D6.1 Scale bridging from micro to macro by microstructure-sensitive modelling and verification by experiments

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Deliverable Information sheet

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Executive summary

This deliverable reports the AALTO-led progress towards a microstructure-sensitive scale-bridging modelling framework for 3rd Generation Advanced High Strength Steels (3rd Gen AHSS). The work is part of WP6, Multiscale modelling and simulation, and directly supports MS7: development of a microstructure-sensitive model for 3rd Gen AHSS.

The D6.1 work is organized around three connected elements: synthetic representative volume element (RVE) generation from Electron Backscatter Diffraction (EBSD)-based microstructure statistics, dislocation-based crystal plasticity modelling using DAMASK/CPFFT, and parameter calibration using nanoindentation and synchrotron HEXRD data.

The current work covers selected Q&P and medium-Mn steels, including QP1400 UC VAS, Q&P1200 EG VAS and MMn1000 UC VAS. DREAM3D and MATLAB workflows were developed for RVE generation and evaluation, while machine-learning-assisted optimization was introduced to accelerate calibration of crystal plasticity parameters. The calibration workflow is still under refinement, and a complete parameter set for all phases and grades has not yet been finalized. The current results nevertheless provide the basis for completing Task 6.3, transferring micro-scale simulation results to macro-scale properties, and supporting D6.2 virtual stamping and crash testing.