GDTECH engineering

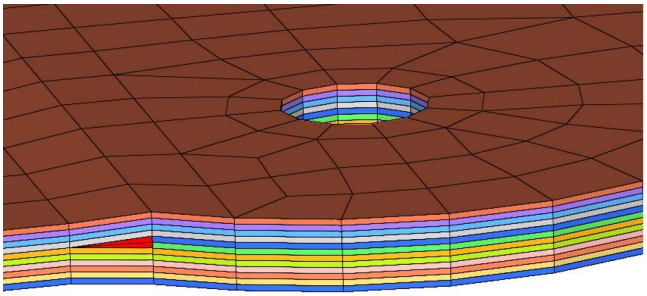
Advanced composite testing, modelling and analysis

Context

With their high stiffness to weight ratio and their anisotropic properties, composite materials are used widely in different sectors such as aeronautics, automotive, energy, marine, as well as building and construction.

As laminated thin-walled structures made of orthotropic plies, composites experience specific mechanical behaviors including geometric instabilities (buckling, post-buckling and collapse) and progressive damage (delamination and damage inside the plies).

The design and analysis of composite materials and structures is not a trivial task. Many parameters must be taken into account (number of plies, orientations, ply shape, stacking sequence, …). It is based on the building blocks approach (also known as the pyramid of tests), and mixes virtual and physical testing. If the goal is to take advantage of these very specific materials, it is essential to work with experts in the field, and to rely on numerical simulation to support the optimal design and sizing.



Meshing and draping of complex 3D structures

Services proposed by GDTech

Studies at all the stages of the pyramid of virtual and physical testing (supported by CAD and CAE)

- Writing of tests specifications
  - Also for damage analysis
  - Test protocol available at coupon level, for inter and intra-laminar damages
- Design, analysis and manufacturing of dedicated tooling
- Definition of instrumentation
- Tests follow up and reporting
- Correlation between tests and simulation
- Proposal for composite structure optimisation

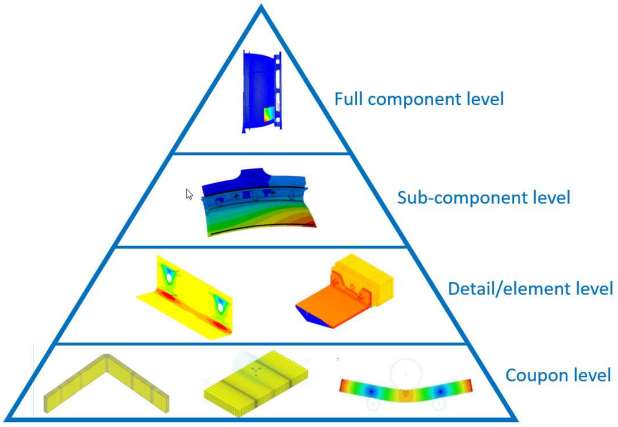
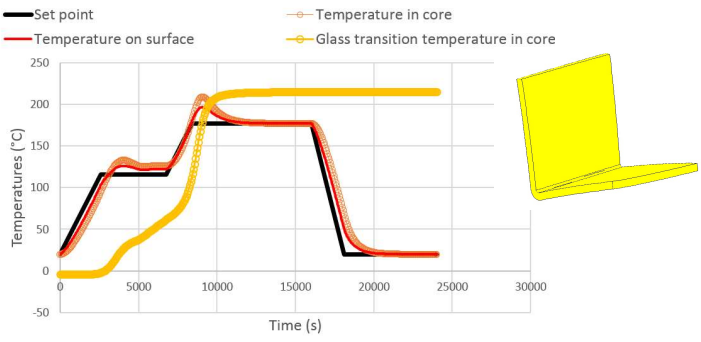


Illustration of the pyramid of tests

Modelling and analysis capabilities

- 2D, multi-harmonic, 3D (shells, solids), interfaces, 3D ply drops, submodeling
- Static analyses
  - Linear, non linear (contact, post-buckling and collapse, non linear material)
  - Failure criteria (including user criteria)
  - Damage analysis (inter and intra-laminar damage models)
- Buckling analyses
- Dynamic analyses
  - Modal
  - Post-buckling
  - Dynamic response
  - Random vibration
  - Impact and crash
- Thermo-mechanical analyses
  - Also for curing simulation (for thermo-sets)
- Structural optimizations
  - Optimal sizing, shape, topology, stacking sequence
- Development of specific damage models in commercial software packages



