SKC

ENGINEERING

STATEMENT OF SERVICES

www.skceng.com

Applus RTD

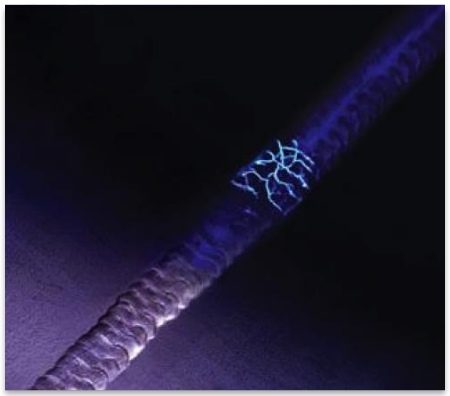
Group Overview

SKC Management Group

SKC Engineering

- Welding Programs & Procedures
- Weld Engineering & Consulting
- Structural Connection Design & Steel Detailing
- Quality Assassance
- Fracture Mechanics & Fitness for Service
- Welding Simulation

SKC Inspection & NDT



- VT, MT, PT, UT, RT
- Advanced UT Methods – Phased Array & TOFD
- Quality Control for major projects -
  - Bridges
  - Hydro & Water Line
  - Marine
  - LNG
- Mechanical Testing

Applus RTD

SKC Engineering

- Founded by Steve Siu in 1997, SKC is BC's premier provider of Welding Engineering & Related Services
- Retained by over 200 companies for their CSA Steel, Aluminum & Rebar programs
- Offices in Surrey & Victoria
- Active across Canada, the US & Asia
- Acquired by Applus RTD, Dec 2015

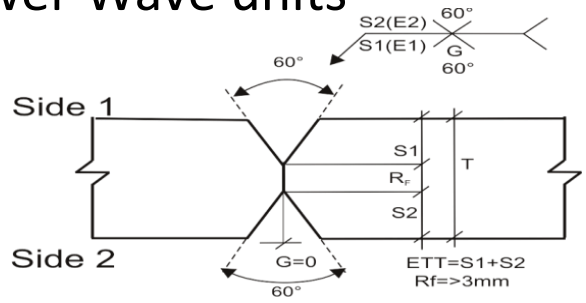
Steve Siu, B.A.Sc., P.Eng
IIW International Welding Engineer
CSA W178.2 Level III, AWS CWI
CSA W47.1, W47.2, W186 Retained Engineer

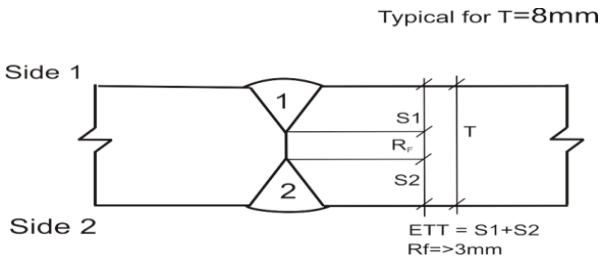
Welding Engineering/Consulting

- Technical support & instructions for new builds, refits & repairs
- Welding:
  - Welding Programs and Procedures
  - Testing
- Materials:
  - Materials selection
  - Quality assurance (Local & Overseas)
  - Failure analysis
- Advanced Solutions
  - Fracture Mechanics and Fitness For Service (FFS)
- Structural
  - Connection design & steel detailing
- Mechanical
  - Complex repair procedures
  - Cranes and hoists
  - Piping layout

