

Adaptive robotised post-weld treatment to enable sustainable designs

Results from FFI-MIDWEST presented by:

Joakim Hedegård, Swerim

Erik Åstrand, Volvo CE

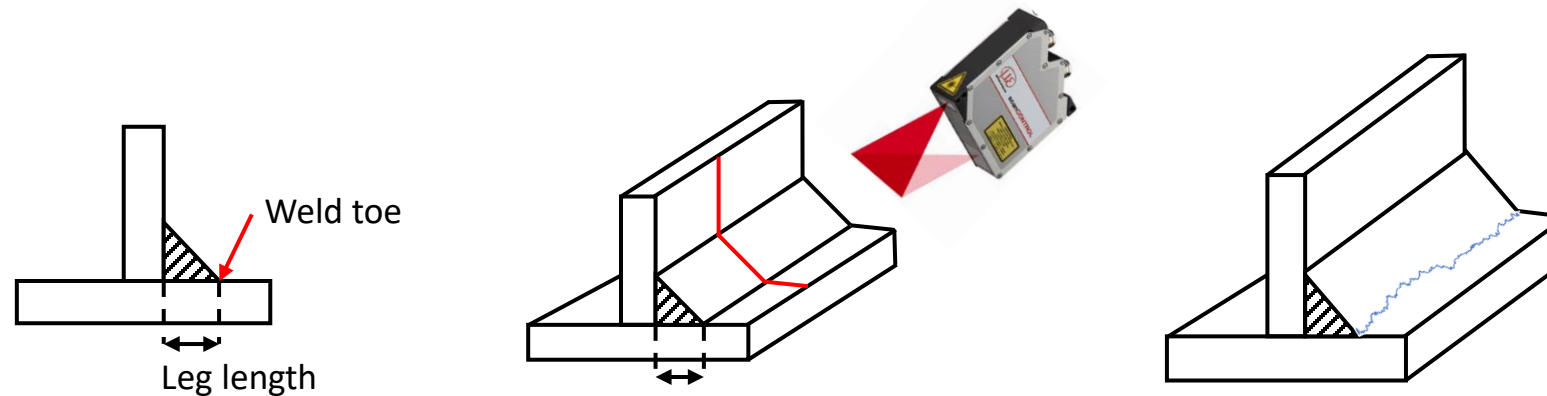
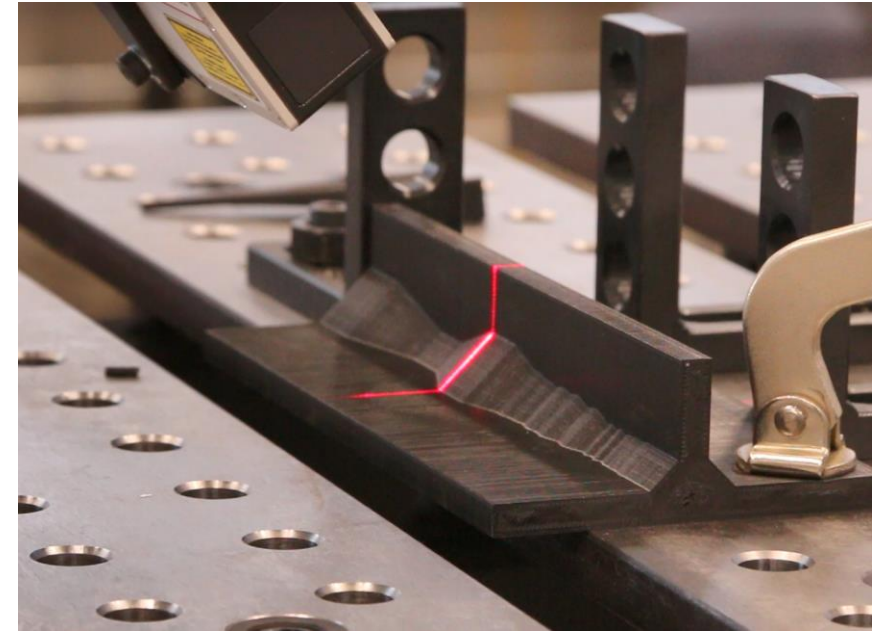
Alexander von Essen, Winteria

Images also from Kurt Broeckx, HIAB, Christian Thune, Toyota MH,
Leif Bäckman & Mikael Reinberth, SSAB

FFI-MIDWEST

The idea with a mechanised post-weld-treatment in robot with an adaptive robot path:

Weld a component, scan the weld and arrange an adapted robot path along the weld toe, treat it with a fatigue-improving technique.



- Laser scan deliver info on weld-toe position along the weld
- Calculations based on this gives an adapted robot path, that follows the weld toe line very accurately

MIDWEST

MED FINANSIERING FRÅN

FFI Fordonsstrategisk
Forskning och
Innovation



MIDWEST – an FFI project enabling robotization of important weld improvement methods

- Scope and objective

Mechanised post-weld treatment in welding robot: weld a component, create an adapted path along the weld and treat to reduce stress and increase fatigue life.

