CWA Skills Summit

Promoting safety, welder education and the trade itself has been the backbone of the Canadian Welding Association (CWA) since the mid-1920s.

Over the years there have been great advancements on many fronts. One way to further our cause is to constantly engage all stakeholders and educate them on the importance of welding.

Just recently, The Honourable Lisa Raitt, Canada’s Labour Minister and the Honourable Tony Clement, President of the Treasury Board and Minister responsible for FedNor, met with members of the Canadian Welding Association to discuss occupational health and safety and employment equity.

During the Skills Summit, hosted by CWA, it provided a great opportunity for the organization to emphasis the welding industry’s contribution to the Canadian economy, and how significant a uniform educational program is for the future progression of the trade.

By having both ministers tour the facility and take the time to hear our voice, it strongly highlights the CWA’s commitment to the Canadian welding industry and its members who have been supporting us for all these years.

Not only did the ministers listen to the changes ongoing in the industry, they also received a crash course in welding when they used the virtual welding simulator, and realized first-hand how technical welding really is. Having said that, minister Raitt did score higher than minister Clement.

Although it was a progressive day filled with encouraging dialogue and another avenue for the CWA to advocate on behalf of the trade, members and the thousands who wake up every morning plying their trade, our commitment to all of you still remains as strong as the welds fusing together a vast array of infrastructure projects that millions of Canadians enjoy and utilize on a daily basis.

Contribute

Like what you see in engage so far? Then help us by:

- Sharing your copy with others
- Contributing ideas, stories, pictures and comments (i.e. the last word section)
- Sending us your comments, concerns and questions

An association is only as good as the members in it, and engage is only as good as the members who contribute to it. Help us grow both by contributing. Drop us a line at: marketing@cwbgroup.org

We look forward to hearing from you soon!
ALLOY CHECK LIST

- Low Alloy
- Stainless Steel
- Nickel Alloy
- Maintenance & Repair

When looking for alloy welding consumables, Lincoln checks all the boxes. With 118 years experience manufacturing welding consumables, Lincoln Electric has become the world’s leader in the manufacturing of Stainless, Nickels, and High Alloy consumables.

These products are available off the shelf from our Toronto, and Calgary locations with all applicable approvals and certifications such as: MIL, AWS, CWB, Lloyds, DNV, TUV & ABS.
Lincoln Electric Company is a world leader in “the design, development, and manufacture” of equipment, robotics and welding filler metals. Now in our 118th year Lincoln continues to bring forth new ideas, technology, and products groups through innovation, internal development and acquisitions.

Our core business has always been welding equipment, and carbon Filler metals, an area in which we have excelled and are the market leaders. However during the past few years Lincoln has moved into the world of Alloys. This has come about by improving, streamlining and expanding our existing operations, and acquisitions of company’s engaged in the development and manufacture of Low alloys, Stainless steels (including Duplex and Super Duplex), Nickel alloys and Cobalt and nickel based hard-facing and wear resisting alloys.

The alloy market in Canada is growing at a phenomenal rate, with oil prices and exploration at an all-time high. Oil companies are moving quickly to take advantage of this surge by releasing major development, and exploration projects related to the oil and gas sector. These projects range from upgrades to refineries, building of separation plants, to off shore oil and gas exploration.

The environment remains the single most important consideration in all our development and construction plans. Cleaner oil extraction through new processes plus using higher grade alloys to increase the life of the existing and new lines, are some of the efforts being made by the engineering and drilling company’s.

Lincoln stands is in the forefront developing products and technologies to support the high alloy industry. Our group of alloy company’s specialize in all the segments that require high integrity products.

Techalloy: Expertise and proficiency in Nickel and stainless steels.

Nickel alloys are often used in severe service conditions where extreme heat, corrosion, abrasion, high pressure or a combination of these conditions are present.

Techalloy also offers a wide variety of stainless grades for all application that require high quality stainless wire. Techalloy also produces Chromium-Nickel 300 series austenitic stainless steels, as well as Ferritic, Martensitic, and Duplex Stainless steels.

Industry Segments serviced by Techalloy products include:

1. Automotive Exhaust Manufacturing: 409NB and 430LCB
2. Chemical and Pharmaceuticals: Duplex and 300 series Austenitic stainless steel
3. Petrochemicals: Nickel based Alloys, such as 718, 625,182, 117, 122,276

Metrode: A niche manufacturer for products related to the following industries:

1. Power generation: with Cr-Mo creep resisting consumables, available in grades such as P91, P92, T23, T24, in addition to the 5CrMo, 9CrMo, plus the standard 1 1/4 and 2 1/4 Cr alloys
2. Chemical/Petrochemical: Filler Metals in the Duplex, Super Duplex, Austenitic stainless provide the product line to weld in this segment
3. Martensitic stainless: Cladding and welding in the power, nuclear and similar alloy grade welding
4. Refineries: High temperature alloys used for elevated temperature service, used in CAT service, to weld matching high carbon stainless steels at service temperature of 400-800 degrees C. Consumables also include welding electrodes for HP40 and HP45 high carbon cast alloys. Lincoln products are approved by all major approving agencies, such as AWS, CWB, ASME, Lloyds, ABS etc. Batch managed inventory is being introduced for all alloy, stainless and Nickel products. Batch managed inventory is the process where we manage our inventory by lot or batch number. This ensures a full traceability and correct certification along with product delivery. 

Under the Lincoln banner we provide the industry with EXCALIBUR Austenitic Stainless electrode that are fully alloyed, designed with low carbon levels to help eliminate carbide precipitation in high temperature service and a smooth arc transfer and self-peeling slag. At the end of the day our ALLOY portfolio consists of over 200 line items, all of which are manufactured by Lincoln and Lincoln owned companies. From a simple welding joint to a 400 KM pipeline of Duplex stainless, Gas fired or Nuclear power plants to high performance craft, we have the product, technology and the expertise to weld whatever your job requires.

Our Lincolnweld submerged arc wires and flux provide us a glimpse of Europe in versatility, excellent slag removal and superior resistance to moisture pick up. Our technical staff is available to help with any aspect of consumable choice, applications or procedures. Facilities are available at Lincoln offices to for product demonstration, training and evaluation for all major welding processes that utilize Lincoln and/or Lincoln group company consumables.

Flux P2007 is used for submerged arc welding of 300 and 400 series stainless steels, as well as difficult stainless such as 347 and 2205. This flux is also used on Nickel-based alloys P3000 and P4000 fluxes are used for austenitic stainless strip cladding using the SAW and the Electroslag processes.
Some would say the first words spoken by Don Gemmell as a child were probably electrode and arc welding because of his passion for the welding industry. It was during his early high school days when he was introduced to the craft by a guidance counsellor. From that discussion, Mr. Gemmell started participating in the school’s welding program.

“It was a lot of fun and I enjoyed the program,” recalled Mr. Gemmell. “I learned a lot, and that was the pivotal moment that influenced me to want to pursue a career in welding. If anything, it has inspired me to share my experiences and expertise to the next generation of welders.”

Already equipped with a solid foundation of the industry, Mr. Gemmell then pursued a 30-year career with Stelco in Hamilton. Starting as a Welder Apprentice and then moving up the ranks and holding such positions as Mechanical Supervisor, Engineering Welding Staff Specialist and Training Manager, Mr. Gemmell knows the business inside and out.

“This industry is always evolving, but it’s evolving for the better, and I wouldn’t change any of the experiences I have had from it,” he said.

Having been directly involved in the trade for over three decades, Mr. Gemmell has witnessed many changes to an industry that is traced back to the Bronze Age. The area that has transformed the most is welding processes, he said.

When he started out, Shielded Metal Arc Welding was predominantly used, however, due to the world economy and productivity demands, semi-automatic and fully automated processes, such as Gas Metal Arc, Flux Cored Arc, Submerged Arc and Robotics to a lesser degree have taken over. “Those are the main types of welding being used today, and they’re quite effective from a productivity standpoint, especially for the structural and pipe/pressure vessel fabrication industries,” he said.

Another area that Mr. Gemmell said has evolved over the years is now there’s more emphasis on the theoretical knowledge of welding, whereas previously, many welders only had practical hands on training. Long gone are the days of a welder grabbing some electrodes and turning the dials on the welding power source to what is believed to be correct. Now, we see Welding Procedure Specifications and Welding Procedure Data Sheets being used as a tool for the welder to follow while ensuring a quality product with reduced rework and defect rates.

“Back 15 years ago, most welders had practical training, but more and more employers nowadays want welders with theoretical knowledge,” he said. “In fact, a lot of the top employers are seeking welders with their Certificate of Qualification or Red Seal qualification.”

