Conference or Workshop Item:

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Vibration Response of Novel Composite Floors Incorporating Perforated Beams for Sustainable Building Construction

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This project is focused on the vibration response of a novel composite flooring system that incorporates perforated steel Ultra Shallow Floor Beams, called USFB. It is a lightweight system that can accommodate long spans; hence it is susceptible to floor vibrations excited by dynamic loads.

Both experimental and computational proposed finite element (FE) studies are conducted in order to investigate various geometric parameters and approaches following a comparative study on a flooring system with bare steel perforated USFBs. The effects of concrete depth, support conditions and web opening spacing on the vibration response of the system are examined. The acceleration response excited by human activities (walking) is also determined. Finally, the equivalent geometric properties of the composite USFB systems are developed.

Emphasis was placed on the fundamental frequency to predict the possibility of resonant behaviour of this novel flooring system. Five practical floor span dimensions assessed and the results revealed that none will experience resonance based on the required minimum floor frequency. The parametric FE studies showed that increasing the concrete thickness did not necessarily increase the first natural frequency; instead, a parabolic behaviour was observed. This indicated that there was a smaller participation of the mass component on the vibration response for the 1st mode. However, higher vibration modes demonstrated a linear increase in the natural frequencies with increasing concrete depth. Moreover, increased natural frequencies were evident when support conditions modelled as fixed and when web opening spacing was reduced. The overall result deduced that the acceleration response experienced was less than the clearly perceptible limits.

In order to encourage simple modelling of perforated USFBs to assist practicing engineers, its equivalent geometric properties corresponding to the Euler Bernoulli beam of constant cross-section are derived. The results showed that the methodology adopted to accomplish correlated well with the FE results.