- Partners

Swerim, KTH, Chalmers, Volvo CE, HIAB, Gestamp, ToyotaMH, ABB, SSAB, Winteria, Weld-Hit, HiFIT. And Robotdalen as subcontractor to Swerim.

- Results

Adaptive treatment in robot (HFMI + TIG) very successful

Adaptive robotic grinding: proof of concept

Very good fatigue results

New product to come – Automated PWT path adjustment

- Financing

VINNOVA FFI-sustainable production
7.8MSEK whereof 3.9MSEK from VINNOVA

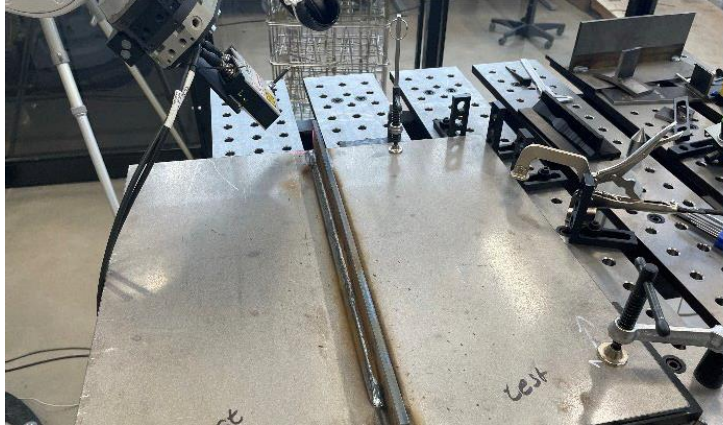
- Project duration & lead

2020-11-13 – 2023-12-31

Joakim Wahlsten & Joakim Hedegård, Swerim



MIDWEST specimens



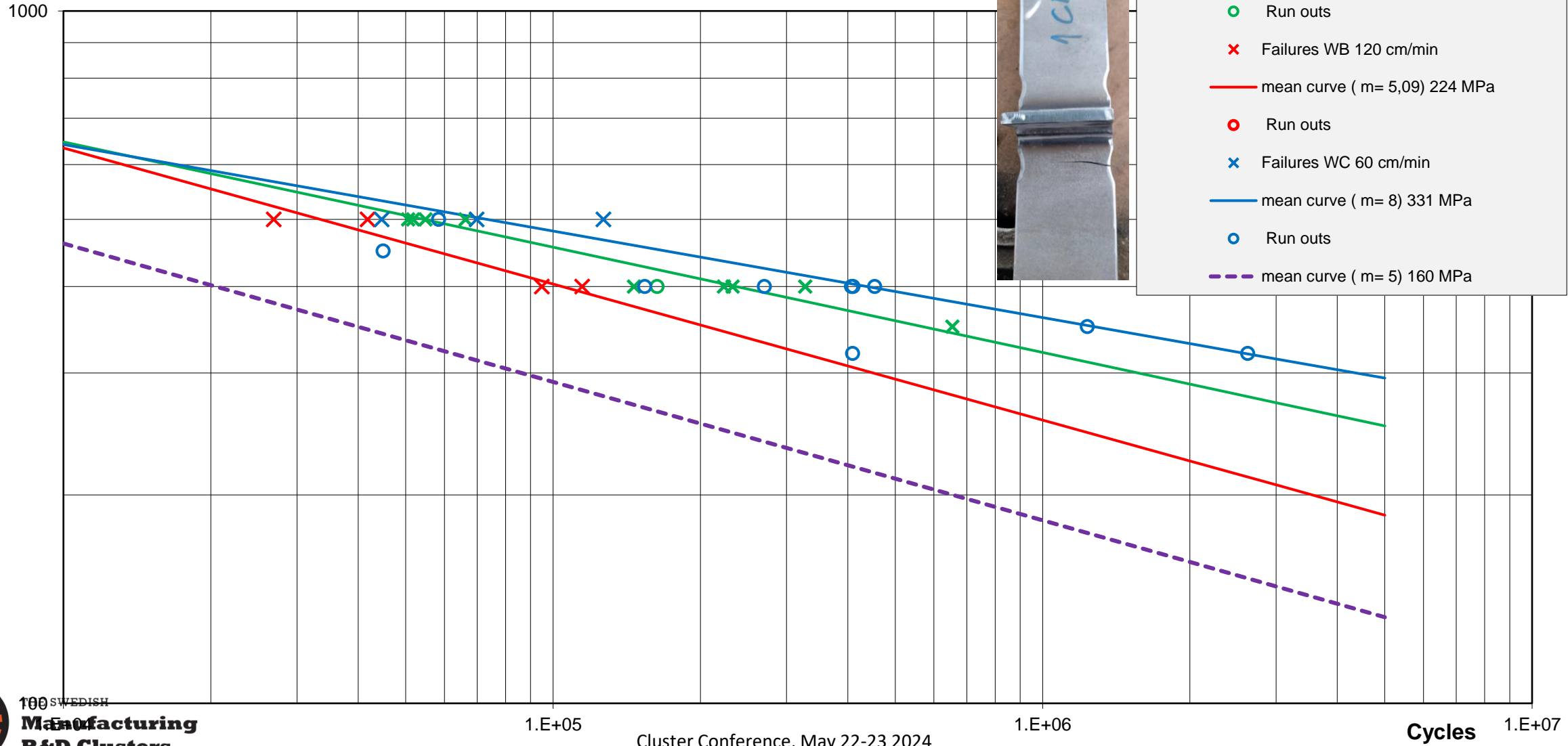
Post weld treatment of welds in different shapes