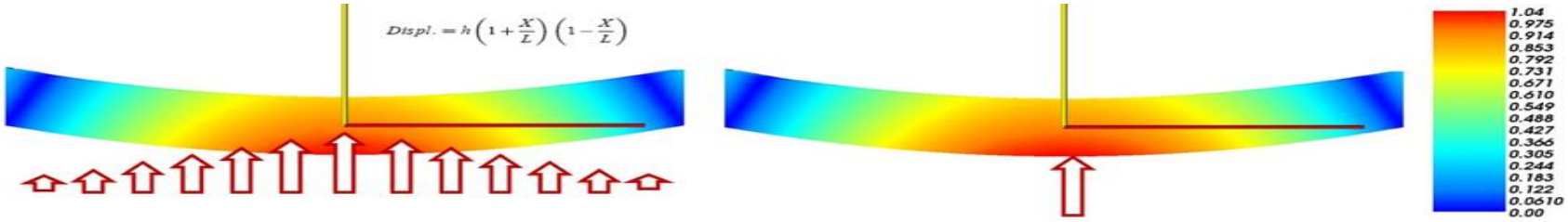
Welding Programs & Procedures

- Our core business is administrating welding programs to:
  - CSA (W47.1 / W47.2 / W186)
  - AWS (D1.1 / D1.2 / D1.5 / D1.6)
  - ASME (Section IX)
  - International welding standards & classification society's (Lloyds / DNV)
- Create welding procedures & welder qualification records
- Interact with regulatory bodies such as the CWB, BCSA, ABSA, Lloyds, ABS etc…
- Testing at your facility or at our welding lab with the latest Lincoln Power Wave units





Advanced Solutions



- Welding simulation using VrWeld
  - Distortion
  - Residual stress
  - Microstructure
- Fracture mechanics & fitness for service calculations
  - levels 1, 2 and 3

    (API 579/ASME FFS-1, BS 7910)
- Crack propagation modeling and life time evaluations

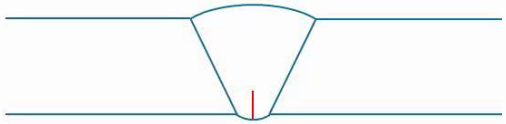
Mahyar Asadi, Ph.D., P.Eng
Ph.D. in Welding Engineering specializing in welding simulation & modeling

Fracture Mechanics Simulation

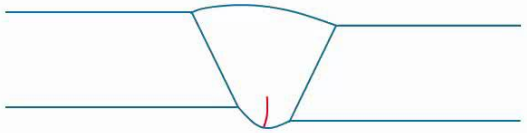
Pipe butt weld

- Comparison of root crack in a steel pipe full penetration butt weld for aligned and mis-aligned pipes
- Pipe dimensions:
  - OD 40″
  - Wall thickness $^{3}/_{32}$″
- Crack growth calculated for constant amplitude fatigue load cycling from 0 to 2 ksi

Aligned pipes



Mis-aligned pipes
- one pipe offset $^{3}/_{32}$″ horizontally and vertically



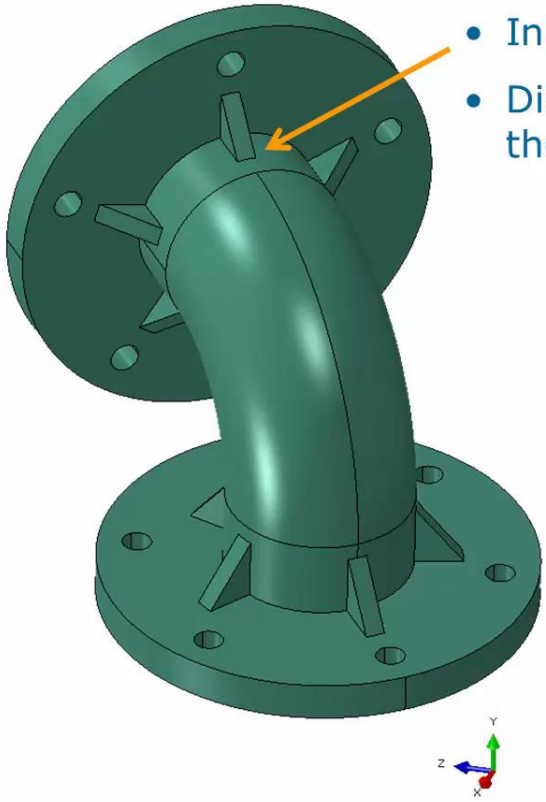
Initial elliptic crack: $^{1}/_{16}$″ deep
$^{1}/_{2}$″ along inner surface

