STRUCTURAL FE-MODEL OF THIN ADHESIVE LAYERS WELL SUITED FOR IMPLICIT AND EXPLICIT ANALYSES

[1]Thomas Brandt, [1]Holger Friese, [2]Boris Heydt, [1]Dr. Ulrich Hindenlang
[1]LASSO Ingenieurgesellschaft mbH, Germany, [2]Metabowerke GmbH, Germany

KEYWORDS -

ABSTRACT - Structural stiffness properties of assemblies are affected to a considerable degree by coupling conditions of construction units. More and more adhesives replace welding and other techniques for joining parts. This kind of connections is a high challenge for a realistic representation in FE-analyses. By the method presented here it is shown how such an adhesive layer can be represented in a simply handled way. Additionally it is still possible to use already existing FE-models of assemblies without modifications of the way of discretisation generally applied.

Starting from a volume representation of the connected parts as well as the adhesive layer, the transition to a shell representation of the parts is performed. Here the adhesive layer is inserted in between the parts as an automatically generated network of rod elements. For this purpose there are nearly no extraordinary demands to the connected shell mesh. There is no need of an identical mesh topology of the connected regions. Also, it is possible to couple structures with shell meshes of different element sizes.

For a correct representation of stiffness properties the cross-sections of the rod elements have to be calibrated with respect to the element sizes and the thickness of the connected parts. Also this process of calibration is automated. The calibration itself has been analysed and tested in a study of convergence.

This FE-representation of adhesive layers has a large variety of applications. There are simple stiffness analyses and crash simulations. For crash simulations an additional failure criterion, which still has to be determined, can be defined. Furthermore it can be used in thermo mechanical analyses and in simulations of the adhesive’s hardening process in course of fabrication. For this specific application a particular material description has to be defined. Here it is necessary to consider that the adhesive does not show a non-negligible stiffness from the beginning but only when re-cooling the assembly. Influences of different thermal expansion coefficients as well as an inhomogeneous development of the temperature field have to be taken into account and can be visualized by this simulation.

The suitability of the developed FE-representation was tested at samples of simple geometry. Subsequently this technique was validated at a car door in hybrid design.

Up to now this simulation of the manufacturing process is the main application of this method, where it has been used frequently and very successfully.