Fatigue could initiate on edges or irregularity in base material instead of in the weld toe.



FATIGUE RESULTS – SSAB specimens

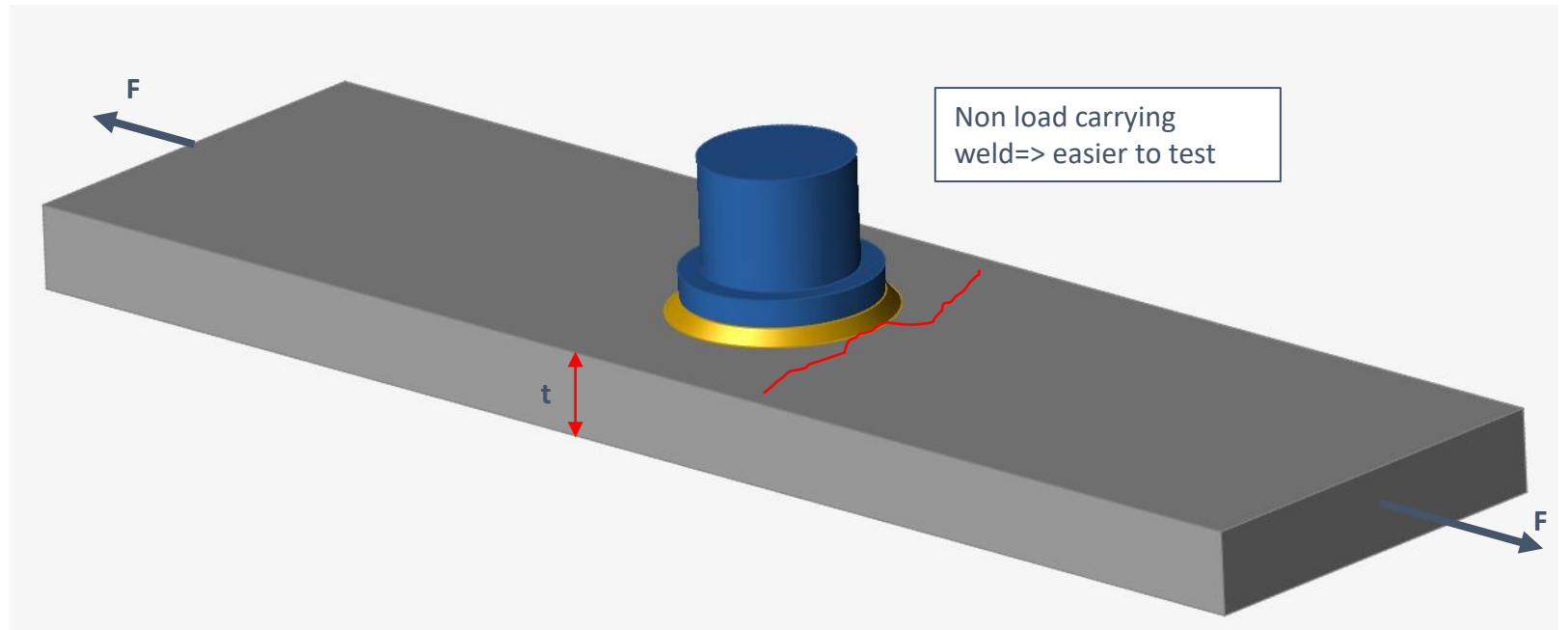
σ_r [MPa]



MIDWEST Toyota demonstrator

Axle on plate

- Very common joint type
- How much thinner can the plate be made, with additional PWT (equal life)?