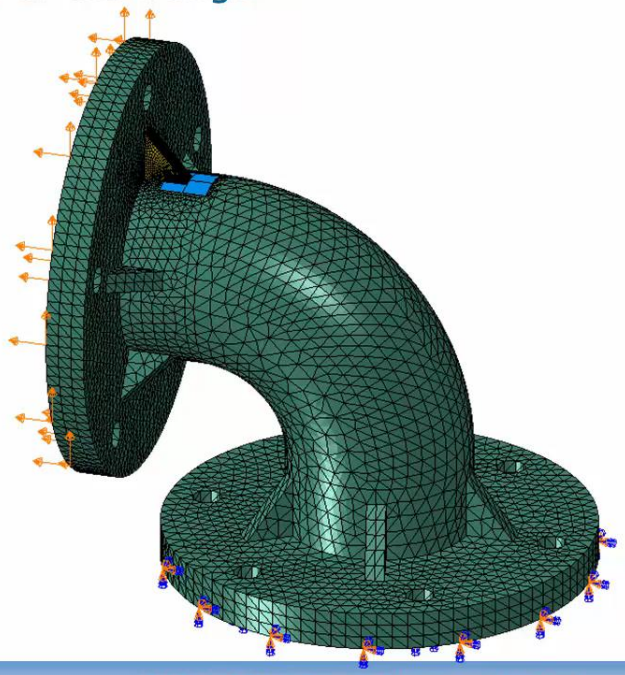
Pipe internal pressure: 0 to 2 ksi

Fracture Mechanics Simulation

Pipe elbow

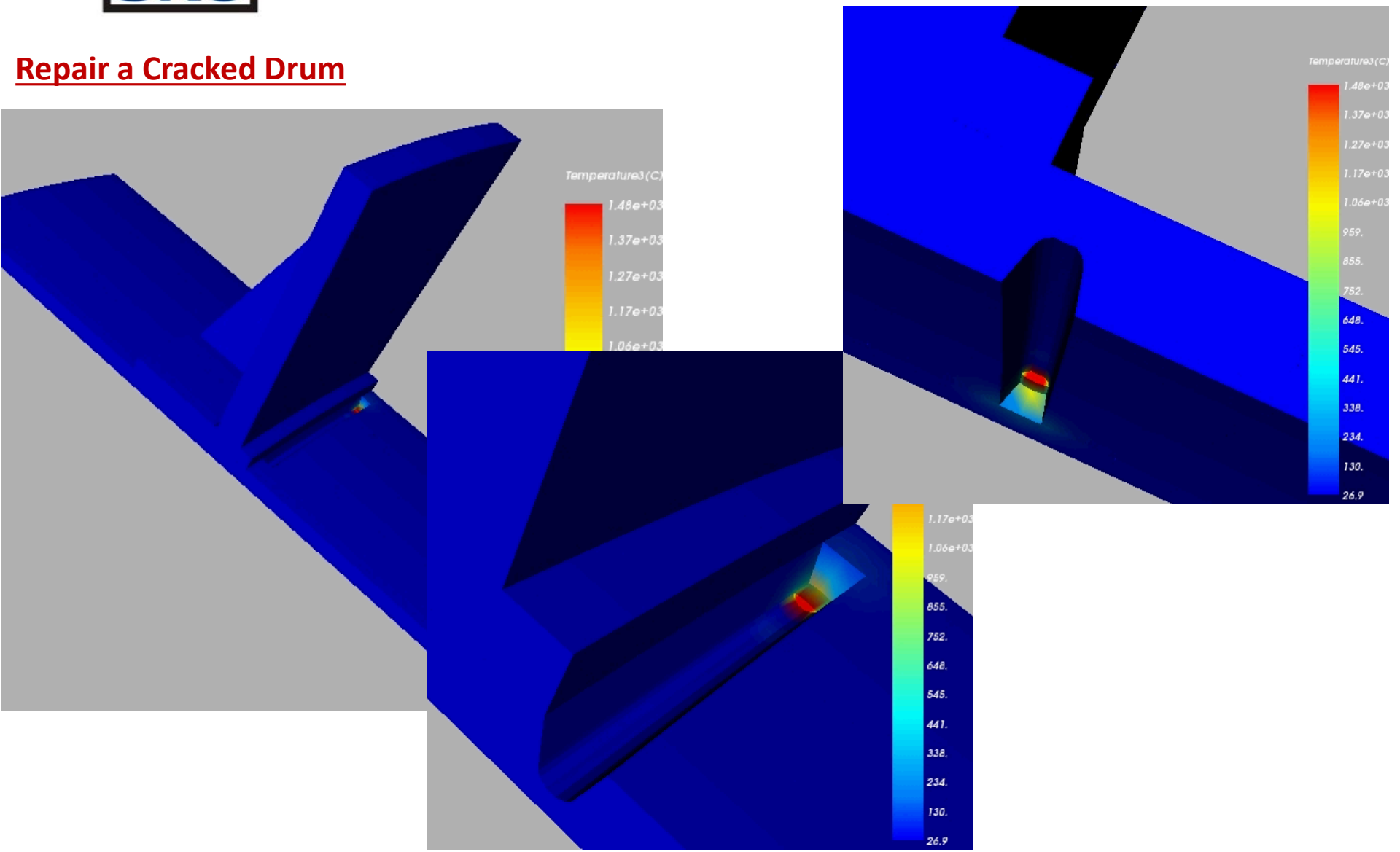
- Initial crack located at root of a stiffener
- Displacement controlled cyclic load on the face of the flange





