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Deformation Characteristics of Fire Damaged and Rehabilitated Normal Strength Concrete Beams

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Abstract : Fire incidents have been steadily increased over the last year according to national emergency management agency of South Korea. Even though most of the fire incidents with property damage have been occurred in building, rehabilitation has not been properly done with consideration of structure safety. Therefore, this study aims at evaluating rehabilitation effects on fire damaged normal strength concrete beams through experiments and finite element analyses. For the experiments, reinforced concrete beams were fabricated having designed concrete strength of 21 MPa. Two different cover thicknesses were used as 40 mm and 50 mm. After cured, the fabricated beams were heated for 1hour or 2hours according to ISO-834 standard time-temperature curve. Rehabilitation was done by removing the damaged part of cover thickness and filling polymeric mortar into the removed part. Both fire damaged beams and rehabilitated beams were tested with four point loading system to observe structural behaviors and the rehabilitation effect. To verify the experiment, finite element (FE) models for structural analysis were generated using commercial software ABAQUS 6.10-3. For the rehabilitated beam models, integrated temperature-structural analyses were performed in advance to obtain geometries of the fire damaged beams. In addition to the fire damaged beam models, rehabilitated part was added with material properties of polymeric mortar. Three dimensional continuum brick elements were used for both temperature and structural analyses. The same loading and boundary conditions as experiments were implemented to the rehabilitated beam models and non-linear geometrical analyses were performed. Test results showed that maximum loads of the rehabilitated beams were 8~10% higher than those of the non-rehabilitated beams and even 1~6 % higher than those of the non-fire damaged beam. Stiffness of the rehabilitated beams were also larger than that of non-rehabilitated beams but smaller than that of the non-fire damaged beams. In addition, predicted structural behaviors from the analyses also showed good rehabilitation effect and the predicted load-deflection curves were similar to the experimental results. From this study, both experiments and analytical results demonstrated good rehabilitation effect on the fire damaged normal strength concrete beams. For the further, the proposed analytical method can be used to predict structural behaviors of rehabilitated and fire damaged concrete beams accurately without suffering from time and cost consuming experimental process.

Keywords : fire, normal strength concrete, rehabilitation, reinforced concrete beam
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