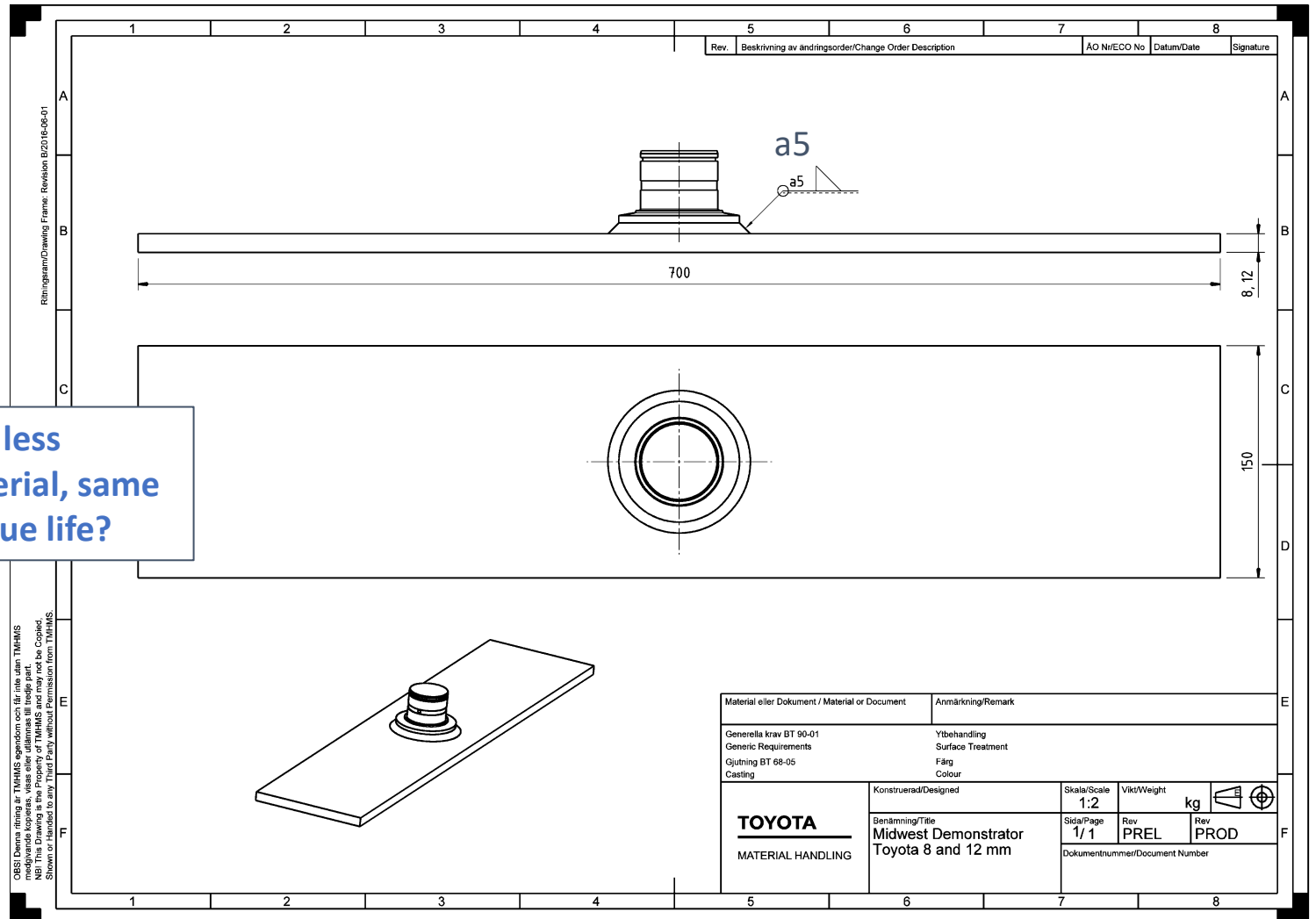


MIDWEST Toyota demonstrator

➤ Four versions, 355 steel:

Name	t	PWT
Base design	12 mm	No
Thin plate	8 mm	No
Thin plate	8 mm	HFMI
Thin plate	8 mm	TIG

30% less
material, same
fatigue life?



