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3D-Deformation Models for Creep Behaviour of Polymer Foams

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Polymeric rigid foams are used as core materials in sandwich constructions, e.g. in aircraft or automotive parts. The good relation mass to stiffness leads to the increasingly use of polymeric rigid foams for highly loaded mechanical applications. So far the mechanical behaviour of rigid foam is not determined precisely. Therefore the core of sandwich constructions is not taken into consideration for the mechanical design. This leads to oversizing and extended material consumption. As polymeric foams behave different under tensile or compressive stress state one has to use an appropriate model to calculate the mechanical behaviour. This paper presents experimental results of long-term tests and indicates a theory to take into account the difference between tensile and compressive behaviour. This theory is based on a strength hypothesis and can be implemented in commercial finite-element programs. The proposed method leads to an improved mechanical design and implies a mass reduction of construction parts.

The combination of a Zwick testing apparatus and a non-contact scanning system enables a determination of the 3D coordinates of the sample surface for each stage of load. On the basis of digital image processing 3D displacements, the strain and the Poisson's ratio can be delivered. The resulting strain-time curves can be approximated by a creep law, e.g. an approach according to *Findley* or *Bailey Norton*. Depending on the data of tensile and compressive tests and the Poisson's ratio one can define three characteristic constants: *d* as the ratio of failure stress at compressive stress state to the failure stress at tensile stress state, ν_{-}^{Cr} is the Poisson's ratio for creep under compressive stress state and ν_{+}^{Cr} is the Poisson's ratio for creep under tensile stress state.

With this data it is possible to consider the compressibility in a model according to *Norton.* Thereby the mechanical behaviour of polymeric rigid foams can be described more accurately.