Mr. Gemmell said the main reason employers are seeking highly skilled welders is because jobs are becoming more technical in scope, which requires good welders to perform the work, but also who understand all theoretical aspects of the industry as well. Not only has Mr. Gemmell mastered the skill of striking the arc, he’s an accomplished Welding Professor as well.
While employed at Stelco, he taught part-time for 18 years at Mohawk College in Hamilton, and then after retiring from the steel industry in 2007, he landed a full-time teaching position at Niagara College.

“This position is very fulfilling,” he said. “It’s a great accomplishment knowing I’m assisting future graduates in accomplishing their goals, while helping the industry in the long run by teaching students the craft, so they can move forward and fill the labour shortage.”

He’s also a Certified Level II Welding Inspector in compliance with CSA W178.2, as well as a Qualified Welding Supervisor as required by CSA W47.1. He is also the Past Chairman of the Canadian Welding Association National Advisory Council and current Chairman of the Canadian Welding Association Hamilton and Region Chapter and an active Authorized National Body governing board member for the International Institute of Welding Program. He is currently on the board for CSAW47.1 “Certification of Companies for Fusion Welding of Steel”

Mr. Gemmell was the recipient of the CWA Robert J. Jacobson Memorial Award in 2007 for his many years of work with the Canadian Welding Association and support of welding education in the Hamilton/Niagara Region. In 2010, he was selected by Skills Ontario as a recipient of the Skilled Trades Hall of Fame Award Welding processes and formal training in theoretical aspects are not the only changes. Since WWII, women immersing themselves into the trade and creating a career in welding has grown. And Stephanie Bucknall, 26, a second year Welding Technician student at Niagara College, will soon be another female entering the industry.

“I thought it would be something that would interest me,” said Ms. Bucknall. “I enjoy seeing my work when it’s completed – it’s a great feeling.”

This isn’t Ms. Bucknall’s first stint at Niagara College; she graduated from the culinary program and tested the waters of that industry for a while before making the decision to go back and study welding. With no previous welding experience, she felt some butterflies, but once in class, they soon disappeared.

“I was kind of intimidated, initially, but the Instructors are great, and made me feel at home,” she said. “Now, I feel part of the class and I’m excited to enter and see what I’ll be learning next.”

Ms. Bucknall, who’s the second female donning a welding mask and coveralls in class, said she enjoys both the technical and practical elements of the welding course. She said understanding how important welding contributes to the overall functionality of everyday life is becoming more intriguing as the course moves forward.

“Welding might be one word, but it’s everywhere. Everything around us, from the bridges we drive across, buildings we work in, to even the cargo ships that import and export supplies to millions of Canadians and individuals globally – all comprise of welding,” she said.

Although Ms. Bucknall plans on jumping right into the workforce once school’s completed, she’s also contemplating furthering her tertiary education, as she has aspirations to become a metallurgical engineer and possibly obtain her doctorate in metallurgy.

“I would like to look into it;” she said. “This program has been great, and I really enjoy the industry, and with so many possibilities out there, exploring them would be rewarding and beneficial.” As for other females considering the trade, Ms. Bucknall said it would be a great opportunity for them because of vast employment opportunities as welding is a profession that continues to thrive even if economies tend to be sputtering along.

“I would definitely encourage females to get into welding because it’s a fantastic trade,” she said. “The opportunities are virtually endless, and the educational aspect of it is rewarding and fun. The sky is the limit for female welders.” Though there’s a vast gap in experience between Ms. Bucknall and Mr. Gemmell, they both share commonalities in terms of safety.

“Safety is our top priority,” said Mr. Gemmell. “This is very important for me both personality and professionally, and I pass that awareness down to every student who steps into the classroom.”
Abstract

A computational weld mechanics (CWM) framework that automates multiple setups, analyses and evaluations to explore a design space for design variations defined by Design of Experiment (DOE) matrices for a given design that is described. Saving an expert-user’s time to prepare several analyses and allocating CPUs for efficient use makes this framework cost and time effective for managing industrial-scale designer-driven optimization and control applications of CWM. A validation analysis is conducted to identify the CWM control vector that minimizes the difference between the computed and experimental data.

Actual CWM problems with continuous and discontinuous parametric design spaces including regression modelling surrogate modelling, sensitivity analysis, and control problems to minimize weld distortion are solved in this framework using derivativefree optimization algorithms that become attractive in this framework.

The study demonstrates exploration of the design space for welding structures such as aircraft, ship, automotive and heavy machinery.

Introduction and Background

Computational welding mechanics (CWM) is a multi-physics problem that predicts the behaviour of welds in welded structures employing the models, algorithms, and software that are now mature and reliable. CWM is capable of supporting manufacturing design at the early stages of design to reduce the risk of high costs and long delays for correction and repair in manufacturing and service life. Unfortunately, there is a little application in routine engineering even in companies with welding core-competency.

Most academic CWM studies on complex industrial welding problems have focused on a simplified manual CWM implementation in combination with theoretical treatments that are very complicated and not feasible for industry to implement or use routinely. In industry the welding engineering tasks are limited by cost and delivery time. Heavy machinery industries, for example, need a weld sequence of several welding beads to be optimized in 30 days. This problem requires a combinatorial optimization with a significant number of analyses to be computed and compared which is challenging task to perform.

CWM models are complex for industrial users because the physics of welding is complex. This complexity means that the industrial user needs training and experience to setup and run a project. The expert-user time to prepare a project is significant and CPU time can be long. In addition, industrial CWM problems require solving several projects. In practice, a designer could not make a decision based on a single analysis and must evaluate many analyses. Human error in the setup of multiple analyses is very likely and managing several analyses may become too complex. In essence, a designer’s skill is developed toward weld analysis and design space exploration but not to setting up complex computational analyses. The design team does not need to know how to setup the CWM project. The design team can focuses on design space exploration. This is similar to solving a math problem using Mathematica that enables the user to focuses on the problem independent of the mathematical complexity hidden behind the Mathematica commands.

It is misguided for the design team to spend time learning a complex computational skill. This is similar to expecting a Mathematica user to know the theory, details and setup, to evaluate the derivative of a complex function.
In CWM, professional users of well-known software such as VrWeld, Sysweld, ABAQUS, or ANSYS strongly agree that meshing and preparing a welding project in actual industrial problems is very challenging and time-consuming. The authors believe that an expert in CWM setup can create an automated reference CWM design and ship it to the design team. They can implement the design of experiment (DOE) matrix to do designer-driven CWM optimization that could require hundreds of analyses with no detailed knowledge of CWM setup required by designers.

This has been the motivation of our work and the current paper discusses the support required to implement optimization in the design stage from a designer’s point of view and a framework with this capability. The framework uses DOE matrices as a communication language for a designer to explore a design space. The optimization methods to create DOE matrices that are well developed in statistics are not in the scope of this paper. If you have the analyses capability to solve a feasible problem, then the optimization and control algorithms to solve a sequence of problems is straightforward.

**Computational Control and Optimization**

Computational optimization of structures developed rapidly since 1970 but CWM remains a quite separate discipline. Few control and optimization papers have been published in the context of CWM. Michaleris implemented an algorithm for a weld optimization problem using direct differentiation. This involves computing the derivatives of the governing equations with respect to the design parameters. For sufficiently smooth problems, optimization with direct differentiation is expected to be fast and accurate because it utilizes the gradient of the objective function. However, the disadvantage is that the code must be written to compute the gradient of the state equation or residual with respect to control parameters. Michaleris’ direct differentiation was the main work for the derivative-based CWM optimization problem.

Derivative-free optimization works with the direct value of the objective function, and therefore the optimization requires the evaluation of an objective or cost function.

A DOE matrix or sequence of DOE matrices to be evaluated is a convenient representation for such optimization. Voutchkov et al developed a surrogate model for a weld sequence optimization to minimize distortion in a tail bearing housing by analysing a DOE matrix of 27 tests chosen from the total space of 46,080 configurations. Tsai et al developed joint-rigidity-method (JRM) to determine the weld sequence to minimize the distortion in a thin-plate panel structure with 18 welds for Hyundai.

There are many effective optimization algorithms that could be employed in CWM. VanderPlatts has a nice introduction to computational optimization for engineers. Nocedal, S. Wright and Bertsekas provide a more advanced mathematical viewpoint. However, lack of support for a robust and feasible implementation of their DOE matrices limits their practical use.

Optimization has three types: continuous optimization, combinatorial optimization and integer programming. In continuous optimization, the design variables are at least locally continuous functions. The optimization process starts with an initial guess or trial solution. The continuous optimization process then follows a path in the mathematical space defined by the design variables toward a min/maximum. The minimum requirement for continuous optimization is the capability to evaluate the cost function for any feasible set of design variables, i.e. at any point in the feasible design space. If in addition one can evaluate the gradient of the cost function with respect to the design variables if it exists, then the computing time can usually be reduced at the cost of implementing and validating the software support needed to evaluate the gradient.