MIDWEST Toyota demonstrator

Welding by robot



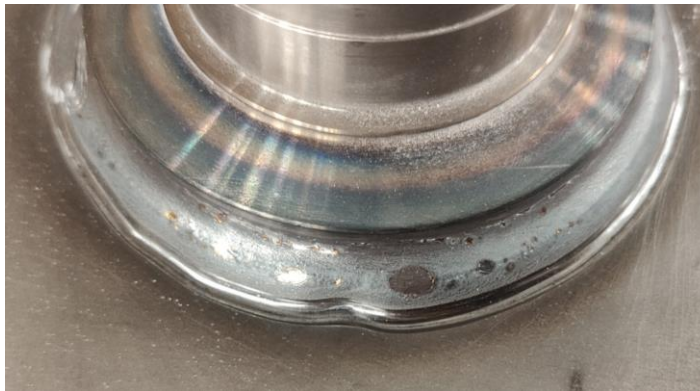
PWT by robot



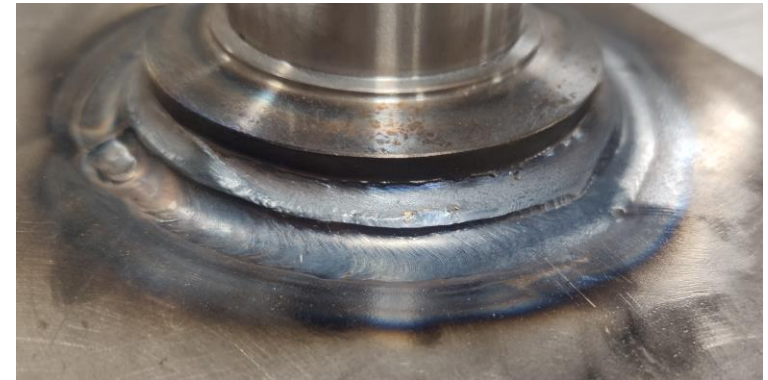
MIDWEST Toyota demonstrator



As welded



HFMI

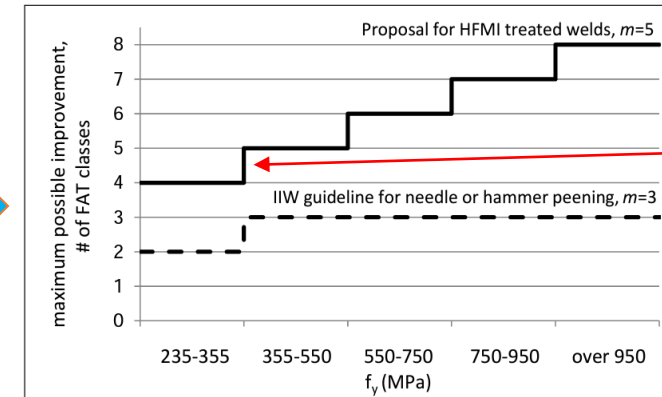


TIG

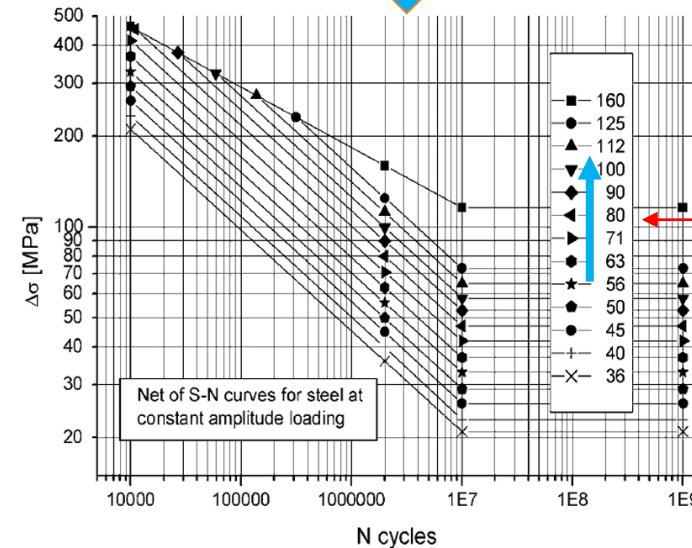
MIDWEST Toyota demonstrator

Adaption of FAT class to HFMI results

	12 mm	8mm	8mm+HFMI	
FAT				MPa
Stress range				MPa
Stress alt. Factor				
Thickness factor				
Stress range				MPa
Risk of failure 50%				
Thickness	12	8	8	mm
Adjusted FAT	78,4	78,4	142,2	MPa
Life	558229	165401	615938	



