**Numerical and experimental evaluation of a developed nonlinear curved spring element under compression force**


ABSTRACT

This paper presents an evaluation of a curved spring element that may be utilized in a developed variable stiffness bracing (VSB) system to confer the variable stiffness characteristic of the system.VSB system is established to protect the structure against dynamic loads induced by earthquake, wind and etc. To obtain the curved shape of the spring, mathematical modeling is conducted. Direct compression experimental tests are conducted for a variety of models with different thicknesses and materials. The results of the experiments show a nonlinear stiffness trend for the curved spring element. In addition, to observe the yielding of the curved spring, different strain gauges are installed in several positions to record the strain in the models during the application of compression load. The results reveal that the geometry and material characteristics have an important effect on the stiffness value of the spring. Furthermore, finite element simulations of models are performed, and results are compared with those of experimental tests. The results from the experiments, as well as model and finite element simulation, show the curved spring's potential to be used in the developed VSB system and can be installed as a lateral resistance system in a structure subjected to vibration excitation such as an earthquake. Finally, the efficiency of the aforementioned system is evaluated via pushover analysis in a bare frame via finite element simulation. The results from pushover analysis illustrate the efficiency of the variable stiffness bracing system in framed structures.



**Keyword:** Variable stiffness bracing system; Finite element simulation; Mathematical model; Energy dissipation system; Direct compression test