If in addition, the second derivative of the cost function can be evaluated if it exists, then computing time could usually be further reduced at the cost of more software development time. Using either or both the gradient and second derivative might make the setup more difficult and time consuming for the user.

In combinatorial optimization, one seeks the optimal combination of some set of variables, e.g. choosing the sequence of weld joints or weld passes that minimize distortion is an important and challenging problem in welding. The fundamental mathematical structure in combinatorial optimization is a graph.
The solution is the path in this graph that minimizes the objective function. A famous combinatorial optimization problem is the travelling salesman problem. This class of problems is often very challenging. For example, Tsai’s method needs \( n(n+1)/2 \) analyses, i.e. 171 for the Hyundai’s thin-plate structure for a sequence of 18 DOE matrices with 18, 17, 16, ..., 1 CWM analyses.

**Computational Design of Experiment**

A designer lives in a design/control space in which each axes is one design parameter. Every node in this space is a vector of one design configuration. There is another space which is the state or response manifold of the system. A map between each node in the design space to a node in the state space requires a CWM analysis. The state space is a vector space and hard to compare in the sense of picking the best. There exists a scalar objective function that is defined by the user as a selection criterion. Therefore, another map is required from the state space to the objective function which is usually a scalar function.

A designer decides which design configuration is to be evaluated in order to explore the design space. If it is written in the form of a matrix, each row is one CWM analysis and each column is the set of values for one design parameter. This is the representation for the computational design of experiment (DOE). Having a DOE matrix, the designer should not have to care how it is implemented. What is useful for the designer is to have the values of the objective function for each row of the designed DOE matrix to make a decision. Therefore the DOE matrix is the communication language between a designer and a machine that automates the mapping between the spaces, and returns the values of the objective function for each row of the DOE matrix. Actual problems can use a DOE matrix or sequence of DOE matrices that require multiple analyses.

**Integrated Optimization with CWM**

Computational analysis on welding dates back to 1970 when Ueda conducted the first computation of residual stress in welds. From 1980 to 2000, CWM research evolved rapidly and, then after 2000, CWM is being adopted quickly by industry.

However, in the authors’ judgment, CWM is currently not well integrated with optimization techniques. Since 2007, the authors have worked to integrate computational optimization and CWM. In this paper, a brief overview of several problems is provided to summarize what has been accomplished.

**Verification and Validation**

One of the essential tasks in CWM applications is the verification and validation of the computational code for a particular welding application. This requires an estimate of the difference between experimentally measured parameters and parameters computed by a computational model including the estimate of the uncertainty in both the experimental data and the computational data. If the difference in the results from valid experiments and predicted by a verified CWM model is sufficiently small, then the CWM model is validated for this particular welding application. In the authors’ experience, the greatest source of error is in specifying the control vector, i.e. the parameters that characterize the weld experiment. Once errors in the control vector have been reduced sufficiently, then errors in material composition, temperature dependent material properties, and evolution of microstructure become important.

Masabuchi published results of a careful experiment that measured thermal, strain and deflection on an edge-weld on a 152 x 1220 x 12.5 mm bar of Aluminum 5052-H32 using columns of four thermocouples, four strain gauges, and a dial gauge illustrated in Figure 1.

![Figure 1: Masabuchi’s experimental test setup](image-url)
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- Aerospace / Transportation
- Body shops
- Sign manufacturing / Shop displays
- Air / Water filter manufacturers

ZIP ONE is available in the US and Canada as of January, 2013.
About Walter Surface Technologies

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Masabuchi’s data was employed in our laboratory using VrWeld to simulate his welding experiment. The temperature dependent material properties of Al 5052-H32 given in were employed in the analysis. The gas metal-arc-welding process was employed to weld the specimen and the welding parameters were current 260 amperes, voltage 23 volts, travel speed 7.34 mm/s, filler metal Al-4043 with 1.6 mm wire diameter, wire feed speed 170 mm/s and the shielding gas was Argon. The specimen was allowed to cool to ambient temperature after welding was completed. The mesh shown in Figure 2 is finer close to weld path on the top edge with a total of 6600 8-node brick elements and 9680 nodes. The final distortion is shown in Figure 3 together with plots that compare Masabuchi’s experimental data with computational results. The validation involves a sequence of DOE implementation for control vector calibration to get computed results as close as possible to the experimental data. This could also be viewed as computing the sensitivity of the experimental results to the control parameters. In other words, the objective function is minimizing the difference between an array of experimental and computational vectors.

Mitigation of Distortion by Clamping

The objective was to minimize distortion for the Masabuchi’s edge welded bar with respect to clamping parameters using parametric design space exploration. Parametric design discretizes the space by given step sizes to create a grid on which each node is one design configuration. The design parameters in this problem were clamping parameters, i.e. prescribed displacements, and the release time after the weld halts. The design parameters, values of prescribed displacement and delay time, have a quite large range of possible variation and therefore the design space is discretized by picking 5 values of nodal prescribed displacement and 9 delay times resulting in 45 nodes in the discrete design space. A full factorial DOE including the 45 nodes was used to give a fully-covered map of the design parameters. The bar was then fixed at both ends and subjected to a range of prescribed displacements opposite to the direction of the camber.

In the first set of tests, a prescribed displacement was directly applied in the middle of the bar. In the second set of tests, a parabolic displacement was prescribed along the full length of the bottom of the bar. Each set of tests had its own grid of 45 CWM analyses for a total of 90 CWM analyses. In addition, the effect of the delay times at which the prescribed displacement is released after the weld was studied.

The grid’s nodes in the design space are defined by the DOE matrix, i.e. 2 DOE matrices of size 45 by 2. The DOE matrix was the main input file to the software. This is quite different from the user using the DOE matrix to separately create and separately solve one project for each row of the DOE matrix. Here, the user sets up only one reference or base project and two DOE matrices with a total of 90 design points.
The designs in each DOE matrix are run as a single project that analyses all 45 design points in 18.4 CPU hours on a single core of a 3.3 GHZ Intel quad-core processor. The user spends no time to set up the analysis for any design point other than the design point for the base or reference project. Figure 4 shows the final distortion after each clamping strategy which indicates significant mitigation compared to the distortion in the reference design. See Figure 3. There was no single optimum for this problem and Figure 5 shows the curves of the best pairs for prescribed pre-bending and delay time that minimize the deflection. Details may be found in.

**Mitigation of Distortion by Side Heating**

A side heater mitigation technique was employed as another strategy for alleviation of Masabuchi’s bar. This technique applies a transient thermal tension by side heaters moving parallel to the weld path. The side heater’s powers, heated area, the distance from the weld either longitudinal or transversal are the design parameters for this technique to be optimized.

In a continuous response surface of a given system, if the initial pattern does not find the optimum, direct-search algorithms can be used to learn from the current observation and find a possible path toward an optimum. The algorithm repeats the learning to follow the path until it reaches the minimum or is halted by some imposed limits.

We employed a recent direct-search algorithm from Kolda, Lewis and Torczon. We also developed a modification to use a least-square approximation to improve the method of following a path to the minimum in the algorithm. This algorithm checks the value of objective function starting from an initial guess and surrounding variation then moves to the best value and repeats until it converges to the optimum point.

Such algorithms requires performing a sequence of DOE matrices including tens of welding tests with different configuration of design parameters to follow the path to optimum design. The analysis consists of 12 sequences of 47 DOE matrices.

The total CPU time was 12 hours and 48 minutes. The user time to set up the project was only to create the DOE matrices for the design. The base project from pre-bending problem was used and therefore there was no need for any effort to setup a new base project. Details may be found in.

Figure 6 shows the final distortion for no-mitigation and side-heating-mitigation techniques.

![Figure 4: final distortions after each clamping strategy.](image)

Figure 5 - The best pair of prescribed displacement and delay time that minimize the deflection.

![Figure 5 - The best pair of prescribed displacement and delay time that minimize the deflection.](image)
Residual Stress Variation due to Welding

The welding process generates residual stress in the structure before in-service loading and this residual stress changes the in-service behaviour of structure. The residual stresses are usually not known to design engineers in many cases, and lack of such knowledge leads to conservative design practices that are expected to increase costs and reduce the performance of welded structures. It is expensive to experimentally measure residual stresses and therefore prediction of residual stresses by numerical modelling is a desirable complement to experimentally measured residual stresses.

Paradowska et al presented a set of experimental data of residual stress measured by neutron diffraction. The residual stress was measured at room temperature in the unrestrained specimen after the plate cooled down. Their experimental set up for the weld is shown in Figure 7. Paradowska’s work was simulated and effective stress is also shown in Figure 7.

