# Digimat allows to significantly decrease safety margins and reduce weight

Simulation of 3D woven materials in Aerospace industry

Industry Challenge

Proportions of composites materials for aerospace applications have dramatically increased over the last decades because of their inherent properties combining high mechanical properties with low mass. However, the major concern of the traditional 2D composites is the reduction of properties due to delamination between plies because of weak through-the-thickness properties. Three dimensional wovens give the possibility to add a 3rd direction of reinforcement with the addition of yarns interlacing through the thickness bringing a better damage tolerance due to impact where delamination is the key failure mode.
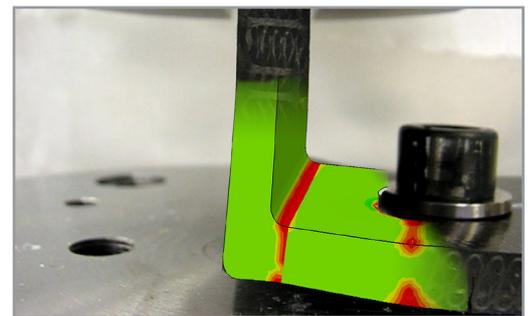
Predictive Virtual testing of 3D woven part

Key Highlights

Digimat: Digimat-FE, Digimat-MF/CAEs
Industry: Aerospace
Application: Simulation of composite parts – space launcher ring

"Today, with the use of Digimat, the prediction of the part's behaviour is much more accurate and it has become possible to significantly reduce the part's weight, a critical characteristic of the space launcher."

– Nicolas Van Hille, Research and Technology Manager, Sonaca

Challenge

1. With the addition of that 3rd direction of reinforcement, possible combination of interlacement become extremely numerous and the time dedicated to the determination of the best weave pattern that meets thermo-mechanical specifications can become prohibitive if not supported by numerical tool like Digimat.

2. Once the behavior of the weave pattern is fully characterized, the performance of the full component under real working conditions must also be evaluated.

3. To understand the properties of the 3D woven architecture and try to reproduce the test conditions at the component level.
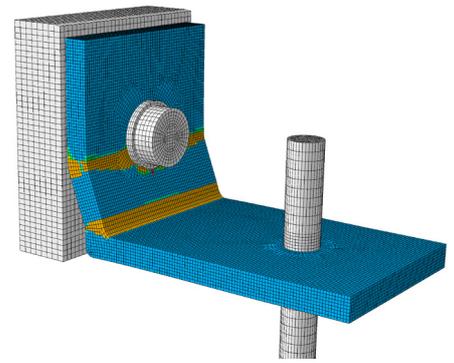

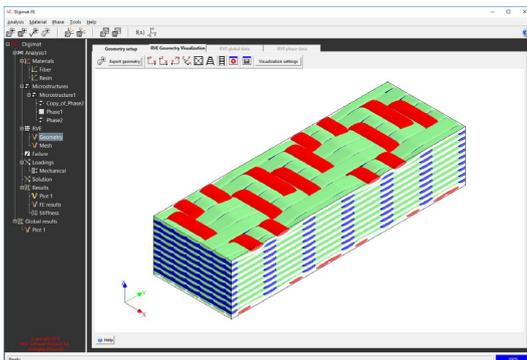Figure : Simulation of the 3D woven part

Solution

Figure : Analysis of the 3D woven weave pattern in Digimat

"The 3D woven technology is new and it has a great potential in aerospace industry" - says Nicolas Van Hille from Sonaca -"To be able to use it, a tool like Digimat is indispensible."

Digimat is used to define the complete multi-scale analysis of the 3D woven part, any type of 3D weave pattern combining different type of yarns.

Digimat contains full capabilities to analyze 3D woven materials:

- Easy definition of the weave pattern and fast computation of its properties (stiffness, failure, coefficient of thermal expansion) thanks to the embedded solver
- Definition of macroscopic equivalent material model that describes the progressive failure behavior of the weave pattern
- Computation of the performance of the 3D woven part under working conditions

Results and benefits

In the past, such estimatimations of the material properties of the space launcher ring were done manually, using analytical formulas. The results were not much in line with the real-life tests. Consequently, big safety margins had to be kept, which made products less competitive. With Digimat solution a significant decrease of safety margins have been achieved and a consequet weight reduction of the space launcher ring.
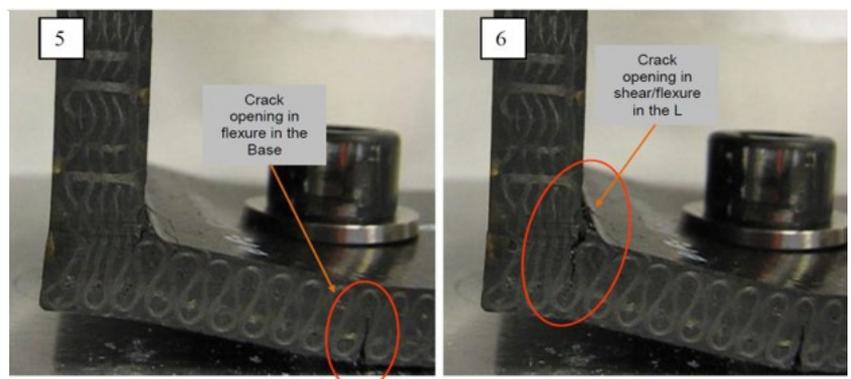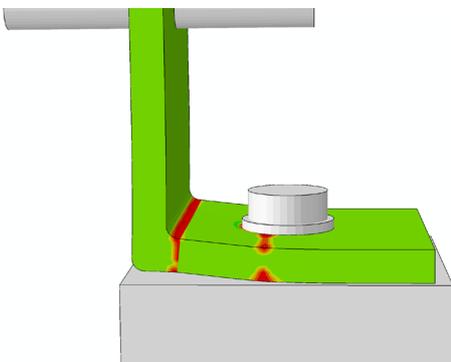

Figure : Good failure mode prediction of the 3D woven part (simulation/experiemental)

For more information on Digimat and for additional Case Studies, please visit www.e-Xstream.com