World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:11, No:09, 2017

Stress-Strain Relation for Hybrid Fiber Reinforced Concrete at Elevated Temperature

Authors : Josef Novák, Alena Kohoutková

Abstract : The performance of concrete structures in fire depends on several factors which include, among others, the change in material properties due to the fire. Today, fiber reinforced concrete (FRC) belongs to materials which have been widely used for various structures and elements. While the knowledge and experience with FRC behavior under ambient temperature is well-known, the effect of elevated temperature on its behavior has to be deeply investigated. This paper deals with an experimental investigation and stress-strain relations for hybrid fiber reinforced concrete (HFRC) which contains siliceous aggregates, polypropylene and steel fibers. The main objective of the experimental investigation is to enhance a database of mechanical properties of concrete composites with addition of fibers subject to elevated temperature as well as to validate existing stress-strain relations for HFRC. Within the investigation, a unique heat transport test, compressive test and splitting tensile test were performed on 150 mm cubes heated up to 200, 400, and 600 °C with the aim to determine a time period for uniform heat distribution in test specimens and the mechanical properties of the investigated concrete composite, respectively. Both findings obtained from the presented experimental test as well as experimental data collected from scientific papers so far served for validating the computational accuracy of investigated stress-strain relations for HFRC which have been developed during last few years. Owing to the presence of steel and polypropylene fibers, HFRC becomes a unique material whose structural performance differs from conventional plain concrete when exposed to elevated temperature. Polypropylene fibers in HFRC lower the risk of concrete spalling as the fibers burn out shortly with increasing temperature due to low ignition point and as a consequence pore pressure decreases. On the contrary, the increase in the concrete porosity might affect the mechanical properties of the material. To validate this thought requires enhancing the existing result database which is very limited and does not contain enough data. As a result of the poor database, only few stress-strain relations have been developed so far to describe the structural performance of HFRC at elevated temperature. Moreover, many of them are inconsistent and need to be refined. Most of them also do not take into account the effect of both a fiber type and fiber content. Such approach might be vague especially when high amount of polypropylene fibers are used. Therefore, the existing relations should be validated in detail based on other experimental results.

Keywords : elevated temperature, fiber reinforced concrete, mechanical properties, stress strain relation
Conference Title : ICCCC 2017 : International Conference on Cement and Concrete Composites
Conference Location : San Francisco, United States
Conference Dates : September 28-29, 2017