The specimen is a low-carbon steel plate 100 x 200 x 12 mm. The filler metal is 14 mm wide and 6 mm high. The flux-cored arc welding process used a 1.6 mm diameter electrode with a 20 mm contact tip to work distance. ARGOSHIELD 52 shielding gas was used with a gas flow rate of 18 l/min. The welding parameters were 260–280 amps, 28–30 volts and a welding speed of 6 mm/s. During welding, the specimen rested on a plate but was free to move with no constraints other than rigid body motion.

A reliability-based design was the objective of this problem that needs to know how the uncertainty in design parameters changes the results. Monte Carlo is a robust algorithm to use in such cases. Increasing the number of design parameters raises the number of points in the sample space and therefore the number of rows in a DOE matrix for the Monte Carlo analysis.

Initially the analysis deals with one parameter, i.e. welding current, and 30 non-repetitive samplings from a normal distribution around 280 amp with standard deviation 5 generates a DOE matrix of size 30 x 1 for different welding currents utilizing 4 cores. Using an accurate model, this DOE matrix gives the distribution of residual stress, i.e. objective function, with respect to the variation in welding current. The second part has four parameters of arc-weld-pool shape and a DOE matrix of 81 x 4 evaluations are used to construct a regression response surface as an estimator.

continued on page 19...
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This response surface is used for a Monte Carlo analysis with 10,000 random sample points from possible values of the parameters to observe the variation in the residual stress in the space of these parameters. Figure 8 left shows the variation of residual longitudinal stress along a line from the weld bead centreline to the side while arc weld current varying randomly and Figure 8 right shows the histogram of distribution 7.5 mm distance from the centre of the weld bead on the plate.

The local evolution state is determined by a high-resolution 3D transient CWM analysis and compared to experimental data characterizing the material resistance for each type of hot cracking. An algorithm determines the hot cracking risk based on the temperature, temperature profile, strain increment, and rate of strain in the hot cracking temperature region. The critical values are obtained from existing experimental data. The CWM model for the hot cracking test was based on the experimental procedure developed by Matsuda et al on an Inconel 600 plate 300x50x2 mm (Figure 9). The welding speed was 2 mm/s.

This test relied on a cross-head speed (CHS) applied at the instant of time the heat source reaches the mid-point of the weld path, for a maximum duration of 3 s. Different CHS were used. The CWM model for the DDC test was based on the CWM simulation conducted by Chen and Lu [20] for a Filler Metal 82 (FM82) plate 100x100x2 mm using welding speeds of 2 and 5 mm/s. This problem demonstrates the capability of using post processors with DOE matrices. Details are in.

**Figure 8 - Variation of residual longitudinal stress while arc weld varying randomly.**

**Figure 9 - The brittleness temperature range (BTR) for Matsuda’s test**

**Hot Cracking and Ductility Dip Cracking in Weld**

Computational weld mechanics (CWM) is used to estimate the likelihood of hot crack nucleation in a weld joint. A Solidification, Liquation or Ductility Dip hot crack nucleates when the evolution of the local state of stress, strain, temperature, and microstructure in the brittleness temperature range (BTR) reaches a critical value. Solidification and Liquation Hot Cracks are associated with melting. In contrast, ductility dip cracking (DDC) occurs in a solid phase. The cause of the drop in material resistance to DDC nucleation at the ductility dip temperature range (DTR) has been attributed to an accumulation of voids, element segregation to grain boundaries, grain size, grain boundary orientation or a combination of these factors.

This problem demonstrates the capability of using post processors with DOE matrices. Details are in.
Welding Sequence Pattern Optimization

Choosing an optimal sequence from the set of all possible combinations of a weld’s sub-passes has always been a challenge for designers. The solution of such combinatorial optimization problems is limited by the available resources. Using a surrogate model based on a simulation model, the solution in the space of all possible combinations can be found with a significant decrease in computational expenses. The discontinuous surrogate model constructs an approximation model from some combinations of sub-sequences of a more expensive model to mimic the behaviour of the expensive model as closely as possible but at a much lower computational cost.

This surrogate model could be used to approximate the behaviour of the weld sequences not analysed with the expensive CWM model. We developed and demonstrated that a surrogate model can minimizes the distortion in a pipe girth weld with six sub-passes by analysing only a few combinations of sub-passes from a total of possible combinations with the expensive model. This project was a pipe girth weld, which are widely used in a variety of engineering applications such as oil and gas industries, nuclear and thermal power plants and chemical plants.

The girth weld connects two pipes of length 356 [mm], wall thickness 17.5 [mm] and outer diameter 324 [mm]. The pipes are part of a longer pipe loop and therefore constraints are applied in the analysis to approximate the effect of the rest of the loop. The weld joint has 5 layers of weld. Each layer is divided into three sub-passes and each sub-pass covers 1/3 of the whole layer. The two pipes are tack-welded prior to welding at three points and each sub-pass starts from one tack-weld and ends on the next one (Figure 10).

Conclusion

A total of 505 CWM analyses are implemented with 33 DOE matrices. Several examples of integrating computational optimization with CWM have been described.

This would not be feasible using manual preparation and implementation. It is feasible by using an automated implementation with DOE matrices of a CWM problem without accumulated people-time to make multiple setups. It is argued that some parameters are more difficult to vary, e.g. varying the mesh geometry or the topology of the geometry and changing boundary condition types. However, for many types of parameters, the authors have shown that it is easy to set up parametric problems for CWM.

The results presented here have demonstrated that using a DOE matrix in CWM is now practical for optimizing many decisions in the design of welded industrial structures. This is a powerful tool for a designer-driven optimization that enables a design group to do the optimization in the early design stages with knowledge of downstream welding and production engineering. This is in sharp contrast with the traditional practice of the designer waiting for the feedback from welding and production engineers to complete the design and handing off the optimization to a specialist. The authors argue that designer-driven optimization of the design of welded structures is now feasible for routine engineering in industry.

Figure 10 - Welding sequence optimization setup
RELIABILITY

SOME COMPANIES CLAIM THEY MAKE HIGH QUALITY WELDED PRODUCTS, PROVE IT TO YOUR CUSTOMERS BY USING THE CWB QUALITY MARK. MAKE YOUR MARK, STAND OUT FROM UNRELIABLE COMPANIES.

Avoid Tragedy by Ensuring Quality - The CWB Group was established in 1947 to enhance public safety in the welding and joining industry. We ensure public safety by qualifying welders and certifying welding companies. You can rely on the Canadian Welding Bureau to maintain the integrity of the welding industry in Canada. Current CWB Certified companies qualify for this new initiative. www.cwbquality.org • 1.800.844.6790
Many welding fabricators and manufacturers want a quality system in their companies that reflects what they do and allows them recognition for their welding and fabrication quality. Standards like ISO 9001 and CSA Z299 can help with this but are very broad based and general in nature delving into requirements that may not be necessary or wanted in a typical steel fabricator.

ISO 3834 is the solution. ISO 3834 is an internationally recognized (in some countries mandatory) quality system standard for companies that weld. The product type is not important – it is equally applicable to structural steel, aerospace, or pressure vessel fabrication. For companies currently certified to W47.1, in most cases, the existing welder qualifications, welding procedures, welding supervisor qualifications are adequate. The additional requirements would include items like material control, inspection, review of contract documents and production planning.

The CWB has recently become accredited by the International Institute for Welding (IIW) to grant ISO 3834 certifications under the IIW scheme. This adds further credibility and recognition to the certification.
INTRODUCTION

IRCO Automation designs and manufactures Welding Positioners, Manipulators, Beam Positioners, Turntables, Turning Rolls, Head and Tail Stocks, as well as fully automated custom welding systems. Minja Zahirovic was more than happy to tell us about some more interesting facts about them.

INTERVIEW

CWA: What can you tell me about your organization at IRCO Automation?

Minja: IRCO Automation is a 50 year old company that has been manufacturing reliable, quality products for the welding industry. IRCO specializes in welding positioning systems as well as custom design solutions that are used in a variety of industries, such as oil and gas, machinery manufacturing, transportation, fabricated metal products, and energy. Our products include positioners, turning rolls, manipulators, head stocks / tail stocks, chucks, accessories, and custom engineered solutions.

CWA: How did you get started in this field?

Minja: I began my career in the welding industry at the brink of a nuclear reactor outage at Chalk River Laboratories (CRL). The nuclear reactor at CRL named National Research Universal (NRU) was one of the primary global medical isotope suppliers; and with its shut down, the world supply drastically plummeted. My company at the time was engaged to develop a complicated set of tools to weld, grind, clean, patch and inspect the nuclear reactor from the inside annulus. This complex project involved a great deal of weld development and required the knowledge of industry experts from all around the world. This project was challenging and fascinating and I have been in the welding business ever since.

