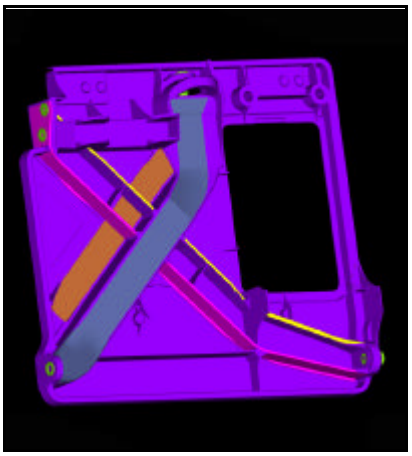
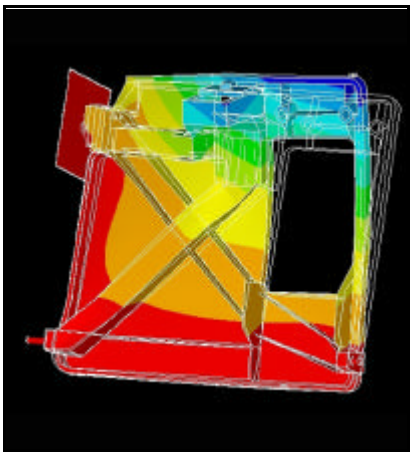
COMPONENT DEVELOPMENT

As a competent partner to various customers, ESORO develops components from initial conception through to pre-production samples. In-house specialists optimize the component properties and characteristics throughout the entire development process. The ESORO know-how is based on many years of experience in the composite sector. The use of modern software tools for modelling component, process and material allows efficient and reliable component design. The various development stages are outlined and the implementation process on a specimen component is presented in the following.

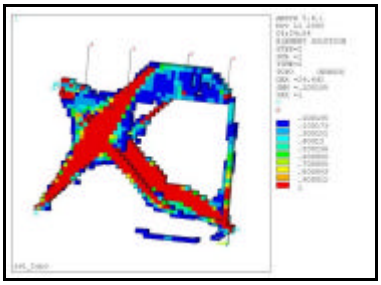
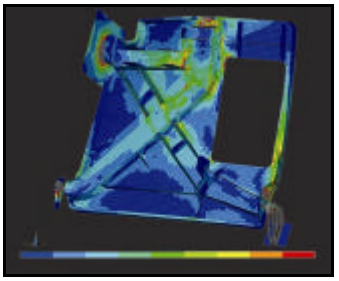
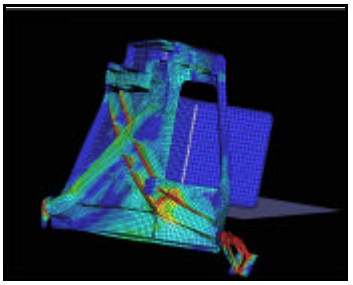




STRUCTURAL ANALYSIS / FEM / OPTIMIZATION

ESORO makes use of numerical simulations (ANSYS) at a very early stage in the component development process. One of our strengths is modelling the anisotropic and non-linear material and structural behaviour simply but informatively. This means that, even at the early phase in which design work is commenced, we are able to incorporate results from analyses and simulations in the design process. This minimises the need for cost-intensive tests for optimum-strength and optimum-cost components. Further FE calculations are conducted for detailed problems in parallel with the design process. In the case of crash-related components we also conduct explicit FE calculations (LS-Dyna). ESORO specialises in analysis of composite components and is able to offer the following calculations:

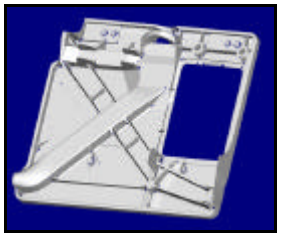
- Structural analysis
- Thermal analysis
- Non-linearities
    - o Geometrical (contact)
    - o Material (anisotropy, visco-elasticity and creepage)
- Crash

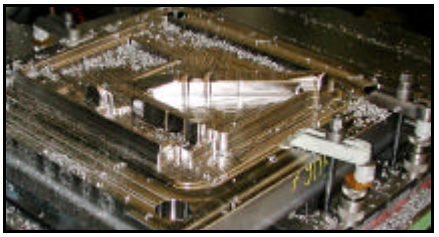
Subsequent validation of our simulation parameters by testing is one of the reasons of our strength in the simulation field.

DESIGN / CAD / MOLD CONSTRUCTION

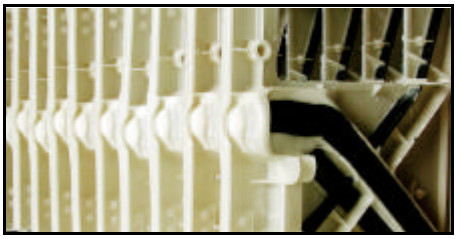
ESORO uses 3-D CAD for component design. Structural and process-engineering informations are incorporated directly in the design process. The component, together with all its parts, is elaborated right down to the very last detail. Data is used directly for tool and mould design. Here as well, process knowledge is incorporated so that components can be produced successfully with the first mould.





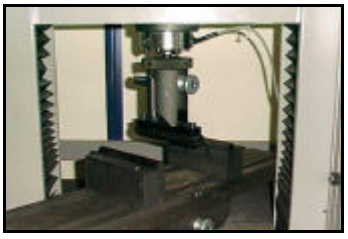
SAMPLE INSPECTION / PILOT PRODUCTION

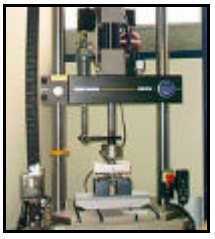
ESORO has the capability of producing small lots and initial component samples in its own technical training facility. This involves defining component-specific process windows for the various parameters and producing testable pre-production batch parts. The systems and operating resources correspond to series-production equipment. This allows a successful transition to series production with slight adaptations on the basis of these inspection samples.



TESTING

ESORO avails of various test facilities in-house. The starting point for the development of a component is the selection of the material. Elementary material data can be determined in our test laboratory using tensile testing and bending machines. In addition, ESORO also avails of capabilities for determining composite-specific material data, such as creep curves and relaxation curves. These form the basis for material modelling. ESORO takes advantage of the know-how for testing components and both developing and providing instrumentation for component-specific test set-ups. Crash-sled tests are run with our test partners.





SERIAL PART: TAILGATE OF SMART FORTWO

The smart fortwo tailgate is the first serial E-LFT application (structural part) and first crash resistant LFT component (cover) with completely visible colored grained surface. Compared to the previous model, the tailgate of the new smart fortwo complies with much higher rigidity and crashworthiness requirements. The tailgate consists of a structural part with a storage compartment and a hinged inner cover with a completely visible grained surface. Both components comply with crash requirements. The structural concept was designed and validated by means of numerical simulations and a series of tests. Main emphasis was laid on the behavior of the inner cover in a frontal crash and the increase of the stiffness of the structural part. The inner cover has to retain the two top roof edges (5.2 kg weight) in case of a frontal crash (at 64km/h with the very high time-lag peak typical of compact cars) in order to ensure occupant safety. To have a minimal investment the same structural concept which can be used for the cabrio and coupé version was elaborated. As consequence of the consequent engineering process, the tailgate fulfils the higher load and stiffness requirements, while a cost reduction of over 10% has been achieved. Since 2007, WeberFibertech has produced and delivered the components for 300'000 tailgates.