FIRE BEHAVIOUR OF WOOD AND WOOD-BASED COMPOSITE PANELS TOWARDS THE DEVELOPMENT OF FIRE-RESISTANT MULTILAYER SYSTEMS

Matheus Alves [1], Luís Mesquita [2], Paulo Piloto [3], Débora Ferreira [1], Luísa Barreira [1], Filipe Mofreita [4]

[1] Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[2] ISISE, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[3] LAETA - INEGI, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[4] Carpintaria Mofreita, Rua da Cegonha N º 12, 5340 Macedo de Cavaleiros, Portugal

ABSTRACT

The use of sustainable natural resources has been practiced by the construction sector as a means to reduce energy demand and increase the efficiency of buildings. In this sense, wood and wood-based materials are alternative and renewable material sources that can be effectively used in building elements, such as doors and partition walls, which are required to provide adequate thermal, acoustic, and fire resistance performance. Such elements play an important role in the fire compartmentation of buildings. Appropriate selection of materials with a reduced potential of ignition and enhanced fire behaviour may reduce the heat flux, and the passage of hot gases and smoke, thus minimizing fire hazards. In the case of wood products, the combustibility of wood usually limits its use in fire-resistant components. However, the fire performance of wooden assemblies can be improved by using engineered wood products and insulation materials, which can be assembled into multilayer systems. This work investigates the performance of wood and wood-based multilayer panels exposed to ISO 834 standard fire curve to improve the knowledge about their fire resistance in terms of insulation (I) and integrity (E) criteria. The study considers pinewood, OSB (oriented strand board), and moisture-resistant MDF (medium-density fibreboard) of different thicknesses. Rock wool with a thickness of 27 mm was also used as a core material. The multilayer systems have a dimension of 580×580 mm, fixed to a wood frame and mounted to a wall made of refractory bricks and mortar. The composite panels were tested in a small-scale furnace. During each test, temperatures were measured using type k thermocouples attached between layers and to the panel surfaces and wood frame. The specimens were considered to have failed when the insulation and integrity criteria were met according to EN 1361-1. The results showed that a 1-hour insulation resistance was achieved when using 16 mm-thick MDF panels on both sides and rock wool as a core material. Similar assemblies using 6 mm-thick and 10 mm-thick MDF panels reached 30 min., and 40 min., respectively. The specimen with 20 mm-thick pinewood on both sides and rock wool core had an insulation fire resistance of 50 min., but had the highest superficial mass and total thickness amongst tested specimens. Pinewood has been tested as a core material sandwiched between two 10 mm- thick MDF panels, and its insulation resistance was 30 min. The assembly with 15 mm-thick OSB placed between two 10 mm-thick MDF boards had the smallest insulation resistance of around 27 min. The fall-off of the exposed panel and warping of the edges of the panels greatly influenced the integrity behaviour of the samples. The insulation performance was mostly affected by the type of material and its thickness, as well as by the relative position of the layer in the composite assembly. The results provide important data regarding heat transmission effects and integrity issues related to the exposure of wood and wood-based composite multilayer systems under fire.

Corresponding Author: Matheus Alves