Vibration Analysis and Human Comfort Assessment of Steel-Concrete Composite Floors Subjected to Human Rhythmic Activities

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ABSTRACT

Steel-concrete composite floor vibrations induced by human rhythmic activities like walking, running, jumping or aerobics consist on a very complex problem. The dynamic action characteristics generated during these human activities are directly related to the individual body and to the specific way in which each person executes a certain rhythmic activity. The analysis of the composite floor structural vibrations should include a dynamic analysis and a comparison of the predicted accelerations to the human allowances related to comfort, although simplified criteria may often be used based on the floor flexibility or the natural frequency. On the other hand, it must be emphasized that this situation is not due to an only single cause, but rather a combination of several ones. The technological advance in the materials field has allowed the use of more resistant and low weight materials that result in slender and more flexible structural floor systems. Therefore, this condition tends to decrease their masses and also the natural frequencies. However, it has been observed in design practice low floor structural damping ratios, which is related to the type of construction, materials, presence of non-structural elements, age and quality of construction. All these combinations make the steel-concrete composite floors very susceptible to the resonance phenomenon, causing undesirable vibrations in the frequency range that is the most noticeable to humans. This way, the main objective of this research is to investigate the dynamic behaviour of a steel-concrete composite floor subjected to rhythmic human activities (aerobics). The investigated structural model is based on a steel-concrete composite floor spanning 40m by 40m, with a total area of 1600m² and represents a typical interior floor bay of a commercial building used for gym. In this research, an extensive parametric study was developed aiming to obtain the peak accelerations, RMS and VDV values, based on five different mathematical formulations used for modelling human rhythmic actions (aerobics). The dynamic response of the investigated structural model have indicated that the steel-concrete composite floor presented high vibration levels that compromise the human comfort, according to the limiting values proposed by several authors and design standards.

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