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Habitability of High-Rise Structures with Belt Truss System

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Abstract

High-rise structures have received a lot of attention as a solution to the challenges associated with space shortage and modern urbanization trends in recent years. Occupant comfort is one of the significant factors in determining quality of the building structures in general, and high-rise structures in particular. This factor is directly associated with the acceleration of the building floors and consequently makes it necessary to control the wind-induced vibrations in high-rise buildings. The present study was an attempt to investigate the habitability and occupant comfort of high-rise structures with belt truss system, using model simulations. TO achieve this purpose, models distinguished by their height and belt truss system location are subjected to wind and earthquake forces. The model analysis result showed that the belt truss impact has a negative correlation with height, and the mid-point along the building height is the optimal location of belt truss system.

Key words: Habitability, High-Rise Structures, Belt Truss, Story Acceleration

1. Introduction

Despite emergence of tendencies for construction of light-weight structures with a higher number of floors, the structures' resilience against wind force has dramatically increased. During the past decades, the studies conducted on structures were mostly centered on performance of structures, failure probabilities, as well as the structures serviceability. In other words, studies in this field were mostly associated with the forces exerted on the structural components, the tensions caused by them, as well as the degree of structural deformations. Nevertheless, occupant comfort is one of the most important and decisive factors in structures in general and in high-rise structures in particular. This factor is directly related to the acceleration of structure floors, thus, it is necessary to control the wind-induced vibrations in high-rise buildings [1]. Extensive studies have been conducted on building acceleration in order to determine the extent to which a building is serviceable and whether structural vibrations cause discomfort to occupants.

Since high-rise structures are supposed to be highly resistant to external forces, the belt truss system can be a suitable option, because this system is easy to implement and cost-effective thanks to the braces that can be easily built and installed along with the truss core. Finally, this system offers considerable lateral resistance. Another advantage of this system is its ability to provide benefits without changing the architectural specifications of the structure. The present study was an attempt to determine the appropriate placement of the belt truss system, based on structure acceleration. Although accurate analysis is very time-consuming and time is of vital importance in executive operations, the results of the present study and determination of a suitable placement for truss, can provide the ground for application of truss in almost all structures with different heights. Over the past decades, many research and experiments have been conducted to determine the threshold of occupant perceptibility in the face of building acceleration. The moving room experiment is one of the most commonly used techniques, in which a person is subjected to a simple harmonic acceleration with different amplitudes, and the data obtained from the perceptions and feelings are collected. The perception range is