CWA: How does your company manage 5 industries so successfully?

Minja: IRCO Automation has a wide variety of standard products and has been a leader in many of these industries as it is a very established company. IRCO is known as a manufacturer of superior quality and our name has stood the test of time. We often receive calls from customers with machines dating back to the 1960s that still work to this day. We have also been constantly adapting to new technologies and refining our products to match what the industry requires.
CWA: What sort of projects are you working on right now?

Minja: We are currently working on large welding lathe systems for weld overlay applications. These systems are designed to increase efficiency in caster overlay repair for steel mill conveyor lines. We are also working on a new line of positioning equipment that will have live feedback with the operator on key parameters such as number of welds, arc on time, etc. These positioners are also designed to be used in a variety of ways, including manual positioning, semi-automated, or fully robotic.

CWA: What would you say is the best part of your job at IRCO Automation?

Minja: The best part of my job at IRCO Automation is that we are involved in a wide variety of applications and therefore face new challenges every day. We also get involved in highly customized solutions so our interaction with customers is always pleasant as they can count on us to come up with virtually anything to help them with their productivity.

Minja Zahirovic, M.Eng., P.Eng. is the VP of Engineering and Manufacturing at IRCO Automation Inc.

To learn more please visit their website: http://ircoautomation.com/
Niagara Technology Centre—Welland Campus
300 Woodlawn Road
Welland, ON L3C 7L3

Learn With Us - Start Your Welding Career at Niagara College
♦ Welding Techniques
♦ Welding Technician
♦ Welder Apprenticeship
♦ Metal Fabricator (Fitter) Apprenticeship

For Further Information:
Don Gemmell, Co-ordinator (905) 735-2211, ext. 7371
dgemmell@niagaracollege.ca

Employers
We offer customized training to suit your needs!
Contact: Sam DiMartino, Workforce Development Consultant (905) 641-2252, ext. 4430
A large number of welding procedures designed in Alberta are based on a “reasonable, good looking” weld, which passes code requirements. This is accepted practice, and often economically appealing. On the other hand, when the proposed weld cannot meet code requirements, practitioners resort to “code interpretation,” to see if borderline cases can be considered acceptable, if not, trial and error is performed (often blindly) with significant cost and delays. As oil and gas industry in Alberta is more involved with sophisticated alloys such as high-grade pipeline steels, stainless steels, and high alloys, the trial and error approach could and should be improved. Similar problems are found in other industries in Canada and the world, for example, with the new AHSS steels in current cars. This presentation will introduce a few basic concepts and tools and will put them together to result in a procedure determination for cases typical of the oil and gas industry. First, the basics of material behavior will be discussed through the CCT curves and carbon equivalent concept. Second, the cooling rate of the material will be discussed accounting for preheat and basic geometries using Rosenthal’s approach. This proposed approach does not need intensive computer calculations or sophisticated measurements and still might involve limited amounts of trial and error. On the other hand, by consciously aiming at the center of the process envelope the likelihood of meeting code requirements on first intention is highest, decisions about preheat or PWHT are made consciously, and natural variations during actual welding are less likely to result in problems.
REGISTRATION

Please confirm your attendance by Monday April 8, 2013.

The registry contact is Bruce Cormier (bruce@grbwelding.com) or 780-436-7342
Please provide number of reservations requested, name or names, company name, membership affiliation and phone number. We thank you in advance and are looking forward to your early registration. You can also register online at: www.cwaevents.org

Times and Location: The March 8 Dinner Meeting will be held at the University of Alberta Faculty Club, 11435 Saskatchewan Drive, Edmonton Alberta.

- Reception at 6 PM
- Dinner at 6:30 PM
- Presentations at 7:30 PM.

The cost is $30.00 Members, $35.00 Non-Members, $10.00 Student Members and $15.00 Student Non-Members.
UPCOMING EVENTS

2013 CISC-Alberta Region
Northlands Edmonton EXPO Centre
Edmonton, Alberta - March 21, 2013

The Alberta Steel Design Awards of Excellence is Canada’s largest steel industry awards program. In 2011, the Awards attracted over 50 sponsors, 45 submissions and over 500 attendees.

The goal of this biennial awards event is to share and recognize Steel Design and Innovation Excellence and to promote awareness of the advantages of steel in construction and create networking opportunities for CISC Members, partners and clients.

To learn more visit: www.cisc-icca.ca/albertaawards

WMTS - 2013
Western Manufacturing Technology Show
Edmonton, AB - June 4-6, 2013

WMTS will provide thousands of manufacturing professionals the convenience of having all the latest in manufacturing technologies, machinery and education under one roof. This event provides a unique and engaging platform for suppliers to demonstrate their products and solutions to the industry. Attend WMTS to source opportunities, network with peers, and learn.

To learn more visit: http://www.wmts.ca

CWA 2013 Welding Educators Conference
Edmonton, Alberta
May 1 - 2, 2013

The CWA 2013 Welding Educators Conference will be held at NAIT 7110 Gateway Blvd., Edmonton, Alberta T6E 0E6 on May 1-2, 2013. Please mark your calendars, more details will be made available in the near future.

7th Asia Pacific IIW
International Congress 2013
Singapore
July 8-10, 2013

CALL FOR PAPERS: After the successful 2009 Annual Assembly of International Institute of Welding (IIW), the Singapore Welding Society (SWS) is organising the 7th Asia Pacific IIW International Congress entitled “Recent Development in Welding and Joining Technologies”. The objective of the conference is to bring together experts to present new research findings and discuss the different perspectives of future developments with respect to welding and joining technologies. It is an important forum for the exchange of knowledge and networking with the relevant experts.

For more information please visit: http://www.iiwcongress2013.com/

PSSC 2013
Pacific Structural Steel Conference
Singapore Structural Steel Society
October 8 –10, 2013

The Pacific Structural Steel Conference is a major initiative bringing together expertise in structural steel research, education and construction from all around the Pacific Rim and beyond to promote cooperation among the structural steel associations and communication on development in the field of steel structures in Pacific countries.

For more information including a list of topics visit: http://www.pssc2013.org/
Welding Perspective Seminar
March 12, 2013 • 5 Speakers from 8AM to 5PM

Cost: $175 Non members - $250, Students and Educators - $75
Please note that attendees will earn 0.7 CEU credits OR 7 hours toward professional development credits.

Address: CWB Head Office – 8260 Parkhill Drive, Milton, ON L9T 5V7

CONTEMPORARY METHODS FOR FATIGUE LIFE ASSESSMENT OF WELDMENTS

The fatigue life of machine and structures is a major concern with regards to safety and cost in service. Numerous analytical techniques are available and can be used with varying degrees of success; however, many questions still arise. Which methodology is best suited for which application? How to define the correct inputs for a specific technique? How can the structure be improved to meet the service conditions? This seminar will address these questions among others and looks at the essential aspects for getting each of these inputs correct for the appropriate analysis methodology from both the design and analysis viewpoint. Any fatigue life prediction procedure consists of three main areas that are used to input the data and carry out the analysis: loading/stress history, material properties and cyclic stress-strain analysis and fatigue damage evaluation. The form of loading histories are similar in most methods; however, the material properties, the local inelastic stress-strain analyses and fatigue damage calculation methods may differ depending on the general philosophy used by an analyst.

Professor Grzegorz Glinka, Ph.D., D.Sc., University of Waterloo

Bio: Dr. Glinka has been with the University of Waterloo since 1989. He was a Post-Doctoral Fellow at The University of Iowa in 1978 and later he has lectured at the University of Metz, France and at the University College London, England. He holds a PhD and DSc from the Warsaw University of Technology. Dr. Glinka is a specialist in fracture and fatigue of steel structures and mechanical engineering machinery. He has also acted as a United Nations expert. His research interests include fracture of materials, fatigue of structures, multiaxial fatigue and creep of engineering materials, computer aided design, FEM-elastic-plastic stress-strain analysis and reliability. His recent research activities concern modeling of fatigue crack growth under random loading and fatigue optimization of welded structures. Dr. Glinka has published over 160 related articles in technical journals and textbooks.

