Floor Vibration Performance of Lightweight Cold-Formed Steel Framing

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Summary

Presented in this paper is a field study on the vibration performance of lightweight cold-formed steel floors. The floors investigated were constructed with different framing methods and construction details, and were tested in either partially or fully finished conditions. The current design practice and the appropriate criteria of vibration serviceability for lightweight floors are discussed. The floor construction details, test methods, and together with the test results are summarized. Based on the vibration criteria recommended for lightweight cold-formed steel floors, the test results show that all the floors investigated in this study demonstrated satisfactory performance against vibration due to human walking.

Keywords: Cold-formed steel; floor vibration; human walking; lightweight floor; vibration performance.

1. Introduction

Over the last decade, cold-formed steel has become an increasingly popular building material for residential and commercial construction worldwide. This increased use can be attributed to the numerous advantages that cold-formed steel has over traditional residential building materials. To meet the ever increasing demand from the industry for design standards and guidelines for cold-formed steel framing construction, the America Institute of Iron and Steel (AISI) has developed a series of design standards for cold-formed steel framing construction. The current edition of the design standard series was published in 2007; among them, there is a newly developed standard for the design of floor and roof systems [1]. However, the issue of floor vibration associated with human walking is not addressed in the standard, primarily due to lack of research and appropriate design guidelines.

Floor vibration as a serviceability concern has not been well addressed in design and construction practice of lightweight floors. Most of North American homebuilders, in constructing lightweight floors, follow the recommendation of the National Association of Home Builders in the United States, which limits the span deflection to $L/480$ under specified uniform live loads, where L is the span length. Such recommendation was established based on long-term practice on residential floors with solid lumber joists, which provide floor systems with limited span lengths. However, the performance of timber floor systems based on such oversimplified design criterion may still be susceptible to annoying floor vibrations induced by human activities.

The high strength and stiffness of steel provide the advantage of achieving longer floor spans. However, floors with longer span and lighter weight are likely to be susceptible to annoying vibrations induced by normal human activity such as walking. It is unfortunate that in current

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