months, then the target CPA would be set to $570. If the goal is to break even at 12 months, then the target would be $750.

It boils down to a tradeoff between rapid growth and cash flow. Maximizing long-term profit might mean spending more now at a short-term loss, with the understanding that your repeat customers will generate far more value over time.

Not a Crystal Ball

These models aren't necessarily predictive. Market conditions will change to make models like this obsolete over time. It's important to experiment so that models can be corrected and optimized. We call that "exercising the model." Even if ads are performing well, we "wiggle" spend settings up and down as often as weekly so that we can ensure that each campaign is performing as expected. If circumstances change, sometimes more dramatic campaign changes are needed so that new models can be created.

We've had well-behaved campaigns change basically overnight, where a nice affine curve like that in Figure 2 suddenly flatlined. We'd get the same mediocre results regardless of what we spent. We still don't know why that happened, but it was a trigger to retire the campaign and move our dollars elsewhere.

Also note that in manufacturing, where inside sales may carry a contract across the finish line, a digital ad "conversion" might simply represent a lead. To close the loop on the value of digital ads, you'll need to understand your lead to order conversion rate and build that into the models.

The Tip of the Iceberg

The model I just described barely scratches the surface. Different ad platforms are set up and behave in different ways, so models must be built for each one. Data collection and attribution can also be tricky, especially when customers touch multiple campaigns across platforms during the acquisition journey.

Regardless, with rich data and incredible analysis tools at our fingertips, we definitely should know whether our ads are making money, how much, and when. Using mathematical models and deliberate experimentation enables ad campaigns that not only work but also produce predictable results that can be optimized with confidence. The practice takes much of the mystery and frustration out of advertising, with incredible results for both growth and profitability. You shouldn't settle for anything less. ■

Caleb Chamberlain is CEO and co-founder of Orem, Utah-based OSH Cut, www.oshcut.com.

Save Time, Money and Weight with Tailored Parts

By Daniel Schaeffler, president, EQS Group, Published in the April 2023 issue of *MetalForming* magazine

Assembled products often contain features that do not contribute to their functionality but exist solely to assist with the manufacturing process. One example: the flanges used for joining adjacent parts. While the flanges add to the material purchase price and weight, typical design approaches require them to facilitate assembly, while ensuring that the part has targeted performance characteristics in different areas. Introducing the joining step earlier in the manufacturing sequence offers significant benefits, at least for certain product designs.

Another constraint in current design approaches: limiting sheet metal selection only to monolithic blanks—one grade, one thickness and one coating for an entire part. There are no constraints on the shape, so the blank can have straight sides or a developed perimeter. Depending on this shape, significant engineered scrap may result from the chosen nesting pattern.

Moving beyond monolithic blanks to tailored blanks adds new flexibility for body-structure engineers, allowing them to design subassemblies with the targeted strength, coating, thickness and deformation behavior in separate sections of the part.

Rationale for Tailored Parts

The earliest tailored parts came from laser welded tailored blanks (LWTB, also referred to as laser welded blanks or tailor welded blanks) — created by welding two or more sub-blanks together. Each sub-blank can differ in thickness, strength and coating.

A tailored part allocates the required material strength and thickness only where it's required in the subassembly. In contrast, conventional design approaches to address areas needing additional thickness — for stiffness or crash performance — entail stamping a primary part as well as a smaller reinforcement and then joining them together, usually with spot welds or rivets. Following this conventional approach requires manufacturers to have the resources, infrastructure and personnel to stamp at least twice as many parts, transport and hold the work-in-process inventory, and then join the parts. Further, joining two stamped parts worsens tolerance-stackup issues related to geometric dimensioning and tolerancing. In contrast, using tailored parts will result in part consolidation, improving material utilization, reducing scrap, and requiring fewer plant resources and less labor.

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Top Tips from Successful Women in Manufacturing

continued from page 1

Those early years were far from easy. Her first priority was to make the company financially sound. Using the knowledge she learned from the corporate world, she set about adding sound financial, accounting and business principals to a firm operating in the metal stamping world.

"When I came on in 2003, we were up to our eyeballs in debt," said Habe. "Those were some tough years and then we went into the recession of 2008. We are now debt free and have been nimble enough to acquire another company without adding more debt."