IIW recommendation
4-5 classes increase
for 355 steel



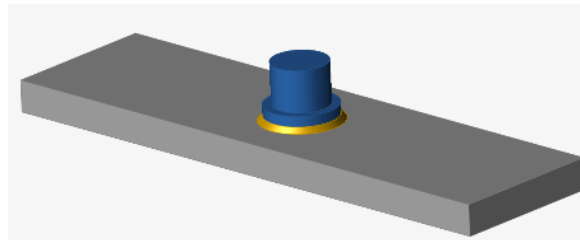
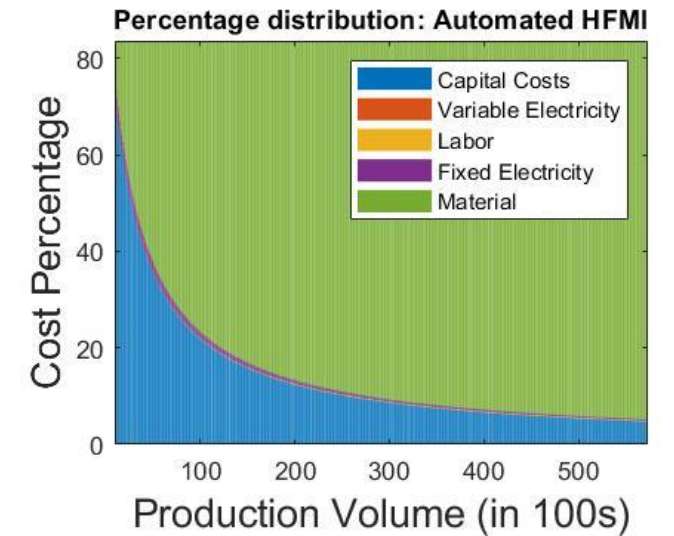
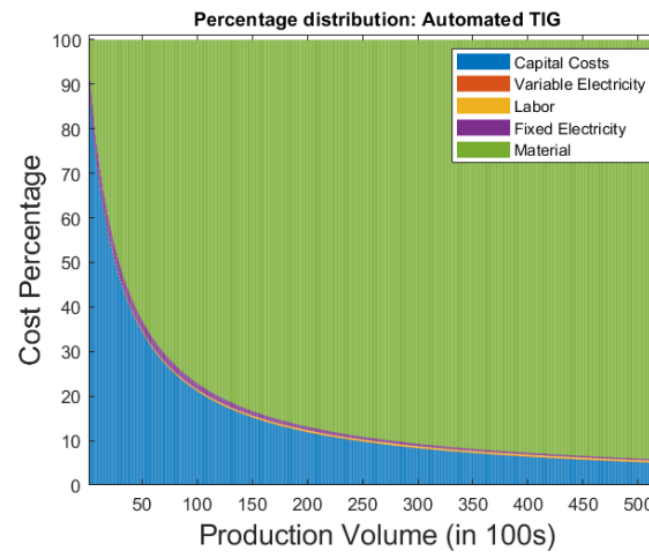
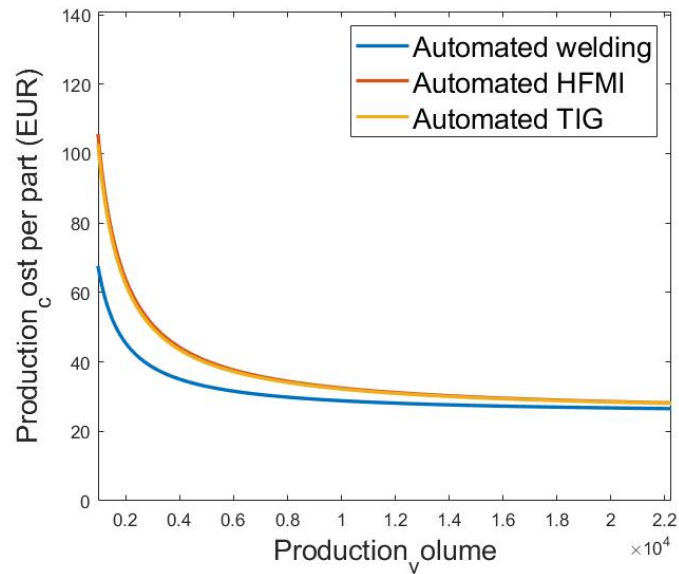
TMH demonstrator:
~5 classes increase



