Master’s Thesis

**Welding simulation of steels using low transformation temperature (LTT) materials**

**Background:** Low temperature transformation (LTT) materials are metal alloys that show zero or positive volume change (i.e. expansion) at the cooling down phase of the welding process. This is due to microstructural transformations that take place within the material. Since the contraction of weld metal during the cooling down phase is the source of tensile welding residual stresses, these materials have the potential to solve the problem of tensile residual stresses at a fundamental level.

**Purpose:** The objective of this project is to analyze welding process for LTT weld material by numerical simulations to evaluate the residual stresses due to welding. The numerical modelling will include thermal-mechanical-metallurgical simulation of a multipass plate to plate welded connection. Analysis tools (Abaqus user subroutines) will be developed during this work.

**Literature study:**
You will carry out an extensive literature study at the beginning of the work. It will cover the following topics:
1. Residual stresses in welded connections: Significance and evaluation
2. Thermo-mechanical properties of steel and LTT material at elevated temperatures
3. Computational welding simulation
4. Effect of solid-state phase transformations in the residual stresses in steel material

**Numerical study:**
1. Development of software tools (FORTRAN subroutines) to model heat source and material behaviour.
2. Collecting the material input data (thermal/mechanical/metallurgical properties) and load input data (heat source modelling)
3. Creating multipass weld FE models
4. Calibrating models using available experimental data
5. Summarising the results

Modeling will be performed with ABAQUS. The work will be carried out at the department of Civil and Environmental Engineering at Chalmers University of Technology

**Organization:**
This research is done in collaboration with industry (ESAB). A team of two students skilled in programming and familiar with computational mechanics will carry out this Master’s thesis. It is expected that it will result in at least one scientific publication.

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