Such turnarounds highlight the role women can play in adding their skills and drive to the workplace. Habe says there is never a dull moment in the industry. There is always some hill to climb or problem to overcome.

A couple of years ago, for example, one of her biggest challenges was when her controller unexpectedly died. Losing the person in charge of finances would be bad enough. But like many small businesses, he had another duty – IT.

"We had just been hacked when he died the week before Christmas," said Habe. "Key people were willing to step up and help but it has been a long process to get back to where I finally feel comfortable."

That taught her the value of persistence and surrounding yourself with good men and women who care about the business and want it to succeed. She is an advocate for a more diverse workplace. All genders and races can add their unique perspectives to the working environment for the overall benefit of the business.

Her advice to women wanting to enhance their careers in the industry or to women considering a manufacturing career? "Although it is still a male dominated industry, don't dismiss manufacturing as there is a seat at the table in a rewarding field," said Habe. "Companies only get stronger when we have different thoughts and ideas."

Women in Welding

Established in 1992, Superior Joining Technologies, Inc is a women-owned business specializing in precision welding. It does micro-TIG welding, micro-laser welding, laser beam welding, 3D multi-axis laser cutting, CNC machining, Nadcap accredited non-destructive testing, CMM services, and more. It has a large aerospace presence with original equipment on 17 commercial airplanes and all space programs. It conducts research and development and helps the industry pioneer new solutions with evolving materials and processes used. In-house skillsets include laser-joining techniques, 5-axis machining, and non-destructive testing.

Panel moderator, Teresa Beach-Shelow, Owner of Superior Joining Technologies, founded the company with her husband Thom Shelow in their garage. It now occupies a 55,000-sq-ft. facility in Machesney Park, Illinois. A major part of that growth came many years ago when Teresa realized lasers were likely to be the next big advancement in manufacturing. Micro-welding applications soon became a mainstay of the company. The company now has five lasers in-house, ranging from a micro-yttrium aluminum garnet (micro-YAG) laser for welding to a multi-axis CO^2 5 kW laser for cutting and welding.

Teresa is a firm advocate for women in the workplace. "The collaboration of men and women, experienced workers and new employees, is a game changer," she said. "I encourage women to be active and participate and I look forward to the day when gender isn't an issue."

To help other women gain a foothold in the industry, she joined several manufacturing associations such as Women in Manufacturing (WiM) and supports local STEM events. She co-founded Women of Today's Manufacturing, an organization that raises scholarship funds for students to further their education in STEM-related fields. Additionally, she created Manufacturing Camp, a one-week camp for teens, as well as camp scholarships. Her effort reached more than 100 regional students. This grew into a nationwide project with nearly a dozen camps every summer when the Foundation of the FMA brought the effort under its wings. Now called "Nuts, Bolts and Thingamajigs," it has influenced nearly 4000 youths in 27 states.

Beach-Shelow noted how women can often complement the skillsets of the men around them. In her case, her background in finance and business dovetailed perfectly with her husband's extensive welding and laser expertise. Together, they formed a powerful team that generated a level of expansion that neither could have achieved individually.

"I encourage women to enter the manufacturing industry for the opportunities that are available, from the shop floor to upper management," said Beach-Shelow. "Wage gaps are shrinking, and women are becoming more visible within the industry in higher management roles and ownership positions."

Believe in Yourself

Matheson, a U.S. producer of industrial gases like argon, oxygen, and nitrogen, has hundreds of stores where people buy gas, welding wire, or anything else they need for welding. Additionally, it supports manufacturers with delivery trucks, bulk and microbulk gases, vending solutions and technical expertise. It certifies its outside sales representatives as AWS Certified Welding Sales Representatives.

Karen Gilgenbach, Zone Vice President, Matheson, followed her father into the engineering field. In school, though, she realized that being behind the computer was not her preference, so she gravitated to roles that balance computer work with being hands-on and being in front of people.

"From the start, I knew that if I got my Certified Welding Inspector credential from the AWS that people would know my goal was to be a technical resource for end users," she said. "As soon as I added 'CWI' to my card after my name, the dynamics in discussions with customers and end users changed. It was one of the most impactful things I did in my entire career."

