Determination of the fibre orientation distribution of a mineral wool network and prediction of its transverse stiffness using X-ray tomography

A method to determine the orientation and diameter distributions of mineral wool fibre networks using X-ray tomography and image analysis is presented. The method is applied to two different types of mineral wool: glass wool and stone wool. The orientation information is obtained from the computation of the structure tensor, and the diameter is estimated by applying a greyscale granulometry. The results of the image analysis indicate the two types of fibres are distributed in a 2D planar arrangement with the glass wool fibres showing a higher degree of planarity than the stone wool fibres. The orientation information is included in an analytical model based on a Euler–Bernoulli beam approximation. The model enables prediction of the transverse stiffness. It is indicated that the glass wool transverse stiffness is lower than the stone wool transverse stiffness. Comparison with experimental results confirms the assumption that the underlying deformation mechanism of mineral wool is the bending of fibre segments between bonds.