MIDWEST Toyota demonstrator

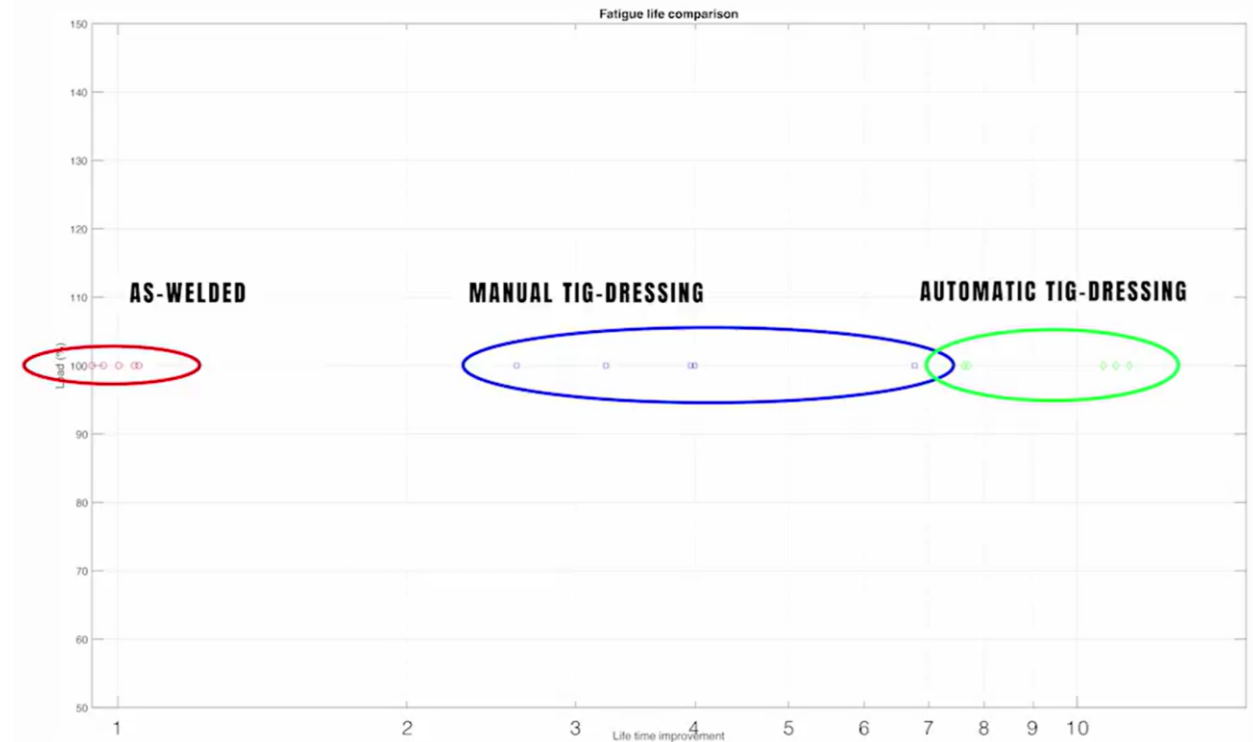
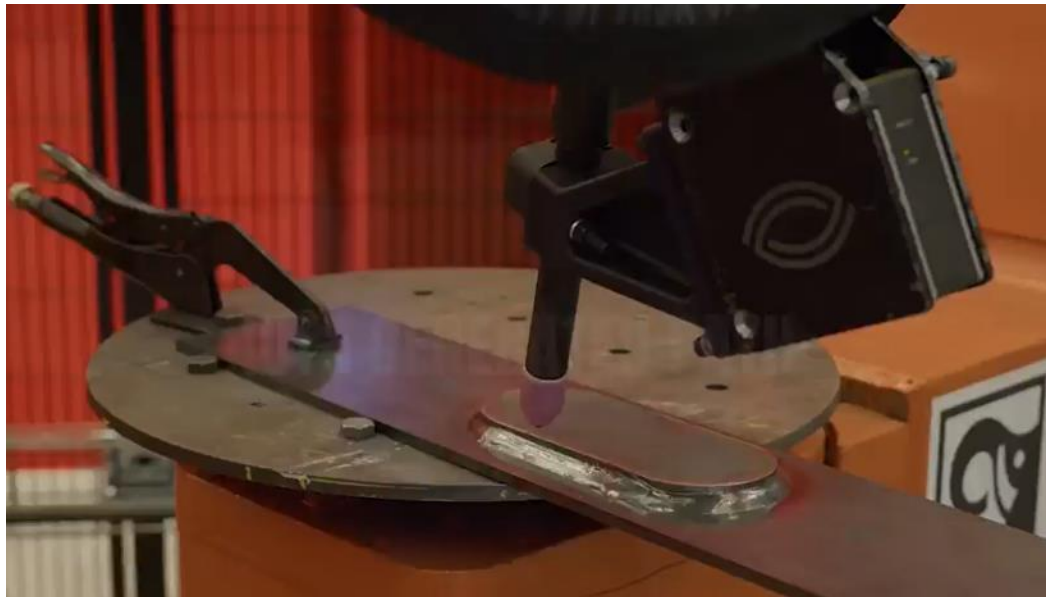
- The developed robotized PWT works very well
- A 12 mm plate can be replaced with an 8 mm plate for regular steel
- Weight reduction 30% with equal life
- More spread in these fatigue results for HFMI and TIG
- TIG gives higher life but more heat deformation
- Further gain possible with HS-steel, lower design stress range and optimised PWT

