LAPIN AMK
Lapland University of Applied Sciences
Industry and Natural Resources
Arctic Steel and Mining R&D-group

METNET seminar, 18\textsuperscript{th}-19\textsuperscript{th} April 2018, Vilnius, Lithuania

On Arctic Welding
Contents:

• Introduction

• First project: WeldArc

• Second project: ArcDigi
Arctic Steel and Mining R&D-group

- Destructive testing
- Measurement services
- Formability testing
- Failure analysis
- Welding research
- Wear testing (included in measurements)
- Mineralogical research and analysis
- Production technology services
- Education

Personnel in research group:
- ~ 5 University degree
- ~ 5 Bachelors degree

Activities
- Projects
- Services
WeldArc
1.4.2015-30.9.2017

Improvement of productivity and quality of welding on special steels in arctic conditions
Arctic business areas

Business opportunities in the arctic regions
Approach

• Reliable guide for **preheating** and repair welds in field conditions

• Possibility to test welding in **harsh conditions indoors** at Cold Laboratory. (Temperature, wind chill, moisture controllable)

• Promoting usage of new high and ultra high strength steels in energy efficient manner

• Improvement of **ecoefficiency** through proper material selection

• Overall increase of **knowledge** on arctic operations
Case studies

• Research and reporting focused on case studies from companies

• Documenting of field testing in real conditions on real subjects

• Comparison of procedure in Cold Laboratory vs. in reality / field conditions

• Where applicable, test of design with prototype before full scale implementation

• Enhancement of information exchange between end users due to networking
METNET seminar, 18th-19th April 2018, Vilnius, Lithuania

Applications
Possible benefits

- Added **reliability** for welding instructions for novel steels

- Increase of **knowledge** about arctic welding and real-time controlling of harsh conditions on laboratory scale.

- Increase the work safety

- Enhancing of national and international competitiveness of enterprises by creating new solutions

- Enhancing the export of welding technologies

- Increase in **ecoeffeciency** of machines and constructions
Cold laboratory as a welding environment

- Increase of knowledge about arctic welding and real-time controlling of harsh conditions comprises of:
  - Dividable 2 chamber test space
    - Big chamber -40°C - +30°C (12.5m x 5.5m x 2.5m)
    - Small chamber -50°C -+80°C (4.5m x 2m x 2.3m)
  - Wind conditions simultaneously 33 m/s
  - Spraying of supercooled (=below freezing point) water as an option
  - Equipped with exhaust removal equipment
  - Other tools may also be tested, such as:
    - Angle grinders, cutters, welding tractors, etc.
Cold laboratory as a welding environment

Arctest-room
-50°C .... +80°C

Imtech-room
-40°C .... +30°C
Monitoring of welding conditions
Welding equipments

Kemppi FastMig X 450

Wise – product line:
Wiseroof+
WiseThin+
WisePenetration
WiseFusion

Retco conveyor

+ Retco preheating unit
Czech Technical University in Prague, CTU

- International collaboration
- Research and development of welding
- Prof. Jakub Dolejš
- Ph.D. student Kateřina Šefčíková
  o Research on welding parameters of hybrid beams
- Mechanical properties of welded joints
  o Tensile test, impact tests, hardness, FE-SEM
- Co-operation with SSAB in Finland, Sweden and Czech
ArcDigi

Digitalisation in Special Steels Construction Process Management

1.10.2017-30.9.2019
Digitalisation in Special Steels Construction Process Management (ArcDigi)

• The overall goal for the project is to develop and apply digitalised solutions (ArcDigi) for the execution of special steel constructions in order to gain the precision and quality control of manufacturing.
• This promotes the utilization of special steels which increases the use of lightweight components in steel constructions resulting in more energy efficient solutions and applications.
• The business potential of SME’s related to the steel construction is boosted with the developed ArcDigi solution.
Execution process

Execution specification
Part and assembly drawings
Welding plan
Material and product standards
Quality control plan
Installation plan

Resource acquisition
Production planning
Manufacturing
Quality control
Installations

Purchasing specifications
Material certificates
WPQR
WPS
Welder qualification documents
Work plans
Inspection documents
Final documentation
ArcDigi toolbox

- design
- guidelines
- purchasing
- materials
- manufacturing
- quality control
- final documentation

METNET seminar, 18th-19th April 2018, Vilnius, Lithuania
Background (ArcDigi)

• One of the most challenging areas in the execution of special steels structures is the needed precision and quality assurance of the welded joints
  – matching and ductile weld requires precise control of critical parameters e.g. voltage, current, welding speed, arc length, material transfer, etc.
  – the appropriate parameter window is very narrow
• Thus welding of the special steels is an appropriate area to start the development of ArcDigi solution
  – integration of intelligence to the steel and welding equipment
  – utilization of mechanisation and robotics in welding
  – integration of sensor and measurement technology to the welding process
Background (ArcDigi)

Source: SSAB SmartSteel
Project targets (ArcDigi)

1. To execute State-of-The-Art study on available digitalised solutions related to the execution and quality management of welding.

2. To develop a process data management system (PDMS) integrating manufacturing information, parameters and test results needed in the welding process and related quality assurance

3. Introduce the developed ArcDigi solution to the steel construction enterprises and execute proof-of-concept studies in welding of special steels.

4. Evaluate the effect of the ArcDigi solution on the production efficiency of welded special steel structures for the steel construction SME manufacturers.
Novelty value (ArcDigi)

Digitalisation has been introduced to welding in recent years. A lot of effort has been targetted on integrating intelligence on welding equipment. Massive R&D effort was put on the future digital manufacturing technologies and systems in national technology programmes.

However, there is a lack of digitalised solution which can be utilized in execution of manufacturing, assembling and maintenance stages.

ArcDigi represents a novel solution for special steel welding process management targetted especially for SME’s acting in steel construction business. New digitalised trends such as IoT and Cloud Services will be utilized.
Work packages (ArcDigi)

WP1 – State-of-the-Art study

WP2 – ArcDigi solution development

WP3 – ArcDigi Proof-of-Concept studies

WP4 – ArcDigi concept potential

WP5 – Project management
Project information (ArcDigi)

Research partners:

• Arctic Steel and Mining (ASM), Lapland University of Applied Sciences
• Arctic Power (AP), Lapland University of Applied Sciences
• Materials and Production Engineering (MPE), University of Oulu
Contact information

- Lapland University of Applied Sciences, Tietokatu 1, 94600 Kemi, Finland

- Head of the Team, Rauno Toppila, rauno.toppila@lapinamk.fi, p. +358 50 310 9542

- Project Manager, Jukka Joutsenvaara, jukka.joutsenvaara@lapinamk.fi, p. +358 50 461 2319
Questions?

Thank you!