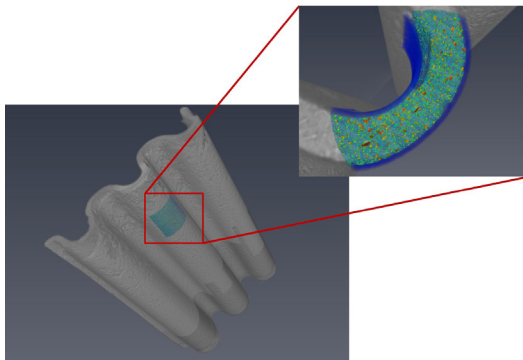


Analysis of roof windows

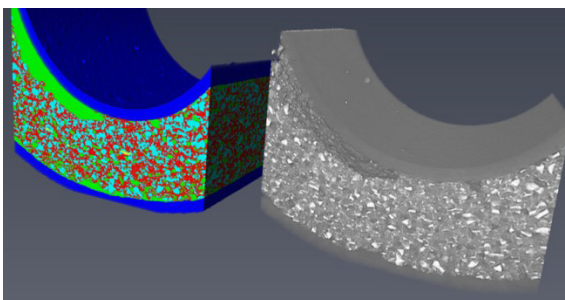
The company VELUX develops and produces roof windows, as well as modular skylights, blinds, shutters and ventilation systems. In order to continuously raise the product range and quality, VELUX is not only engaged in improving the production process, but also the individual materials used in the products. Exterior window components such as the installation components are exposed to significant mechanical deformation during processing and installation as well as harsh climatic conditions during service life on the roof. This leads to very high requirements on materials used as well as manufacturing processes.



Wavy structure of the studied window part.



3D rendering of a CT scan showing an overview and the position where a zoom scan was acquired.



Left: Segmented sample showing individual materials in different colors. Right: 3D rendering of the same area without segmentation.

Challenge

In this project, the company is interested in studying the structure of a corrugated sandwich of materials after processing, installation and different operational exposure conditions. Effects might be visible on various length scales and changes might occur on the outside, but also within the sample. Using X-ray Computed Tomography (CT), it is possible to penetrate the whole material and obtain a 3D image of the studied sample. First, overview measurements on the whole sample were performed. Then, higher resolution measurements were performed by zooming into selected areas. In this way changes at different length scales are covered best. The materials in the samples differ in both density and chemical composition, which results in a different degree of X-ray absorption. Therefore, the individual materials can be easily separated using a task known in image analysis as segmentation. Then, statistical analysis is used to determine the amount of one material relative to another one, e.g. to determine the content of air.

Collaboration

Through the collaboration between VELUX and the 3D Imaging Center at DTU, the parts that had been exposed to different conditions were characterized using micro X-ray CT scans and subsequent image analysis. This collaboration was part of the LINX project in which researchers at leading Danish universities collaborate with scientists in industry to solve industry-relevant problems using advanced neutron and X-ray techniques.

Results

Using image segmentation, four materials with different absorption properties were detected: a very strongly absorbing component of high (electron) density, which appears very bright, another strongly absorbing material, also bright, a less absorbing matrix in gray, and some internal air, present as dark voids. While the composition of the matrix and the stronger absorbing parts does not change significantly between the samples, significant differences could be seen in the amount of air present in the sample. However, this is likely related to the variability due to sample preparation. In addition to these findings, differences on the outside of the material were observed, such as a degradation of the surface.

Imaging Industry Portal

The Imaging Industry Portal is a part of the 3D Imaging Center at DTU and assists companies in using and implementing 3D Imaging in research, development and production. The portal offers research-based 3D Imaging services and provides companies with the latest equipment and the most advanced knowledge within 3D Imaging and data analysis. The Imaging Industry Portal works as a gateway to ESS and MAX IV, as well as other large scale facilities.

www.imaging.dtu.dk/english/Industry-Portal

DTU 3D Imaging Center