This is a CWA National Event presented in conjunction with the Ontario Chapter
FACTORS INFLUENCING THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF PIPELINE GIRTH WELDS

Construction of large diameter, high pressure pipelines from remote regions in North America requires development of modern high strength steel pipe, innovative welding technologies, and further advancement of strain-based design (SBD) methodologies. Achieving the required level of weld metal overmatching, together with adequate ductility and good low temperature toughness is more challenging as the strength of the pipe increases. With greater use of advanced high-productivity pulsed gas metal arc welding (GMAW-P) process variants (single versus tandem or dual torch) there is a need to understand the effect that different cooling rates and complex thermal cycles have on weld properties. Research at CanmetMATERIALS has focussed on developing an in-depth understanding of weld metal (WM) and heat affected zone (HAZ) microstructure and mechanical property relationships for a range of mechanized pipeline girth welding options. In this presentation some results from evaluations of all-weld-metal (AWM) tensile properties, Charpy V-notch (CVN) impact transition toughness behaviour, and fracture toughness resistance will be highlighted. Some of the factors influencing the mechanical properties were established by means of detailed microstructural characterizations in conjunction with thermal simulation techniques. Development and application of WM and HAZ thermal cycling experiments allowed a more fundamental understanding of microstructure – property relationships to be established.

Jim Gianetto, CANMET Materials - Natural Resources Canada

Bio: James (Jim) Gianetto is a Certified Welding Engineering Technologist and a Project Leader at CANMETMATERIALS in Hamilton, Ontario. He graduated from Northern College of Applied Arts and Technology and has more than 25 years experience in welding research. He has authored or co-authored over 65 conference, journal and technical publications on the evaluation of high strength steel weld metals, HAZ structure-property relationships and other materials science topics for naval, marine, offshore, and pipeline applications. He is the Chair of the Canadian Council of International Institute of Welding (CCIIW).

AVOIDING HYDROGEN INDUCED CRACKING

The presentation will discuss all aspects of hydrogen induced cracking, HIC, also known as cold cracking or delayed cracking. It will cover the causes of HIC, determining the susceptibility of welded assemblies to HIC, the detection of HIC and strategies to prevent the formation of hydrogen induced cracks.

Ken Thorn, CWB Group

Bio: Ken received BA. Sc. in 1976 and MA. Sc. in 1979 in Mechanical Engineering from the University of Waterloo. Ken has an exceptionally broad welding background which includes: welding procedure development, shop floor trouble shooting and problem resolution, conducting failure, metallurgical and weldability evaluations for a large number of clients from a broad spectrum of industries.
PRODUCTIVITY IN CANADIAN SHOPS TODAY

Our market is facing competition from all around the globe. Many ways are available to save money. But how many companies don’t know the real cost of their welding operations? What is the real cost of a foot long weld? Do we have the right design regarding the weld size? Where is the money is wasted? Many factors influence the cost of welding and may increase them, and in several cases, they could be minimized by following simple rules. This presentation will show some statistics and examples of real cases and highlights the potential of the CWB Value Optimizer productivity improvement program. If you know the costs of you welding gas and grinding wheels and are unaware of your arc time cost, this topic may be of interest to you.

Martin Daignault, B.Éd, IWP - CWB Group

Bio: Martin started with the CWB Group 10 years ago as training coordinator. He received a Bachelor of Education (UQAM) and graduated with a degree in management at (HÉC university). Martin started his career at Air Liquide in 1989. As a level III inspector, he also provides certification services to companies in the Montréal region. In his work at CWB, he has had the chance to visit thousands of companies working in the welding business mainly in Canada and also in France, Italy and Mexico. This gives him a good overview of different production methods used around the world. He is actively involved in the industry as the chair of CWA-Québec chapter and is a member of the National Technical Committee for Skills Canada.

WELD FAILURES, “ALMOST FAILURES” AND REPAIR SOLUTIONS IN SELECTED PROJECTS

Certain weld failures and repair solutions in carbon and stainless steels will be discussed. These will range from failures in carbon steel products for armoured vehicles to corrosion failure due to aggressive chemical liquors. A repair solution for an offshore crane and for nuclear pipework will also be discussed. The author will draw on his experience and show how the failures were analysed and how solutions were achieved. The presentation will illustrate that fundamental knowledge is a sound thing and that “cutting of corners” is not a wise path to take.

Mick Pates, CWB Group

Bio: Mick’s education includes a M. Sc in Welding Technology, a B. Sc. In Physical Metallurgy and he is also a Certified International Welding Engineer. He has been involved with joining and NDE in the nuclear, structural, aerospace, marine, petro-chemical, defense industries, micro-electronics and offshore production on a global basis. Mick currently works in the CWB Product Development Group and as an instructor.
<table>
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<tr>
<th>Time</th>
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<tr>
<td>8:00 AM - 8:45 AM</td>
<td>Registration &amp; Breakfast</td>
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<tr>
<td>8:45 AM - 9:00 AM</td>
<td>Opening Remarks and Introductions</td>
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<tr>
<td>9:00 AM - 10:00 AM</td>
<td>Speaker: Gregory Glinka, <em>University of Waterloo</em> &lt;br&gt;Topic: Contemporary Methods for Fatigue Life Assessment of Weldments</td>
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<tr>
<td>10:00 AM - 10:15 AM</td>
<td>Break</td>
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<tr>
<td>11:15 AM - 12:00 PM</td>
<td>Speaker: Martin Daignault, <em>CWB GROUP</em> &lt;br&gt;Topic: Productivity in Canadian Shops Today</td>
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<tr>
<td>12:00 PM - 12:45 PM</td>
<td>Lunch</td>
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<tr>
<td>12:45 PM - 2:00 PM</td>
<td>Speaker: Ken Thorn, <em>CWB GROUP</em> &lt;br&gt;Topic: Avoiding Hydrogen Induced Cracking</td>
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<td>2:00 PM - 3:15 PM</td>
<td>Speaker: Jim Gianetto, <em>CANMET</em> &lt;br&gt;Topic: Factors Influencing the Microstructure and Mechanical Properties of Pipeline Girth Welds</td>
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<td>3:15 PM - 3:30 PM</td>
<td>Break</td>
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<tr>
<td>4:45 PM - 5:00 PM</td>
<td>Discussion and Closing</td>
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To register, please call 1-800-844-6790, email info@cwa-acs.org or visit cwa-acs.org. You can also register online at: [www.cwaevents.org](http://www.cwaevents.org)
As a continuation of our CWA Insight Speaker Series, we are pleased to offer this new seminar.

**Speaker Bio**
Marie Quintana is the Technical Director & Chief Engineer, Consumable R&D for The Lincoln Electric Company. Ms. Quintana joined Lincoln Electric Cleveland in 1995 after a 17 year career in shipbuilding where she was involved in welding process development primarily for high strength steels. She is an active participant in Pipeline Research Council International activities and represents Lincoln Electric on the PRCI Board. She has been active in welding research for over 30 years with specific interest in arc welding consumables for steel construction and associated test methods. Ms. Quintana holds degrees in Materials Science and Metallurgy from University of California, Berkeley and University of Connecticut, respectively.

**The Seminar Purpose**
The purpose of this seminar is to provide experienced users with new insights and methods for improving weld consistency and mechanical performance, particularly for the higher strength grades. Also, this provides first time users of an HSLA steel with enough knowledge and techniques to ensure a successful transition from mild steel welding. Seminar to be held on April 11, 2013.

Please note that attendees will earn 0.5 CEU credits OR 5 hours toward professional development credits.

**Who Should Attend**
Materials Engineers, Designers, Specification Writers, Consultants, Production Managers, Welding Engineers & Supervisors, Quality Assurance Professionals, Educators, Students.

**Location**
- Alberta Innovates Technology Futures (AITF), 250 Karl Clark Rd., Edmonton, AB, T6N 1E4

**Sign up now:**
The registration costs are $425 for CWA members, $525 for non-members, and $150 for students. Applicable taxes are extra. The fees include course materials, continental breakfast, lunch and breaks.

To register, please call **1-800-844-6790**, email info@cwa-acs.org or visit cwa-acs.org.
Upcoming CWB Institute Courses

CWB

Welding Supervisor Seminar - Steel
This five day course is designed for Welding Supervisors who want to increase their knowledge of managing a Certified welding shop. This course is also of interest to engineers, shop foreman & quality assurance personnel.

- Milton - Feb 11-15
- Edmonton - Feb 25 - Mar 1
- Calgary - Feb 11-15
- Winnipeg - Jan 28 - Feb 1
- Dartmouth - Feb 18-22
- Langley - Jan 21-25

Welding Health and Safety
Want to expand your knowledge of welding health and safety and learn how to identify welding hazards in your welding shop? Get information on how to reduce the risk of accidents and injuries to your employees.

Welding Supervisor Seminar - Aluminum
This three day course is designed for Welding Supervisors who want to increase their knowledge of managing a Certified aluminum welding shop. This course is also of interest to engineers, shop foreman & quality assurance personnel.

- Milton - March 6-8

Welding Inspection Course Level 1
The Level 1 inspection course is 9 days of instruction, reviewing the necessary welding and welding inspection theory to challenge the Level 1 Welding Inspector certification examinations. Day 10 of the course gives you the opportunity to challenge the CSA W178.2 Visual Welding Inspector Level 1 certification examinations.

