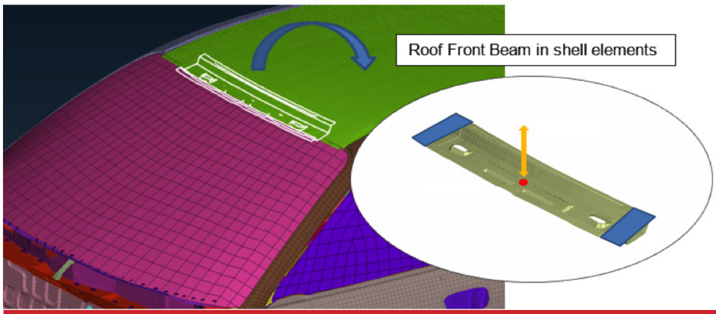
Case Study: e-Xstream engineering

Digimat to identify damping behavior of an SFRP and enrich NVH structural FEA

Challenge

The stiffness and damping behavior of short fiber reinforced plastic materials is anisotropic, frequency dependent and fully driven by the local fiber orientation tensor. Due to the injection molding process, the fiber orientation differs at every single point of a part made of SFRP.

However, due to its high damping performance, engineers choose SFRP more frequently than metal in their NVH simulations. In order to optimize the design processes efficiently on these parts, simulation must take into account the anisotropy of damping and link to the fiber orientation.



Prediction of the damping behavior of a roof front beam in NVH simulations

"Using all capabilities of Digimat helps design engineers to perform quick and efficient material analysis that enables them to enrich their knowledge of materials characteristics, and also structural FEA engineers to master efficiently their behavior prediction and optimize their design."

– Sylvain Calmels, Business Development Engineer, e-Xstream engineering

Solution

Digimat, effective modeling solution

To identify the vibrational characteristics of the material and enrich input data on FEA to improve the design process, a 2-step procedure has been followed with Digimat.

Step 1: Material engineering at RVE level

Input:

- Calibrate an anisotropic viscoelastic Digimat material model: viscoelastic resin + elastic chopped fibers
- Perform DOE through transient dynamic FEA on RVEs with various fiber orientation tensors and for various load directions and frequencies

Output:

- Damping vs frequency curves for several load directions and several fiber orientation tensors to measure the level of anisotropy

Step 2: Structural engineering at part level

- From step 1, identify the highest and lowest damping vs frequency curves.
- Perform frequency response FEA with each curve

Output:

- Range of response according to the highest and lowest damping behavior to be expected from the material.

Results/Benefits

- Applicable from material models already calibrated for crash teams
- Enrich material knowledge for vibrational performances through an easy and quick numerical procedure
- Enrich structural FEA with a better estimation of the parts damping behavior

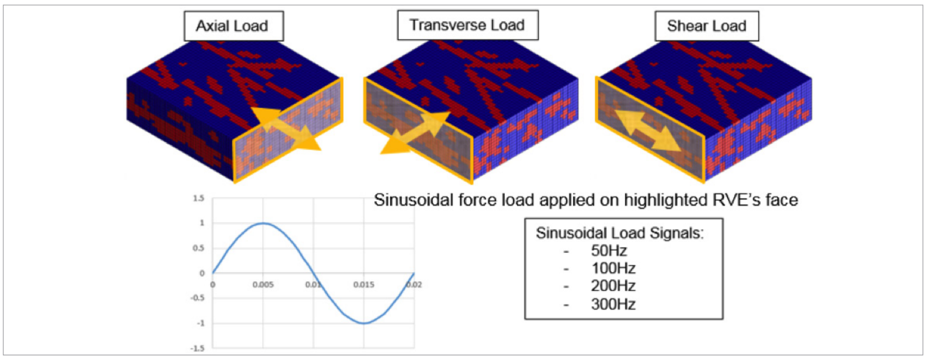


Figure 1: Material engineering through FEA at RVE level to identify the vibrational characteristics of the material

Key Highlights:

Digimat:
Digimat-MF, Digimat-FE

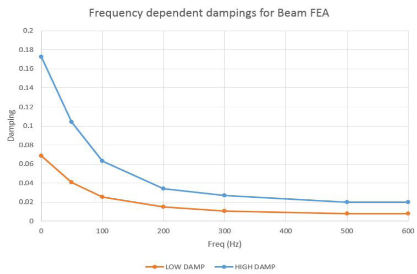
CAE Technology:
Marc, Nastran, Moldex3D

Industry:
Automotive

Application:
Frequency Response on a Roof Beam

Performances:
NVH

Step 1: Material engineering



Step 2: Structural engineering

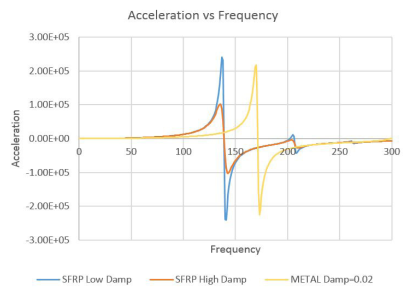


Figure 2: Highest and lowest damping curve identified through FEA at RVE level helps to provide an image of the response level range to be expected from the part

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

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