

Nonlinear Dynamic Analysis of Structures with Hyperelastic Devices

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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May 13, 2004

Blacksburg, VA

Keywords: Earthquake Engineering, Inelastic Behavior, Nonlinear Analysis, Hyperelastic
Bracing

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(ABSTRACT)

This thesis presents the results of an investigation of a multiple degree of freedom (MDOF) structure with hyperelastic bracing using nonlinear and incremental dynamic analysis. New analytical software is implemented in the investigation of the structure, and the study seeks to investigate the effectiveness of hyperelastic bracing as a seismic protection device. Hyperelastic braces incorporate a new idea of a nonlinear elastic material that gains stiffness as the brace deforms. Structural behaviors of particular concern for an MDOF frame are stability, residual displacement, base shear, and dispersion. The structure is analyzed under two ground motion records of varying content, and for two separate P-Delta cases of varying severity. Two sets of hyperelastic braces are investigated for their influence under the two ground motions and two P-Delta cases. Each scenario is analyzed using nonlinear dynamic analyses to investigate the response histories, and Incremental Dynamic Analysis (IDA) to investigate dispersion and the behavior of specific response measures as ground motion intensity increases. IDA curves are created for interstory drift and base shear for comparison between the two response measures. The research shows that the inclusion of hyperelastic braces in the MDOF frame improves the overall stability of the structure and reduces the amount of dispersion and residual displacement. The hyperelastic braces are shown to give positive performance characteristics while not detrimentally increasing system forces under regular service loads. The results highlight the benefit of the unique stiffening properties of hyperelastic braces as a seismic protection device.

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Acknowledgements

I would like to acknowledge and thank everyone who has helped me during the course of my research. First I would like to thank Dr. Charney as my advisor and committee chair for challenging and guiding me through the research process. I appreciate all of the help and knowledge he has contributed to my research. I would also like to thank my other committee members, Dr. Raymond Plaut and Dr. Carin Roberts-Wollmann, for their contributions and insights as committee members.

I would like to express my deep appreciation to the Via family whose generous contribution to the Virginia Tech Department of Civil and Environmental Engineering has made the funding for my research possible. The Via Fellowship, along with the Aspires research grant through the College of Engineering, has allowed me to be fully funded and supported through my time at Virginia Tech.

I would especially like to thank my family and friends for their encouragement during my time at Virginia Tech. It is their support that has motivated and focused me through the whole process. Special thanks go to my parents, Bob and Linda Saunders, for the help and confidence they have given me. I couldn't ask for more loving parents, and I can only hope to gain some of the wisdom in life that they've shown me. Everyone has taught me that how you work is important, and who you're privileged to work with is invaluable.