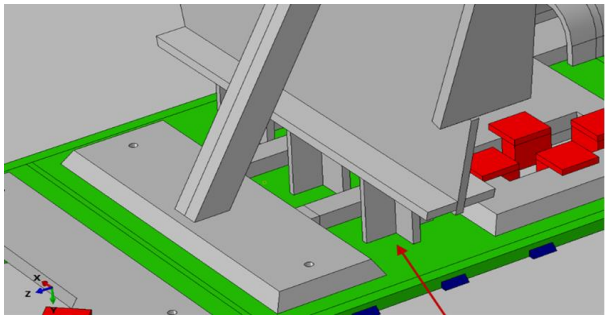
"Skill and Knowledge of Weld Modeling & Simulation"

The course is a blended course, including a theory and weld simulation lab, where we train audiences for a comprehensive understanding of the weld modelling and simulation through practical examples and hands-on experience with the QWeld plugin of welding modelling in the Abaqus platform. The sessions cover the theory, fundamentals, and practice of welding modelling, including thermal, microstructure and mechanical analysis. The structure of the course comprises theory and laboratory sessions.

In theory sessions (8 hours), we talk about the algorithms and models embedded in a weld modelling software (not limited to Abaqus). We introduce and compare the thermal models for welding and cover the technical terms for employing the models. The course opens the discussion for types of microstructure models that can fit a welding analysis. We also talk about mechanical analysis and related considerations that are part of welding modelling. Theory sessions contain topics of governing equations, boundary conditions, moving heat source models, the mapping between the moving coordinate system and the fix coordinate system in the weldment, microstructure modelling in the weld and heat-affected zone (HAZ), and mechanical behaviour of the weld, including modelling of distortion and residual stress in welded structures.



In lab sessions (20 hours), audiences learn about the QWeld modelling software and how properly set up a welding simulation project. More importantly, they learn and implement how to address a frequent welding challenge by using the software.
The course comes with a project where trainees deliver an innovative distortion control plan for a short panel structure with multiple welds. We help trainees prepare the model of panel welding in the QWeld to evaluate the deformation on the web-plate using various functions that quantify a 3D distortion after welding the panel. We then direct the trainees through five work-plans for the doing-and-learning from the project.

- *Work-Plan 1* leads trainees to mitigate the distortion by the mean of tack welding on the web-plate. They develop different scenarios for tack welding (location, number, pattern, size, etc.), run the scenarios and compare to pick the best one.
- *Work-Plan 2* leads trainees to mitigate the distortion by the mean of fixturing/clamping on the web-plate. They develop different scenarios for fixtures and clamps to pick the best one using the model.
- *Work-Plan 3* leads trainees to mitigate the distortion by the mean of weld sequence design. They develop a different sequence of depositing welds (permutation, direction, segmentation, etc.). They need to find the right sequence out of thousands of possibilities.
- *Work-Plan 4 and 5* are an innovative mix of work-plans 1, 2, and 3 to explore the best-combined scenario for the lowest distortion. In the end, trainees develop a single best plan for writing a distortion control plan that delivers the lowest distortion.

The Deliverable comprises the best welding plan for fabricating the panel with the lowest distortion. Trainees present the plan and approach at the last session of the class with a Q&A session.

The duration of the course is one month. We recommend starting the course with a blended theory and lab session over the first week, for example, 1.5 hr theory and 2 hours lab for five days. Trainees then work on the project for three interactive weeks with instructors to complete the project.

IT Requirement: we provide QWeld software; however, You need to have a commercial Abaqus license. Academic centers need Research Abaqus Licence (not a teaching licence) for this course.