- Calgary - April 15-26
- Saskatoon - Jan 28 - Feb 8
- Dartmouth - April 8-19

Level 2 Upgrade Course
This seven-day course (52.5 hours) is designed for Level 1 Welding Inspectors who want to further increase their knowledge of inspection and testing techniques.

- Edmonton - Feb 6-15
- Milton - Feb 19-27
- Dartmouth - Feb 27 - Mar 8

ASME B31.3
This 1-day ASME B31.3 course will familiarize Welding Supervisors and Inspectors with the correct inspection requirements for oil and gas transmission pipelines, processing piping and related steel structures. At a general level, the course will cover key topics relating to the scope of the standard with respect to welding and inspection, use of applicable tables and charts to determine correct inspection methods, and the correct fit-up and inspection of critical welded components as they relate to the safe operation of oil and gas related piping and structures.

- Calgary - March 7

CSA Z662
This 1-day CSA Z662 course will familiarize Welding Supervisors and Inspectors with the correct inspection requirements for oil and gas transmission pipelines, processing piping and related steel structures. At a general level, the course will cover key topics relating to the scope of the standard with respect to welding and inspection, use of applicable tables and charts to determine correct inspection methods, and the correct fit-up and inspection of critical welded components as they relate to the safe operation of oil and gas related piping and structures.

- Calgary - March 6

QUASAR

QUASAR Internal Auditor Training
QUASAR’s ISO 9001:2008 Internal Auditor Training course provides you with the tools to help your company operate more cost effectively and efficiently.

- Milton - April 10-11
- Winnipeg - April 23-24

* Courses are offered in English Only unless specified it’s in French.
Materials & Processes
This detailed 5-day (40 hours) training course will provide NDT technicians and Quality Control personnel with an extensive understanding of the production, composition and properties of metals.

- Calgary - Mar 18-22

Radiation Safety & Protection (CEDO)
This five-day course (40 hours) will provide the knowledge and confidence for participants to assume the responsibilities of a Certified Exposure Device Operator.

- Edmonton — March 11-15
- Calgary — Feb 4-8

Industrial Radiography Certification Level 1 & 2
This seventeen day course (136 hours) will provide the NDT knowledge and the confidence for participants to assume the responsibilities of a Level 2 Radiographic Technician. This comprehensive course includes the theory and practical applications of the Radiographic Inspection method, a review and use of test equipment, along with the use of standards, specifications and procedures,

- Calgary — April 8-26

Ultrasonic Level 1
This five-day course (40 hours) will provide the NDT knowledge and the confidence for participants to assume the responsibilities of a Level 1 Ultrasonic Test Technician. This comprehensive course includes the theory and practical applications of the Ultrasonic Testing method, a review and use of test equipment, along with the use of standards, specifications and procedures.

- Calgary — June 10-14

Industrial Ultrasonic Inspection Level 2
This ten-day course (80 hours) will provide the NDT knowledge and the confidence for participants to assume the responsibilities of a Level 2 Ultrasonic Technician. This comprehensive course includes the theory and practical applications of the Ultrasonic Inspection method, a review and use of test equipment, along with the use of standards, specifications and procedures.

- Calgary — June 17 - 28
- Milton - April 19 - May 10

Radiation Safety Officer (RSO)
This five-day (40 hours) course is a skills development and professional upgrading course for personnel with industrial radiography experience. It is designed for the new or newly appointed RSO in charge of an Industrial Radiography Radiation Safety Program.

- Calgary — May 13-17

Liquid Penetrant Level 2
This five-day course (40 hours) will provide the NDT knowledge and the confidence for participants to assume the responsibilities of a Level 2 Liquid Penetrant Technician.

- Milton — Feb 25 - Mar 1
- Calgary - May 27-31
- Dartmouth - Jan 14-18

Magnetic Particle Level 2
This five-day course (40 hours) will provide the NDT knowledge for participants to assume the responsibilities of a Level 2 Magnetic Particle Technician.

- Milton — Mar 4 - 8
- Calgary - June 3-7
## CUSTOM SOLUTIONS TO MEET YOUR CORPORATE OBJECTIVES

<table>
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**Total Vehicle Price (CAD)**

$30,995.00  $24,151.00

Prices and content availability as shown, are subject to change and should be treated as estimates only. Actual base vehicle, package and option pricing may vary from estimate because of special local and pricing availability and pricing adjustments not reflected in the dealer’s computer system. Contact your client support representative for the most current information. Reference PQQ539466 11-15-11

For additional information on fleet pricing on other manufacturers, please contact Rosa.

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Share Your Knowledge
The CWA is now accepting Abstracts for the 2013 Annual Conference. For consideration, topics should fit within one of the Conference’s three streams:

Welding Technology
The focus of this stream is on research and applied research relating to welding. Suggested topics include: Advancements in Welding Technology & Application, Metallurgical Processes & Materials, Welder Health & Safety, Welding of Steel Structures/Components, with a particular focus on the following industry sectors: Construction, Shipbuilding, Energy, Steel, Automotive and Mining.

Non-destructive Testing and Evaluation
The focus of this stream is on the testing and evaluation of welded structures. Suggested topics include: Advancements in NDE/NDT Technology, Failure Analysis, New Inspections Methods, Best Practices, Certification, Codes and Standards.

The Business of Welding
The focus of this stream is on how to develop sustainable business practices that allow business owners to maximize business opportunities locally as well as expand successfully into international markets. Suggested topics include: Business Financing & Insurance, Government Funding, Securing Business Opportunities, Quality Management Systems, Importance of Certification, Welder Recruiting & Training.

Submitting Process:
Abstracts must be submitted in Microsoft Word format conforming to the following criteria: 200-300 words or less in length, and must provide sufficient detail for a fair assessment of the work to be presented. All abstracts must include authors’ names and contact information along with a photograph and an approximate 100 word biography.

Papers must be submitted in Microsoft Word format conforming to the following criteria: Not to exceed 15 pages, 11 point Arial font, 1.5 line spacing. Speaker details: Name, Job Title, Company and contact information (including email). Copyright status: Indicating ownership of material, noting any prior publication(s). Material must be submitted in electronic format to: Dan.Tadic@cwbgroup.org
We look forward to your contributions and appreciate your participation.

Important Dates:
- **February 24th**: Last date for Abstract submissions
- **March 30th**: Notification of acceptance
- **September 30th**: Last date for full paper submission
- **October 15th**: Power Point presentation submission
Welcome to the Canadian Welding Association WeldingIndustryJobs.org

The Canadian Welding Association has teamed with the Workopolis NicheNetwork to power WELDINGINDUSTRYJOBS.ORG, Canada’s largest and best career centre for the Welding Industry. Whether you are a Job Seeker looking for a rewarding and exciting career opportunity or an Employer, looking for that hard to find candidate that’s right for your operations, WELDINGINDUSTRYJOBS.ORG is your powerful, secure and confidential SEARCH solution.

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Hypertherm acquires AccuStream waterjet products company

Hypertherm, a U.S. based manufacturer of advanced cutting systems, today announced the acquisition of AccuStream, a Minnesota based manufacturer of waterjet cutting products.

The acquisition will advance Hypertherm’s strategy of providing customers with the optimum cutting technology—whether plasma, laser, or waterjet—for their particular cutting application, supported by the company’s control and software products for increased performance and ease of use. At the same time, AccuStream and its customers will receive access to Hypertherm’s substantial engineering resources and global infrastructure.

“AccuStream’s core values and focus on building reliable, highly precise cutting products makes the company a perfect fit for Hypertherm,” said Hypertherm founder and CEO Dick Couch. “We believe waterjet cutting is an excellent complement to Hypertherm’s existing plasma and fiber laser technologies and look forward to working together to advance the capabilities of waterjet technology.”

“Hypertherm’s worldwide sales and service infrastructure is ideally suited to expanding the availability and support of our waterjet products,” said Eric Chalmers, AccuStream’s co-founder and president. “I am also excited about joining a company with such a high level of commitment to its team, and focus on developing market-leading technology.”

Hypertherm does not plan any major changes to AccuStream’s operations. All positions including manufacturing will remain in New Brighton, Minnesota and no workforce reductions or consolidations are planned. In addition, Hypertherm plans to provide AccuStream associates with the full complement of Hypertherm benefits, including profit sharing and full participation in its employee stock ownership plan.

The transaction was structured as a purchase of substantially all of the assets and assumption of certain liabilities of Accustream Inc. Financial terms of the transaction are undisclosed.

