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Structural Damage Detection in a Steel Column-Beam Joint Using Piezoelectric Sensors

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Abstract : Application of piezoelectric sensors to detect structural damage due to seismic action on building structures is investigated. Plate-type piezoelectric sensor was developed and proposed for this task. A film-type piezoelectric sheet was attached on a steel plate and covered by a layer of glass. A special glue is used to fix the glass. This glue is a silicone that requires the application of ultraviolet rays for its hardening. Then, the steel plate was set up at a steel column-beam joint of a test specimen that was subjected to bending moment when test specimen is subjected to monotonic load and cyclic load. The structural behavior of test specimen during cyclic loading was verified using a finite element model, and it was found good agreement between both results on load-displacement characteristics. The cross section of steel elements (beam and column) is a box section of 100 mm×100 mm with a thin of 6 mm. This steel section is specified by the Japanese Industrial Standards as carbon steel square tube for general structure (STKR400). The column and beam elements are jointed perpendicularly using a fillet welding. The resulting test specimen has a T shape. When large deformation occurs the glass plate of the sensor device cracks and at that instant, the piezoelectric material emits a voltage signal which would be the indicator of a certain level of deformation or damage. Applicability of this piezoelectric sensor to detect structural damages was verified; however, additional analysis and experimental tests are required to establish standard parameters of the sensor system.

Keywords : piezoelectric sensor, static cyclic test, steel structure, seismic damages
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