Welding Modeling and Simulation

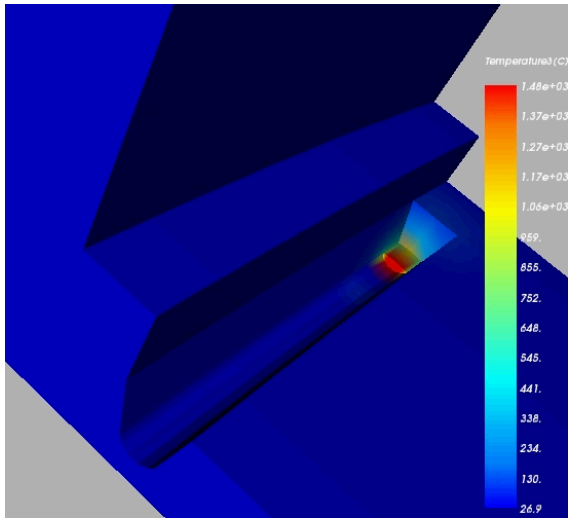
Repair a Cracked Drum

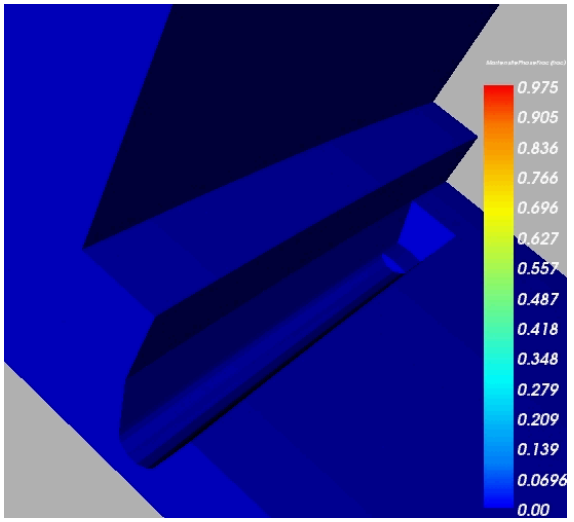


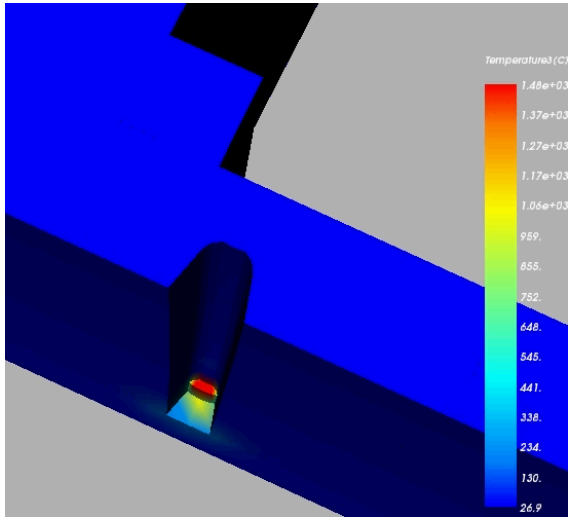
Welding Modeling and Simulation

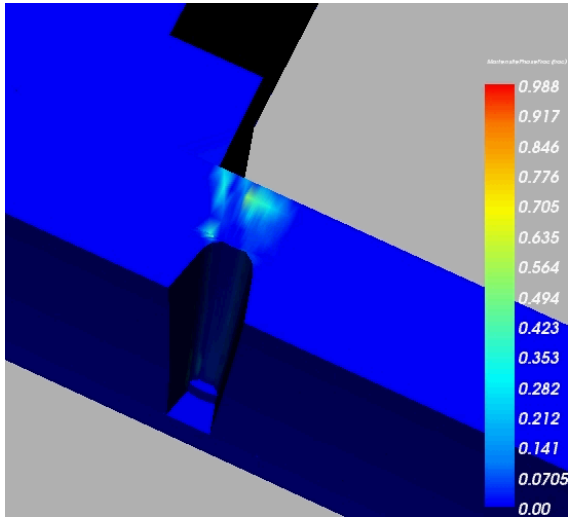
Repair a Cracked Drum

