Abstract

This paper assesses the structural and environmental performance of lightweight hollow-core concrete slabs incorporating volcanic scoria aggregate. An experimental study was conducted to compare three slab specimens made with normal-weight concrete, scoria aggregate concrete, and scoria aggregate concrete with 2% steel fibers. Flexural tests were performed to obtain force-deflection curves and cracking patterns for each specimen. An embodied carbon study was also conducted to compare the GWP (global warming potential) of steel framing schemes that use hollow-core slabs and slabs on metal deck.

Experimental results show that the flexural strength of the volcanic scoria specimen is comparable to that of the normal-weight specimen, with the scoria specimen experiencing lower overall stiffness. The fiber-reinforced scoria specimen displayed lower initial stiffness but surpassed the other specimens in flexural strength and crack resistance.

The embodied carbon study shows that for all 20-40’ × 30-60’ column grids, the GWP of a typical hollow-core system using volcanic concrete is lower than a typical lightweight concrete slab on metal deck system, with systems using volcanic concrete having a lower GWP than systems using typical artificial lightweight concrete or normal weight concrete.