In 2007, she became Co-Chair of the National Robotic Arc Welding Conference at 26 years of age. She credits her fellow Co-Chairs as mentors who were willing to help the next generation see their own potential. She encourages other women in the industry to take on mentoring roles. Here advice to women entering the field?

"Even when things seem difficult or risky, believe in yourself or no one else will," said Gilgenbach. "Be willing to accept that failure can be the price of admission – you won't succeed at everything you ever attempt but if you attempt to follow your dreams you will win at enough to be really rewarded for the effort." ■

Leadership Exchange — Building the Future Workforce

continued from page 5

development. She is acutely aware of the problem posed to the industry due to the lack of skilled workers. As baby-boomers move on and younger workers move up in the workforce, we are lacking people with trade skills. The situation is worsened as there is a shortage of new blood with the desire to learn those vital skills. She believes the key is training. Engage with unskilled workers and find ways to help them gain new skills that will provide them with a more fruitful and fulfilling career.

She advises companies to help unskilled employees and potential employees by partnering with organizations, such as the PMA and its training resources METALFORM EDU and technical seminars, as well as its industry-recognized Smart Standards/ credentialing organization, NIMS, that can assist manufacturers in developing and sustaining best practices on training and retention.

"Often, companies know they need training but have little to no idea how to execute and sustain an effective training process," said King. "Poor or no training leads to low morale, lower performance, lack of productivity, increased stress, and high turnover."

Learning and maintaining training best practices, she added, can help overcome the short-term skills gap and improve retention. It's one of the best investments a company can make.

For our future talent pipeline, King believes companies need to actively promote the value of manufacturing and improve our image. The younger generation sometimes view it negatively based on a view on how it was many decades ago.

"The good news is that we have changed and it's time to let everyone know," said King. "Connect with your community, local school districts, job centers, and underserved demographics to build your next generation of workers."

Another tip: Use your associations. For example, PMA has 17 member-concentrated districts in North America and one of their functions is to help connect member companies to their communities. Another way to reach future workers is through organizations such as Edge Factor that use a range of workable methods to help with such initiatives.

"I also recommend learning the general interests of each generation and work to meet their needs (is it more flexible hours, better benefits, promoting good deeds or social awareness?)" said King. "Sharing values will help attract a more diverse group of employees who are happy in your company." ■