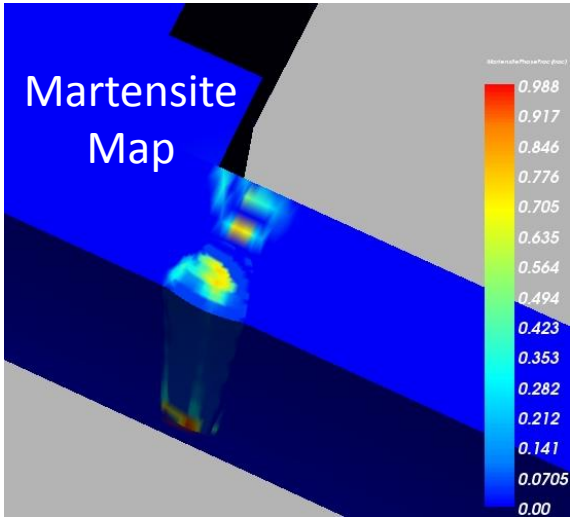
Martensite Formation







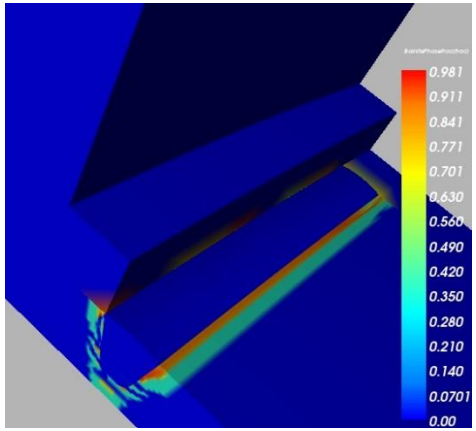


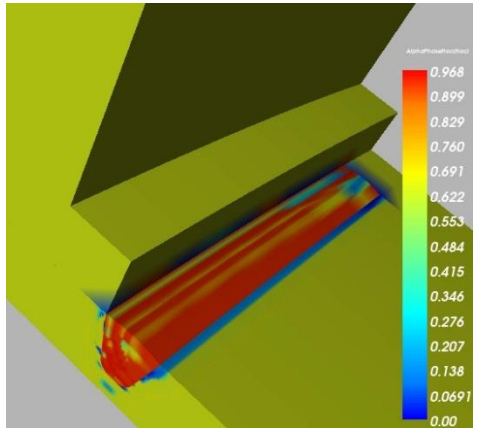


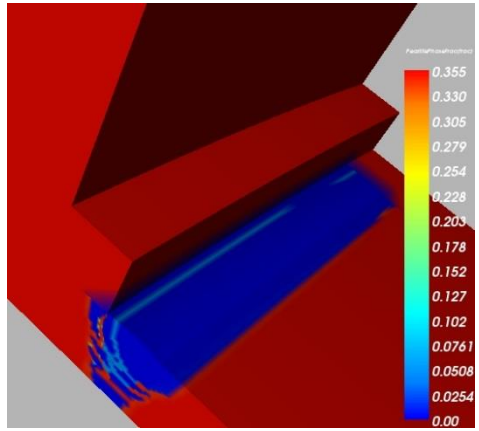
Welding Modeling and Simulation

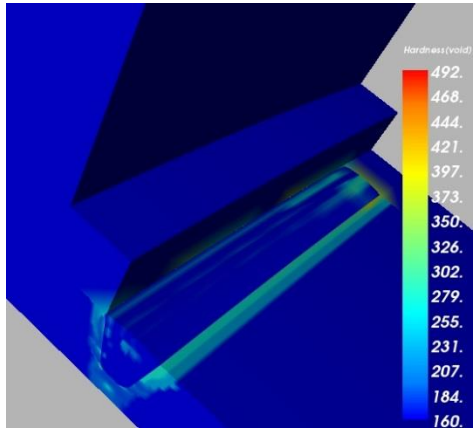
Repair a Cracked Drum – Microstructure Modeling

