Applicability of High Conductive Cement Paste as Self-sensing Repair Material utilizing Piezoelectric Behavior

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The piezoelectric effect is a phenomenon in which a potential difference is generated by the change in distance between electric charges due to the mechanical deformation of certain solid materials. Due to this phenomenon, the deformation of the solid material can be estimated by measuring the potential and electrical resistance. Since concrete is made-to-order, the types of constituent materials and the ratio differ for each structure. Hence, it is difficult to lead material deformation from piezoelectric behavior which depends on crystal structures and conductivity of materials. However, if a material with known conductivity and piezoelectric behavior is used as the piezoelectric sensor, it is considered possible to conduct non-destructive deformation testing of reinforced concrete structures in real-time. Carbon fiber is a material for improving the performance of concrete and has high conductivity. A cement paste mixed with it shows high piezoelectricity. If the cement paste mixed carbon fiber is used as a piezoelectric sensor, it can manage the reinforced concrete structure efficiently. We fabricated specimens which simulate concrete structures repaired with a high conductive cement paste mixed with carbon fiber and conducted a uniaxial cyclic loading test. The measured potential changes in repair material parts are compared with the strain changes in specimens. Based on the result, the applicability of a highly conductive cement paste as a piezoelectric sensor was determined.