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Conference-at-a-Glance

Wednesday, September 13

TECHNOLOGY	8:00 AM	10:00 AM	12:00 PM	2:00 PM
3D/ADDITIVE MANUFACTURING	NEW! F18: Serious About Selling AM Parts? - What You Need to Know About Metrology and GD&T **Room S502A**		NEW! F101: Smart Simulation & Portable Factories for Additive Manufacturing **Room S502A**	
AUTOMATION	NEW! F28: Small Manufacturers Can Overcome Custom Automation Challenges **Room S404BC**	NEW! F29: Steel Detailing Software for Equipment Investment **Room S404BC**	NEW! F201: Empower & Adapt Using the Cloud Platform to Increase Capacity and Support Remote Work **Room S404BC**	NEW! F202: Automation Structural Framing or Cabinetless System **Room S404BC**
CUTTING	F38: The Most Versatile Machine Tool with Endless Applications **Room S501D**	NEW! F39: Upgrading a Qualified Cutting System & Understanding Your Cutting Gas Purity **Room S501D**	F301: 3D Waterjet Cutting: The Next Dimension **Room S501D**	NEW! F302: Cutting Solutions: Plasma Using IoT & Automation **Room S501D**
FINISHING	NEW! C18: Maximize Your Powder Coating Performance **Room S253B**	NEW! C19: Come On, Do the Automation **Room S253B**		NEW! C102: Get Immersed in Ecoat **Room S253B**
	C28: Let's Have a Blast...Cleaning **Room S253C**	C29: Innovations in Cleaning Methods **Room S253C**		NEW! C202: R.O.I. Drives Profit in Finishing **Room S253C**
	NEW! C38: Drive Profit and Performance in Your Job Shop Through Digitization, Automation, and Optimization **Room S253D**	NEW! C39: Automation Options for Your Powder Line **Room S253D**		C302: Minimizing Energy and Water Usage with New Technologies in Paint Finishing Systems **Room S253D**
FORMING & FABRICATING	F48: Roll Forming: Advanced Techniques and Design **Room S403A**	F49: Addressing Modern Day Materials in Roll Forming Processes **Room S403A**	NEW! F401: Fabricating Directly From the Design Model: Connecting CAD & BIM to Fabrication Shop Machinery **Room S403A**	NEW! F402: Energy Saving Technologies and Digitalization in Industrial Air Filtration **Room S403A**
	NEW! F58: Specialty Tube & Pipe Processes **Room S403B**	NEW! F59: Fabrication Shop Floor Tools to Track Productivity & Tooling Management Systems **Room S403B**	NEW! F501: Sourcing Material & Modern Supply Chain Strategies **Room S403B**	NEW! F502: Understanding the Software for Sheet Metal Fabrication Machines **Room S403B**
JOB SHOP	NEW! F68: Leveraging Your ERP System: Don't Get Left Behind **Room S404D**	NEW! F69: Developing Your Manufacturing Departmental Leadership for Maximum Productivity **Room S404D**	F601: How to Maximize Productivity and Effectiveness of Your Current Employees **Room S404D**	F602: Build a Competitive Advantage: Government Incentives and R&D Tax Credits **Room S404D**
LASER	NEW! F78: New Laser Welding Techniques **Room S502B**	F79: How to be Successful in Your Laser Welding Applications **Room S502B**	FW4: Industrial Laser Workshop for Fabrication (12:00 - 4:30 PM) **Room S502B**	
MANAGEMENT	NEW! F98: Black Swans Among Us - Preparing for Future Disruptions **Room S402B**	F99: Unseen Risks that Drive Up Operational Costs and Drive Down Profits & How to Recover **Room S402B**	NEW! F901: Manufacturing Project Management: Strategies for Success **Room S402B**	NEW! F902: Leading with a Servant Mentality & Navigating Changes with Positivity **Room S402B**
MARKETING & SALES	F118: Inbound Marketing 101 for Industrial Companies **Room S404A**	F119: Marketing Doesn't Have to Suck: How to Make the Most of Your Marketing Without a Big Team **Room S404A**	NEW! F231: Double Your Quote Requests in 30 Days with Conversational Marketing **Room S404A**	NEW! F232: AI-Powered Marketing Automation: Start Building a Strategy **Room S404A**
ROBOTICS	NEW! F128: What's New in Robotic Weld Technology & Preparing for Your First Robotic Weld System **Room S401D**	NEW! F129: Benefits of Robotic Automation Systems & ASTM Standards **Room S401D**	F221: How to Hire and Manage a Robotic Workforce: (RaaS) **Room S401D**	NEW! F222: Technology & Approaches to Optimize Robotic Systems **Room S401D**
SMART MANUFACTURING	F138: How to See into the Future with Data and Leverage for Predictive Planning **Room S402A**	NEW! F139: Cyber Attack & Ransomware; Protect Your Organization from Exposure & Risk **Room S402A**	FW5: Getting Started with Smart Manufacturing Workshop (12:00 - 5:00 PM) **Room S402A**	
STAMPING		S19: Metal Stamping Press Maintenance Best Practices **Room S501A**	S101: Reducing Die Repair Costs and Optimizing Die Maintenance Programs **Room S501A**	S102: Cost Effective Die Improvements to Ease In-Press Maintenance **Room S501A**
	S28: Creating Operational Excellence in the Press Shop **Room S501BC**	NEW! S29: Intelligent Metalforming **Room S501BC**	NEW! S201: Stamping Optimization **Room S501BC**	
WORKFORCE DEVELOPMENT	F148: Onboarding Strategies that Set New Team Members Up for Success **Room S401BC**	NEW! F149: Breaking the 7 Habits of Negativity & Relationship Building for Sustaining a Positive Workplace **Room S401BC**	F421: Thank You Very Much! Gratitude Strategies to Create a Workplace Culture that ROCKS! **Room S401BC**	NEW! F422: Skills for Success Model & Teaching the Next Generation About the Trades **Room S401BC**

WELDING	W8: New and Improved Welding Symbols and Applications of AWS A2.4! **Room N230AB**	8:00 AM – 2:00 PM
	W9: The Power of Fusion: Building a Workplace Culture That Keeps Your Best Welders from Becoming Someone Else's **Room N227B**	2:30 PM – 4:00 PM
	W10: The Following Codes Will Be Discussed With Emphasis On WPS Development and Qualification and Prequalification: D1.1 Structural Welding Code - Steel and D1.2 Structural Welding Code Aluminum **Room N231**	10:00 AM – 12:00 PM
	W11: Professional Program - Day 3 **Rooms N138-N140**	8:00 AM - 5:00 PM