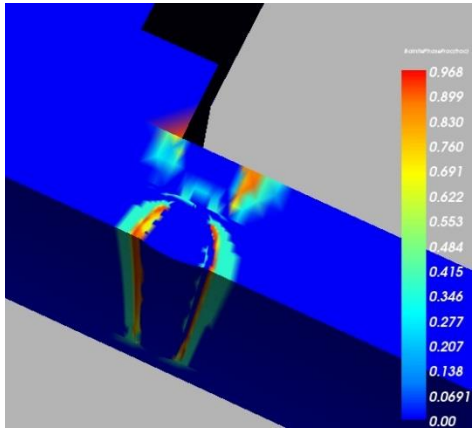
Bainite Map | Pearlite Map | Ferrite Map | Hardness Map

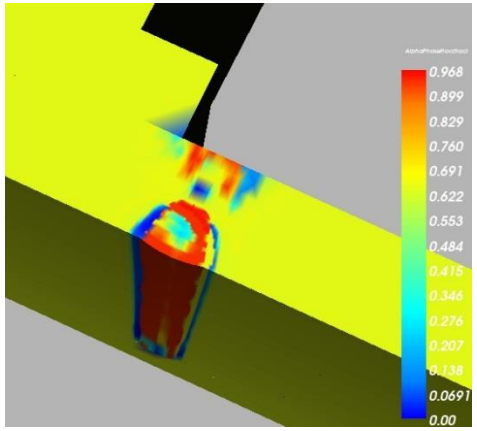


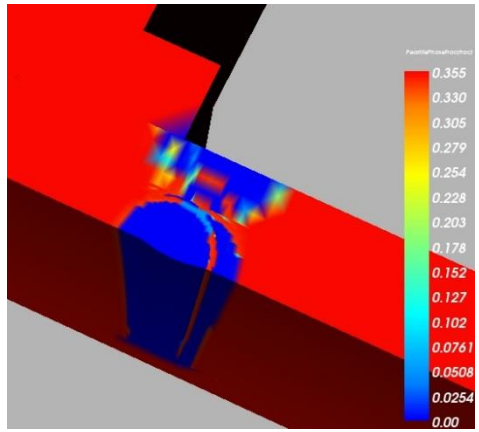


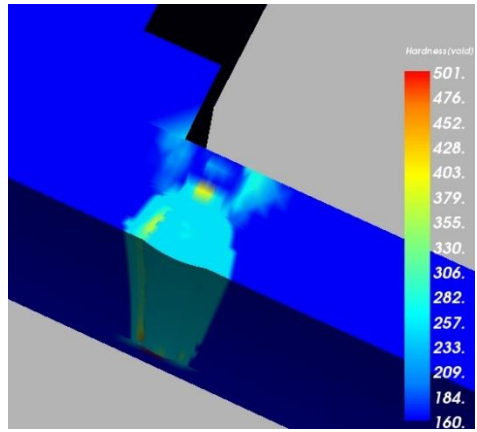










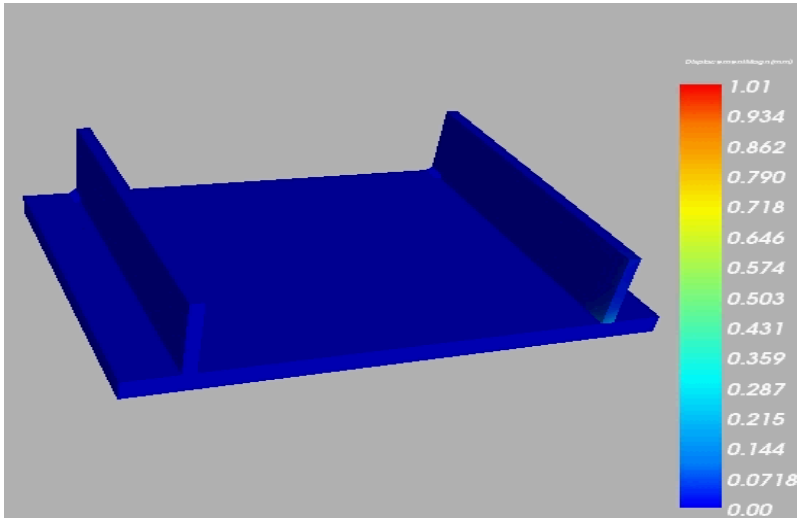


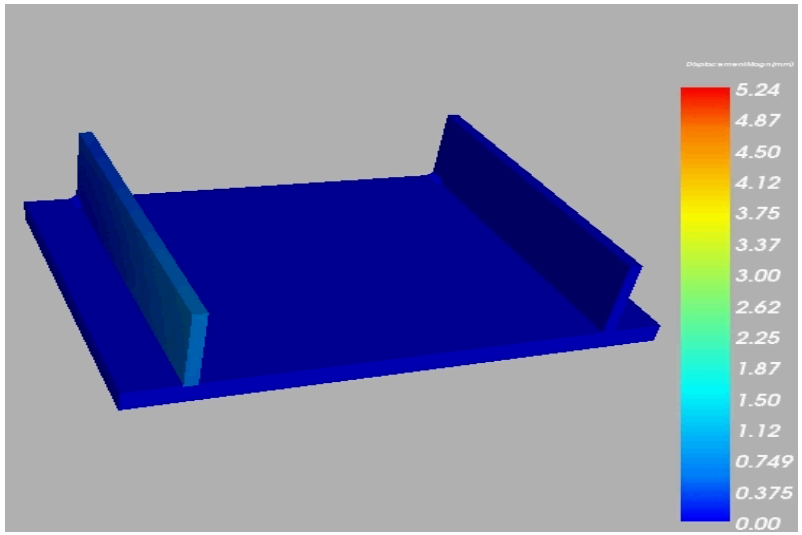
Welding Modeling and Simulation

Weld Sequence Pattern:

How to preform **multi welds**
to get minimal distortion

One of the most difficult engineering task





Lab Work & Failure Analysis

- Full service mechanical testing lab certified to CSA W178.1
- Our lab offers the following services:
  - Tensile testing of samples
  - Charpy Impact Testing
  - Bend Testing
  - Macro and Micro Hardness Testing
  - Macro-etch
  - Metallurgical Microscopy
  - Positive Materials Identification

Sepehr Gerami, M.A.Sc., P.Eng

Typical Industries

- Ship building, ship repair and other marine
  - Seaspan, Allied, Zodiak, Babcock, Esquimault, FMFCB
- Pipeline & Penstock
  - Cloudworks, Tyson creek, Mayo B, Kokish, Thretheway
- Bridgework
  - Shell Sharkbite, Port Mann, Kicking Horse Canyon, St Patrick's Bridge
- Structural Steel
  - Kelowna Hospital, York Theater, Spruce Creek Mine, Hamilton Transit
- Rides & Amusements
