Thermal resistance of insulated precast concrete sandwich panels

ABSTRACT

Many nations are already working toward full implementation of energy efficiency in buildings known as Green Building. In line with this perspective, this paper aims to develop a thermally efficient precast concrete sandwich panels (PCSP) for structural applications. Therefore, an experimental investigation was carried out to determine the thermal resistance of the proposed PCSP using Hotbox method and the results were validated using finite element method (FEM) in COMSOL Multiphysics Software. The PCSP were designed with staggered shear connectors to avoid thermal bridges between the successive layers. The staggered connectors are spaced at 200 mm, 300 mm and 400 mm on each concrete layer, while the control panel is designed with 200 mm direct shear connection. In the experimental test, four (4) panels of 500 mm×500 mm and 150 mm thick were subjected to Hotbox Test to determine the thermal resistance. The result shows that thermal resistance of the PCSP with staggered shear connection increases with increase in spacing. The PCSP with 400 mm staggered shear connectors indicates the best thermal efficiency with a thermal resistance (R value) of 2.48 m2 K/W. The thermal performance was verified by FEA which shows less than 5% error coupled with a precise prediction of surface temperature gradient. This indicates that, with conventional materials, thermal path approach can be used to develop a precast concrete building with better thermal resistant properties. Hopefully, stakeholders in the green building industry would find this proposed PCSP as an alternative energy efficient load bearing panel towards sustainable and greener buildings.

Keyword: Green buildings; Precast concrete; Sandwich panel; Shear connection; Staggered connection; Thermal resistance