MIDWEST - LCC for Toyota demonstrator

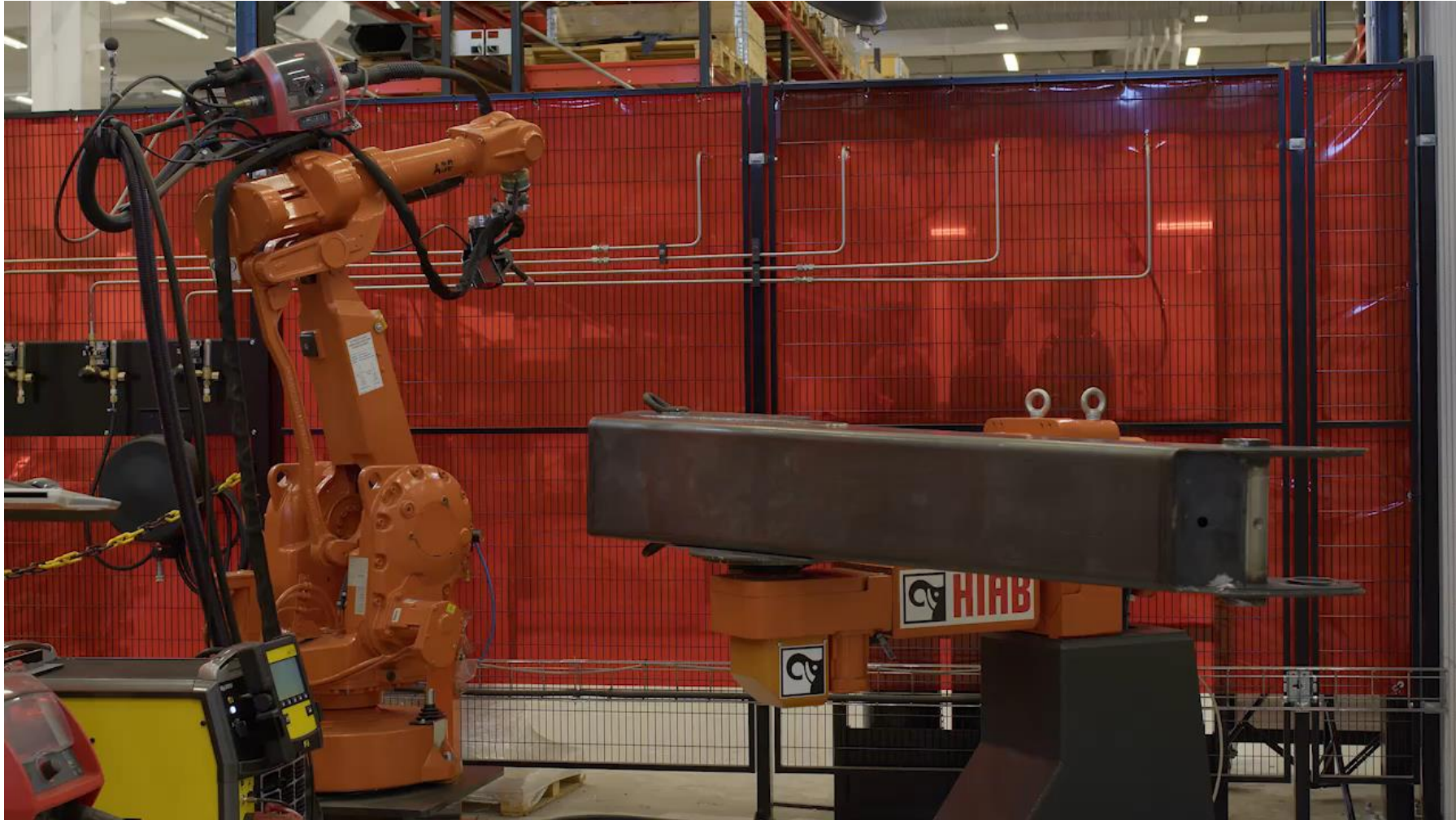


MIDWEST Volvo+HIAB demonstrator

- The developed robotized TIG-process works very well
- The process windows are larger than for manual TIG
- Significantly increased fatigue life



MIDWEST Volvo+HIAB demonstrator



Conclusions

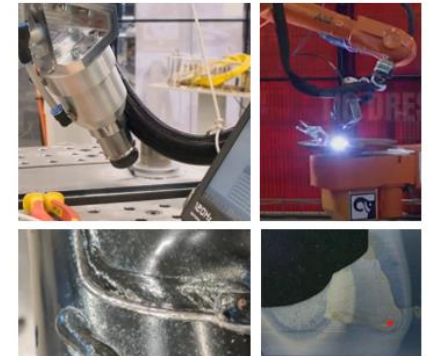
- The developed robotized PWT with adaptive path works very well for TIG & HFMI
 - Weight reductions of 30% or more are possible
 - Substantially increased fatigue life for welded designs treated with robotized PWT
 - Further gain possible with HS-steel, and optimised PWT
 - New product to come – Automated PWT path adjustment
 - The new possibilities – and other PWT methods - are to be further explored in a MIDWEST-2 that will be applied for.
- Are you interested in participating? Contact:

Joakim.hedegard@swerim.se & Joakim.wahlsten@swerim.se

MIDWEST - Mechanised Post-weld treatment of welded structures for automotive and cargo

Mekaniserad efterbehandling av svetsade konstruktioner för fordons- och lastapplikationer

Open report
Publik rapport



Authors: Joakim Wahlsten, Joakim Hedegård, David Franklin, Zuheir Barsoum, Kaushik Iyer, Yuki Banno, Gustav Hultgren, Erik Hellström, Kurt Broecker, Lars Rydahl, Robin Kadi, Erik Åstrand, Anton Johansson, Michael Roll, Mikael Reinberth, Torbjörn Narström, Leif Bäckman, Christian Thune, Angelica Djurberg, Rolf Andersson, Michael Neher, Amar Björnsson, Eric Lindgren, Martin Engman, Alexander von Essen

Date: 2024-01-31

Project in: FFI Sustainable Production / Hållbar Produktion



THE SWEDISH
**Manufacturing
R&D Clusters**

Cluster Conference, May 22-23 2024



Automatic PWT and Beyond

Commercialization of the research results

Yesterday

Today

Tomorrow

Joint preparation

Joint tracking

ONWELD
QINMAN

Digital VT

Automated QA

MIDWEST

Automatic PWT



MIDWEST etc.

Autonomous path planning



Autonomous path planning

Possible applications

Automated treatment of the joint or selected part of the joint

Automatic repair

Self-adjusting production cells

Full 3D joint tracking of complex geometries

Weld sequence planning in multi-layer welds including WAAM



Automatic PWT module ready

Working module for ABB robots.



Thank you for the attention!

Questions ?

Contact: Joakim Hedegård, Swerim
joakim.hedegard@swerim.se