  - Disney Land Shanghai, Water slides, magic carpets, roller coasters
- Cranes & Lifting Devices
  - DP World Terminals, Falcon Equipment, Commercial Truck Equipment

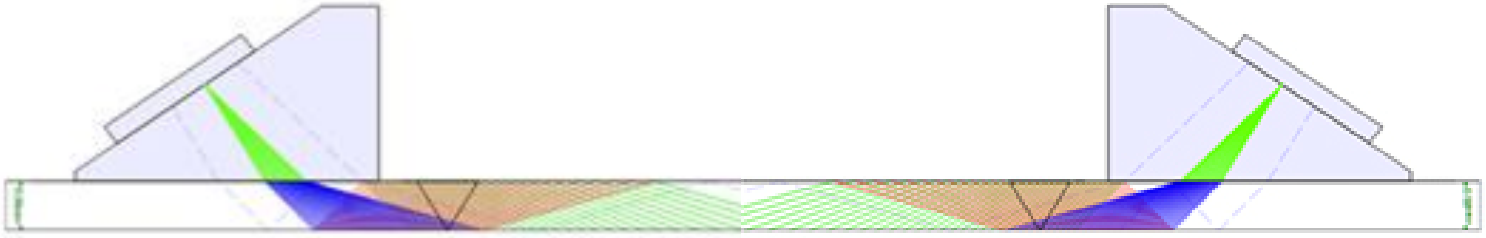
NDT & Inspection

- SKC / Applus RTD combines SKC's professional services with Applus' international NDT experience
- Full service NDT offerings including:
  - VT, MT, PT, UT, RT, ET, HT, PMI
- Advanced services including PAUT, TOFD & digital radiography
- CGSB & SNT-TC-1a certified technicians
- CSA W178.1 certified with level III oversight
- QA review of NDT reports, procedures & film

James Allan

CGSB Level III, UT, PT, MT

PCN Phased Array UT (PAUT)



Approach to QA/QC

- Review Contract Requirements and Define project deliverables
- Identify required QA/QC activity and required qualification of individuals
- Risk Analysis: Cost Vs Impact
- Develop custom quality manual and ITP
- Transparent reporting to client

QA/QC Deliverables

- Sealed welding procedures
- Daily activity reports, DAR
- Monthly executive/progress reports
- Signed Inspection & Testing Plan
- Final report on all QC & QA,
- Turn Over Package on all QA activity including supporting documentation; MTR's, NDT Reports, Inspection Reports etc.