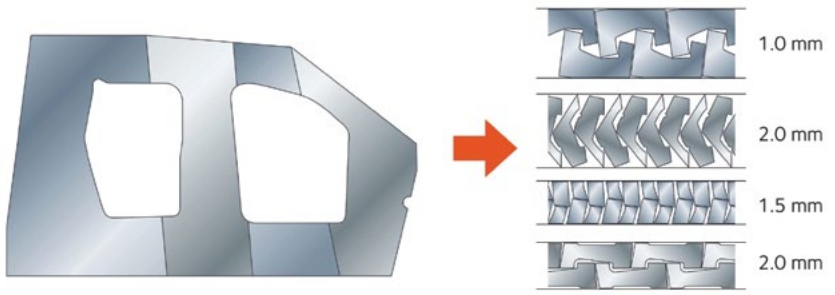
Schedule subject to change. Detailed Conference Program session descriptions, speakers, pricing, room locations and more can be found at **fabtechexpo.com/conference**.

Basic Intermediate Advanced

Save Time, Money and Weight with Tailored Parts

continued from page 15

Build quality also should improve. Joining formed parts, each with their own springback and tolerances, is more challenging than joining flat blanks first and then stamping the tailored blank. Also expect improved product performance due to continuous sections rather than relying on fastened joints to transfer loads. Eliminating spot welds or rivets also can reduce noise, vibration and harshness. A continuous weld line used to fabricate tailored products means a more efficient load path and improved dimensional integrity.



A welded blank, such as the one shown here from an ArcelorMittal tailored-blanks catalog, places strength, thickness and corrosion protection only where the propertiesare needed.

Material Utilization

Improvements in material utilization may be the strongest factor promoting the use of tailored parts in engineered components. Some parts (such as the door opening panel shown in the accompanying figure) have large cutouts destined to become engineered scrap. For parts such as these, structural requirements necessitate using numerous reinforcements, or making the part from a blank as thick as the thickest section.

In the case of the door opening panel shown, the rocker area closest to the road is at risk of exposure to road salt, and as such body structures must use galvanized steel throughout the entire blank, even though the roof line has minimal risk of corrosion. Converting this part to a LWTB allows for optimized nesting of the individual components, with material strength, thickness and corrosion protection deployed only where the end product benefits from those characteristics.

In addition, reduced width requirements of the sub-blanks can allow stampers to select from a larger array of material suppliers or to use master coils yielding slit mults. At the other extreme, blank dimensions larger than rolling-mill capabilities become feasible, allowing, for example, the stamping of inner side panels of tall SUVs and cargo vans.

Types of Tailored Parts

LWTBs represent just one type of parts where designers can specify

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The Role of the CWI or SCWI in Fracture Critical Applications

continued from page 10

many more such special requirements, is found throughout section 8 and explains the challenges to inspectors ensuring that all requirements are met every time FCMs are identified.

Conclusion

Even with a high-level review of requirements outlined in section 12 of AASHTO/AWS D1.5M/D1.5, inspectors seeking to expand their work experience into infrastructure — specifically bridge construction and fabrication — will be faced with a large volume of knowledge to master. The three year experience requirement for a lead inspector can be met by working on bridge fabrication under the supervision of a lead inspector. Once the experience requirement is met and documented by the employer, the inspector can then consider a lead inspector role.

For current CWIs interested in bridge inspection, the authors recommend a code review course focusing on AASHTO/AWS D1.5M/D1.5 and the NBIS for a thorough understanding of the requirements for materials, procedures, as well as the roles and responsibilities of all personnel involved in bridge design, fabrication, and construction.