AccuStream Inc. specializes in the quality engineering, manufacturing and sales of high-pressure waterjet components and replacement parts designed to optimize performance and lower costs for users. The AccuStream A and AS Series of waterjet intensifier pumps, featuring the company’s exclusive Advanced Intensifier Technology™ (AIT), are widely recognized for their outstanding reliability and cost-effective performance. AccuStream replacement parts are known for their quality and are available for all major brands of waterjet cutting machines.

Hypertherm designs and manufactures advanced cutting products for use in a variety of industries such as shipbuilding, manufacturing, and automotive repair. Its product line includes handheld and mechanized plasma systems and consumables, as well as fiber laser and now waterjet products, in addition to CNC motion and height controls and CAM cutting software. Hypertherm systems are trusted for performance and reliability that result in increased productivity and profitability for hundreds of thousands of businesses. The New Hampshire based company’s reputation for cutting innovation dates back more than 40 years, to 1968, with Hypertherm’s invention of water injection plasma cutting. The associate owned company, consistently named one of the best places to work in America, has more than 1,300 associates along with operations and partner representation worldwide.

For more information please visit http://www.hypertherm.com
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The CWB Group’s comprehensive Z662 Welding Procedure Registry plugs a hole in the industry by ensuring consistency with exceptional oversight. As an impartial, independent body, our Welding Procedure Registry reduces risks because our reviewing processes are thorough, while ensuring Weld Procedure Specifications (WPS’s) and Procedure Qualifications Test Reports (PQR’s) surpass current industry standards. If you’re eager to maximize your company’s potential and minimize risks, then contact us for more information regarding our Z662 Welding Procedure Registry at 1.800.844.6790.
Bernard has a new catalog available to help guide customers in their selection of the company’s semi-automatic MIG guns and consumables. The new full-color Bernard Semi-Automatic MIG Guns & Consumables catalog includes valuable product feature and benefit information, as well as comparative reference charts and amperage rating charts to make it easier for customers to determine the right product for their welding needs.

Bernard included full-page spreads in the catalog that feature details on its popular Bernard™ Q-Gun™ Series, along with its Bernard Dura-Flux™ Self-Shielded Guns and the new Bernard FILTAIR® Fume Extraction Gun. It also features information on the new Bernard T-Gun™ and TGX™ Semi-Automatic Guns (formerly Tregaskiss™ TOUGH GUN™ and TGX Semi-Automatic MIG Guns). Each page offers photos, diagrams and charts that are easy to read and compare with other products in the catalog.

Customers can also find information on Bernard consumables in the Bernard Semi-Automatic MIG Guns & Consumables catalog, including Centerfire™ Series nozzles, contact tips and diffusers, as well as various types of liners.

To order a copy of the new Bernard Semi-Automatic MIG Guns & Consumables catalog, please contact Bernard customer service at 800-946-2281 or info@bernardwelds.com. Copies are also available for download at http://www.BernardWelds.com/literature-downloads-p152361.
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Anyone who is interested, or who knows of someone that may be interested in this position, should submit a covering letter and their resume in writing to: Odessa Olinares, Human Resources.

Resumes can also be sent via e-mail to odessa.olinares@cwbgroup.org or faxed to 905-542-1318.

WELDING CAREER WORKBOOK
Promoting Welding to the next generation, the Canadian Welding Association Welding Career Workbook is now available to local High Schools.

To request your copies today, please email us at: info@cwbgroup.org
Diamonds are the strongest material known to mankind* yet even they can break. Above is a cracked diamond embedded in a drill bit used to drill through rock for mining. The bit was comprised of hundreds of diamonds which, in a few hours of drilling, had worn down and cracked. Contrary to popular belief, it seems diamonds aren’t necessarily forever after all.

Sometimes images of metals exhibit patterns worth pausing over. Steel Image of the Month is intended to share metallographic sights that one could find aesthetically pleasing. If we weren’t so technically minded, we might even call it “art.”

*strongest material under compressive loading to be exact.
Honeywell Safety Products introduced Uvex AcoustiMaxx Stereo Bluetooth eyewear, an all-in-one solution combining maximum impact protection with hands-free voice communication. Uvex AcoustiMaxx enables workers in remote or noisy environments to focus on the task at hand while remaining protected and in contact with their teams, improving safety and productivity on the job. This marks the first time Bluetooth-enabled eyewear is available for industrial applications.

“Uvex AcoustiMaxx is ideal for safety managers faced with protecting workers in environments where communication is challenging, yet essential,” said David Iannelli, senior product manager for Honeywell Safety Products. “This launch underscores our commitment to addressing specific occupational needs through leading-edge technology and innovation, and to supporting a safety culture in every workplace.”

Uvex AcoustiMaxx Stereo Bluetooth eyewear features a wrap-around lens design for maximum versatility and meets the ANSI-Z87.1-2010 standard for impact protection. It comes with Genesis® S lenses in both clear and gray to serve a variety of applications, as well as Uvextreme® high-performance anti-fog lens coating for long-lasting wear. An easy, economical lens replacement system extends the product’s lifetime value. At only 52 grams, the dual-purpose eyewear offers lightweight comfort.

In addition, Uvex AcoustiMaxx end-users enjoy crystal-clear, acoustically isolated, in-ear voice communication. Uvex AcoustiMaxx allows communication with cell phones, smartphones and any other Bluetooth-enabled voice communication product.

Dual-microphone technology reduces ambient noise pick-up, while a high-performance balanced armature driver delivers superior stereo sound. Howard Leight® SmartFit® and Accusonix®T replaceable eartips ensure sound isolation for extremely clear communication.

Uvex AcoustiMaxx provides six hours of continuous talk and approximately seven days of standby service. Its lithium-polymer rechargeable battery lasts up to 12 months. Water resistant, the product is FCC and Bluetooth SIG certified.

Uvex AcoustiMaxx Stereo Bluetooth eyewear is available now through major safety equipment distributors in the U.S. Contact Honeywell Safety Products customer care at 800-430-5490 for additional information and where it may be purchased. Uvex brand safety eyewear is offered for sale by Honeywell Safety Products exclusively in the Americas.

For more information please visit http://www.uvex.us
Does Canada have a labour shortage or a skills shortage?

A recent report highlighted evidence of a growing mismatch in the Canadian job market. Many people remain without jobs, even as many employers complain that they cannot fill available job vacancies. With the national unemployment rate at 7.4 per cent – well above the pre-recession level of about 6 per cent – and with 5.2 unemployed workers for every available job opening reported by employers, it would seem that Canada is not suffering generalized labour shortages.

To read the full article click on this link:
http://www.theglobeandmail.com/report-on-business/economy/economy-lab/does-canada-have-a-labour-shortage-or-a-skills-shortage/article5992219/
Winter Home Info brought to you by HUB International

Getting Your Home Winter Ready

Winter is a season celebrated by Canadians coast to coast. Some enjoy winter activities, some take off to sunny destinations! Whatever winter means to you, it is important to make sure your home can take whatever winter throws your way.

Here are some tips for protecting against common issues:

- **Prevent build up of ice and snow on your roof** - this can cause seepage, wall and attic cracking, and roof collapses.

- **Prevent frozen pipes** - drain and shut off pipes to outdoor faucets, install a low temperature alarm if you plan on being away.

- **Control heating system problems** - avoid fires, puff backs and smoke damage by servicing your furnace and boiler annually. Clean chimneys and flues regularly.

- **Going away on vacation?** - contact your insurance broker. You may be required you have someone check your home regularly if your home will be vacant. Have someone bring in your mail and alternate leaving lights on.

As a CWA member you are eligible for exclusive group rates on your Home & Auto Insurance! Call HUB today for a free, no-obligation quote.

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Railroads have been the backbone of North American commerce for over 100 years. Although critical to the movement of many of the things we take for granted, the rails that carry our TVs, fuel oil, cars and raw materials wind their way thought our country without much notice. These “ribbons of steel” provide an unbroken connection across the country thinks in part to thermite welding. A leader in this field of welding is Railwel Canada (part of the Railtech International) who for the past 65 years has been providing thermite welding products to the rail industry. As a company, Railtech understands that not all railways are created the same, and as a result they have become a global supplier by recognizing the specific needs of each of their customers.

Railtech’s long involvement in the rail industry has allowed them to become highly specialized in the science behind and application of rail welding technology as well as related track service activities. This experience is delivered worldwide, and is not always applied to the “rails” we associate with railroads. There are several kinds of “rail” and one interesting project was at the Rogers Centre (formally the SkyDome) in Toronto. In this case they welded a complicated rail design on the roof of Rogers Centre (Skydome) and the most amazing part is that the roof had to open and close so the structure of the design had to be carefully created.

Just goes to show that welding, regardless of where it starts, can lead to some interesting places.

For more information please visit http://www.railwel.com/