Inspection & Test Plan

Inspection & Testing Plan (ITP)

Owner: _____ Date Issued: _____

Project: _____ ITP#: 3000mm OD - SAW Pipe

ITP Title: Penstock Fabrication Revision: 4

Item No.	Activity	Control Item	Project or Industry Standard	Inspection or Test Frequency	Acceptance Criteria	Record Document	Responsible Party: QC	Responsible Party: QA SKC
1	Steel Selection / Receiving	Chemical and mechanical testing	API 5L 44th Ed.	On material arrival for every heat	API 5L 44th Ed. Charpy V-notch min 40J @ 0C 1/2" thickness -4% (12.19mm) to +10% (13.97mm) . Design based on tensile not yield strength	> Raw material incoming inspection report > Raw material mill certs and test reports from the 3 test agencies	H,T,D	T,D (test in Canada)
2	Pipe Manufacturing	Welding Procedure Specifications (WPS) Issued	ASME Boiler and Pressure Vessel Code - Section IX	Initial Set-up	API 5L 44th Ed.	> Weld procedure, SAW & procedure qualification record	H,D	V
		Repair **Welding Procedure** and welder qualification		Every repair welder	API 5L 44th Ed.	> Welding procedure, SMAW & procedure qualification report	H,D	V
		Welding Consumables control		Random throughout production	API 5L 44th Ed.	> Welding Flux MTC > Welding wire & rod MTC	H,I,T,D	V
		Forming Control (Diameter, weld bevel, root gap etc.)	API 5L 44th Ed.	Each pipe	API 5L 44th Ed.	> Visual and dimensional inspection record	H,I,D	W,V
		Forming Control (Bell & Spigot) exterior circumference, ends..		Each pipe as applicable	API 5L 44th Ed.	> Visual and dimensional inspection record	H,I,D	W,V
		Coil scalping/splicing		100% UT Each splice	API 5L 44th Ed.	> Weld procedure	H,I,D	W,V
3	Weld NDT	Visual Inspection	API 5L 44th Ed.	QC 100% of all welds QA 20% every shift	API 5L 44th Ed.	> Visual inspection record	H,I,D	W,S,V
		UT Testing	API 5L 44th Ed.	QC 100% of Each Weld QA 10% each shift	API 5L 44th Ed.	> UT Test report	H,T,D	W,S,V
		Repairs		QC 100% of Each Weld QA 50% each shift	API 5L 44th Ed.	> UT Test report	H,T,I,D	W,S,V
		Liquid Penetrant		100% of each penchole weld	API 5L 44th Ed.	> PT Test report	H,T,D	W,S,V
4		End Preparation & Dimension	API 5L 44th Ed.	Each pipe prior to coating	End preparation drawing	> Visual and dimensional inspection record	H,I	M
		Weld documents	ASME B31.3 Cat M Fluid Service	Each pipe prior to coating	All documentation complete and compliant with this ITP	No record provided		H,V
		Finished pipe inspection	API 5L 44th Ed.	Each pipe prior to coating	Pipe is compliant with this entire ITP	> Finished product inspection record	H,I,D	H,I,D

Responsible Party Legend:
I - Inspect, W - Witness, H - Hold (Can't proceed to next manuf. step), D - Document,
T - Test, V - Verify (Document review) S - Surveillance (Shop review)

ITP Acceptance	Initial	Date
Owner		
Contractor		
SKC		

Applus RTD

Summary

- For 18 years SKC has been delivering on its mission to provide the **best possible service** for our clients in the fields of **Welding Engineering, Inspection & Non-destructive Testing**
- Newly acquired by Applus RTD, expanding our geographic reach
- We have a diverse set of skill and talents in our field offering a perfect combination of advanced technical knowledge combined with practical welding experience
- We are a progressive and growth and are always looking to take on new challenges
- We look forward to working with you