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FATIGUE LIFE ESTIMATION OF JOINTS IN VEHICLE BODY DEVELOPMENT BASED ON A LOCAL APPROACH AND MESH-INDEPENDENT MODELLING

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ABSTRACT

This lecture presents a method to evaluate spot-shaped joints by simulation with respect to stiffness and operational strength. Based on the simulation processes for mesh independent spot welds, thoroughly proven in practice, this method has been expanded for self-piercing rivets and short laser seam welds (RobScans).

The FEM models of the single components and the joints represented by simple stiffness models are automatically combined to a complete structure by DOF equations. Each of the represented joints must show the stiffness behaviour and local deformations of a real joint.

To validate the strength behaviour, the relevant typical load situations like peel tension or shear tension of such connections must comply with the requirements for stiffness, stress and fatigue behaviour of real specimen.

These are the criteria for having a capable transfer procedure from deriving the nodal forces from the coarse stiffness model, applying the forces to a parametric solid model of a joint database and obtaining nearly the same stress distribution in the crucial notches as one gets by FEM calculation of the whole structure in the same mesh density like the fine parametric model.

Furthermore, for evaluating the damage situation of the joints, the stress situations evoked by the load-time-history of a structure have to be found just by linear superposition according to the load factors of the nodal forces. With these stress-time-histories in the notches of spot-shaped joints, the damage calculation is done by linear damage accumulation. Again the comparison with the results from rig testing is the main criteria for a good simulation quality.

The general procedure is presented with focus on the latest implemented module in the software FEMSITE - RobScan (Robot-guided Remote Scanner for Laser Beam Welding – small laser beam welds with a big variety of joint topologies).