

FLOOR VIBRATIONS: GIRDER EFFECTIVE MOMENT OF INERTIA
AND COST STUDY

by

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Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

CIVIL ENGINEERING

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February 7, 2002
Blacksburg, Virginia

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(ABSTRACT)

Studies on the effective moment of inertia of girders that support concrete slabs using joist seats as the horizontal shear connections, and a cost efficiency analysis comparing composite and non-composite floor systems that meet vibrations design standards, were conducted.

The first study was undertaken because over-prediction of girder effective moment of inertia was the suspected cause of several recent vibration problems in floors supported by widely spaced LH-series joists. Eight purpose-built floors of the type in question were subjected to experimental tests of girder effective moment of inertia and girder frequency. Frequencies were tested for two live loading cases. Three separate test configurations were made with each floor by changing the seat-to-girder connections between bolted, welded, and reinforced. In the study, 1) the accuracy of the current design practice is assessed, 2) a new relationship was proposed, and 3) suggestions for finite element modeling are made.

In recent years, composite construction has been used to improve cost efficiency by reducing structural weight and in some cases by reducing story height. However, vibration problems are a design consideration in composite floors because lighter floors tend to be more lively. It is not clear if cost savings can be made with composite construction if vibrations are considered in the design. To compare the cost of composite and non-composite floors that satisfy AISC/CISC Design Guide criterion for walking excitation, four typical size bays were analyzed using commercial design software that finds the least expensive member configuration for a given bay size. All acceptable bay configurations of member sizes and spacing were evaluated for least non-composite and composite costs, then these results were compared. The findings show that composite construction can be more economical when initial dead load deflections do not control the design.

Acknowledgments

I wish to thank several people. Some directly and others indirectly helped me with this work. Dr. Thomas M. Murray, my committee chair, inspired me to seek vibrations research, hired me to do it, and provided valuable guidance throughout. My other committee members, Dr. Charney and Dr. Setareh, provided valuable input and gave willingly of their time. Likewise, I thank NUCOR Research and Development for sponsoring the research. Their partnership with Virginia Tech is valuable. Dennis Huffman and Brett Farmer, the laboratory technicians, put as much lab work into this project as anyone, including me.

My classmates at Virginia Tech never hesitated to help me when I asked. Rahsean Jackson sweated it out with me in the lab, constructing the test floors. He helped me more than I helped him. Guy Anderson wasted time with me during the work-week and then put in “overtime” with me over the weekends. Joe Wickline was the one to define graduate students working on the weekend as overtime. His easygoing attitude always wore off on me, a little.

My classmates from The Citadel, became men able to handle a project like this one with me. I drew from those memories everyday.

My parents, Frank and Zoe, and my sister, Anna, can never know how much I appreciate them. My parents have always put me before them. My sister is an extremely valuable friend.

My soon to be wife, Crystal, has been a constant source of encouragement and inspiration. She was unimaginably patient in dealing with me while I dealt with this project.

Finally, God has given me more than I deserve, including the friendship of those spoken of above.

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