Curing simulation and resulting shape distortion

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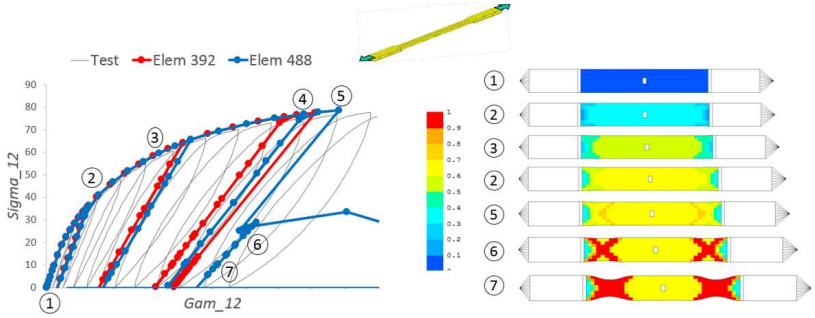
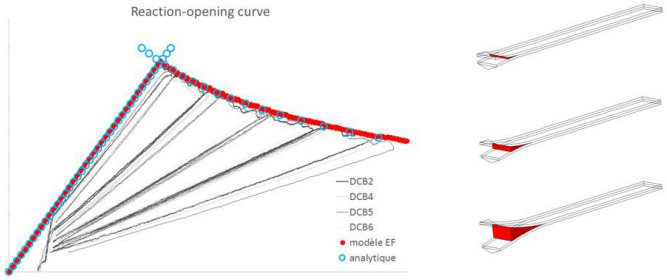
Illustration 1: identification of the parameters of advanced damage models at the coupon level

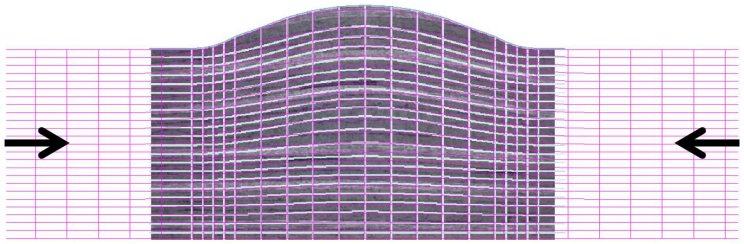


Intra-laminar damage propagation in a woven fabric (in the plies)



Inter-laminar damage in a laminate (delamination)

Illustration 2 : study of the effect of defects (waviness)



Waviness modeling / superposition of real defect and mesh

Prediction: simulation matches test results

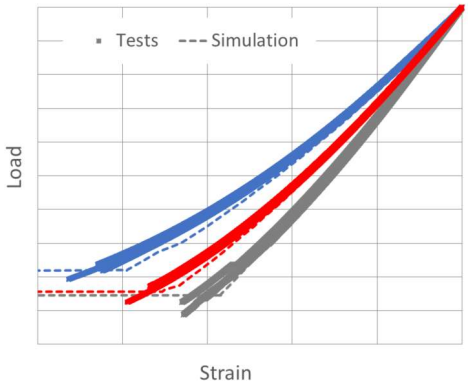
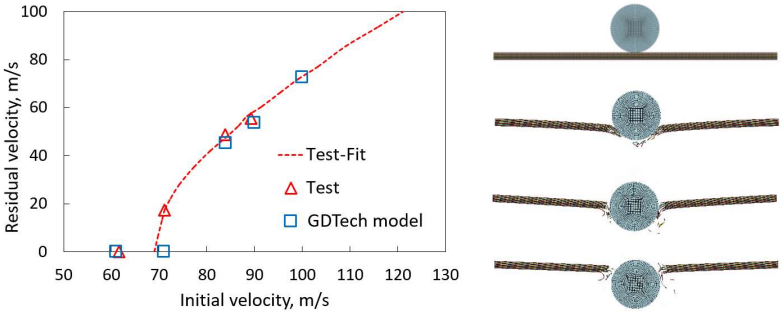
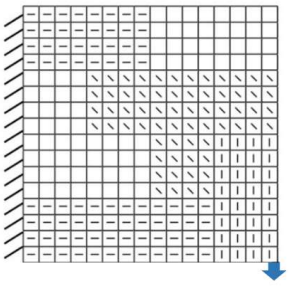


Illustration 3 : high velocity impact

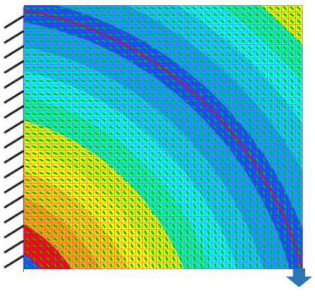


Residual velocity of the impactor and modeling of the penetration

Illustration 4 : optimal fiber orientation



Local fibers (including stacking sequence)



Global curved fibers optimisation

More information

In order to provide a comprehensive service in the field of composite materials, GDTech works with partners for testing on composite materials:

- University of Liège: for static testing (www.ulg.ac.be)
- V2I : for dynamic testing (www.v2i.be)

Contact us now

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