Design of a variable stiffness bracing system: mathematical modeling, fabrication, and dynamic analysis

ABSTRACT

This paper presents a new bracing system with variable stiffness springs; this adaptive structural control system is designed to protect buildings against severe vibration and ground movement. The developed variable stiffness bracing (VSB) system comprises four nonlinear steel leaf springs that provide nonlinear and variable stiffness capacity at different frame displacements. The inelastic actions of the VSB system′s nonlinear leaf springs keep the energy dissipation characteristics and ductility of moment-resisting frames. At large vibration amplitudes, the VSB device restrains unallowably story drift. Therefore, frames display ductile performance. We developed a mathematical model to simulate the mechanical behavior of the system, including the stiffness nonlinearity of the springs. Moreover, we evaluated the efficiency of the VSB implementation in a single-degree-of-freedom system by dynamically analyzing different models: a moment-resisting frame, a conventional braced frame, and a frame using the VSB system. This article discusses and proves the effectiveness of the proposed system through numerical analysis.

Keyword: Variable stiffness bracing system**;** Newmark method**;** Dynamicanalysis**;** Mathematical model**;** Energy dissipation**;** Ductility