For new applicants to the AWS CWI program, we highly recommend certification with AASHTO/AWS D1.5M/D1.5 (current edition) as the code of choice. ■

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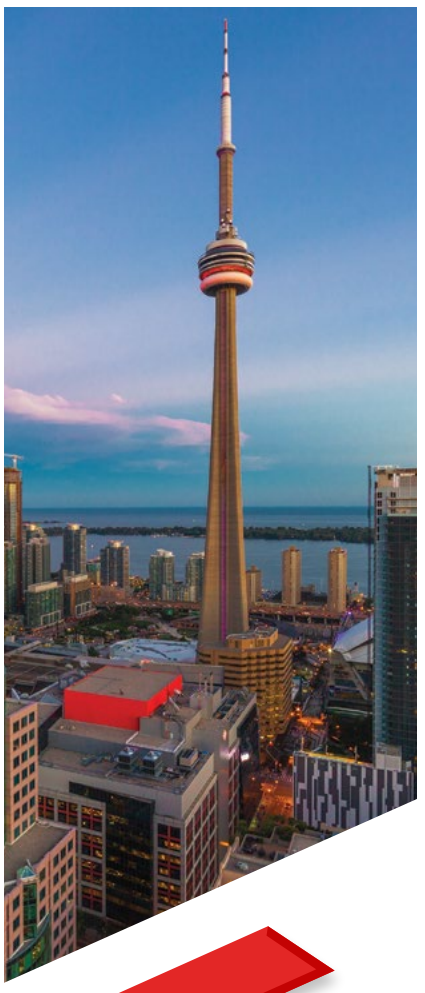

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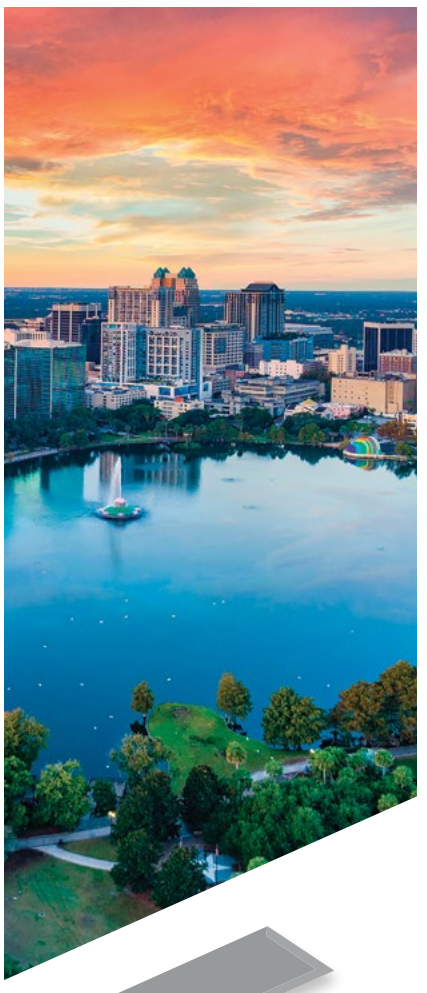

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Save Time, Money and Weight with Tailored Parts

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material strength, thickness and corrosion protection where these properties are most needed for part function, and remove weight that does not contribute to part performance. Other tailored parts include patchwork blanks, tailor welded and tailor rolled coils, tailor rolled tubes (TRTs) and tailor welded tubes (TWTs). Each of these can be cold formed, and when appropriately designed, may be hot formed as well.

Patchwork blanks consist of a smaller patch blank spot welded to a main blank underneath; the two components may differ in strength and thickness. The spot welds hold the blanks together to prevent shifting during forming operations. One reason to deploy a patchwork blank rather than a LWTB: if the reinforcement is located within the boundaries of the main blank.

Butt welding at the sub-blank edges creates a LWTB; similarly, welds can join entire coils together edge-to-edge, creating tailor welded coils. The new strip either is directly blanked, or recoiled for future blanking or for use as feedstock for continuous coil-fed operations such as progressive-die and transfer-press stamping, and rollforming. Variations in strength, thickness and coating occur across the coil width.

Another option: tailor rolled coils (TRCs), which feature variable thickness and strength down the length of the coil rather than across its width. The gap between rolls in traditional sheet rolling mills decreases in sequential stands to produce progressively thinner sheets. Each roll stand contains structurally supported components to ensure the most uniform thickness possible. In contrast, when producing TRCs, the gap between the rolls used for thickness reduction is intentionally varied smaller and larger in a controlled sequence, allowing for different strip thicknesses in the direction of rolling. TRCs usually require annealing after rolling due to the high degree of cold work. Controlling the amount of thickness reduction in certain areas may allow for local strengthening in the thinner regions after annealing.

