High-Temperature Thermophysical Properties for the Numerical Simulation of Construction Materials Ex-posed to Fire Load

Dr. Erhard Kaschnitz, Andreas Cziegle, Austrian Foundry Research Institute

Timber used as a construction material has become growing attention in the construction industry within the last decades. It is found nowadays not only in traditional areas such as detached houses of rural space, but also in high-rise buildings in urban regions. With the growing use of timber, fire protection requirements are increasing; to manage risks associated with fire, the knowledge of the fire resistance of wooden structures is crucial. However, the fire resistance of timber structures must be verified by time and cost consuming fire tests. In order to better predict fire behavior of wooden construction elements, to shorten development time, and to reduce development costs, numerical models based on finite methods have been developed. Thermophysical properties of wood in different states (dry, moist, pyrolyzing, charred) and at elevated temperatures are required for these models. However, timber is a material for which data of thermophysical properties at elevated temperatures are sparse or only treated in a limited manner, not considering the species of wood, different density, moisture content, or the anisotropic behavior of wooden material.

In this work, results of measurements of thermal conductivity derived from thermal diffusivity, heat capacity, thermal expansion, and density of spruce wood in the dry, moist, and charred condition in their respective temperature ranges are presented. The anisotropic behavior of wood and charred material as well as the pyrolysis is also considered. These findings contribute to the development of numerical models to predict fire behavior of timber structures.