TRCs are the feedstock used to produce tailor rolled blanks and variable-thickness TRTs, or as the feedstock for a rollforming line. In the case of TRTs, properties and thickness vary down the length of tube but are consistent radially.

Conventional welded-tube production starts with rollforming monolithic strips to the desired shape and welding the free ends together to create a closed section. The TWT production process allows the designer to create complex variations in shape, thickness, strength and coating as a function of the starting LWTB. These tubes can be hydroformed to further expand design options. ■

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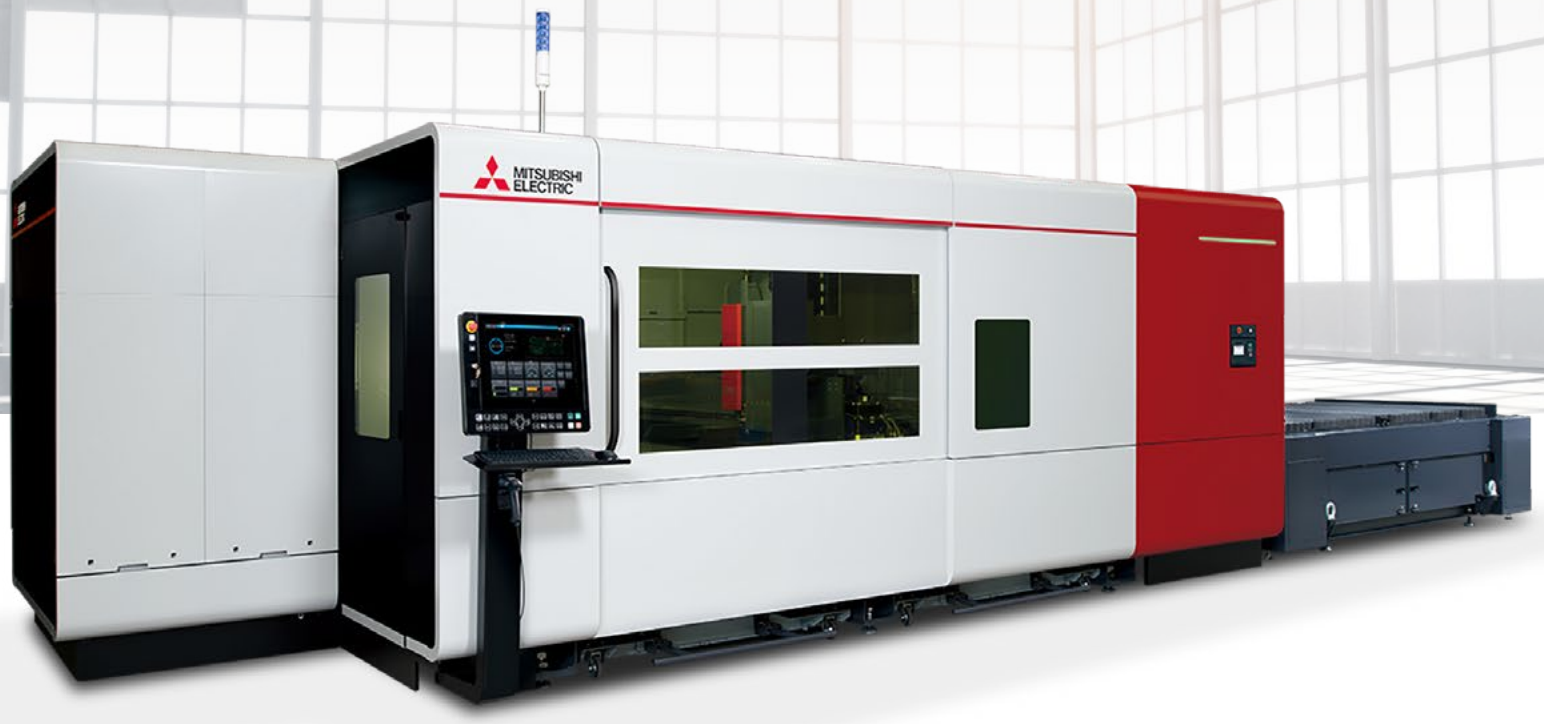

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