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Editorial

Durability and ductility of FRP strengthened beams, slabs and columns

Reinforced Concrete (RC) was introduced as a new technology about one hundred years ago. Worldwide application and long experience have shown that, when properly designed, well built, and maintained, RC structures generally exhibit a reliable and durable behavior. Nevertheless, porosity and cracking of concrete, as well as, corrosion of steel reinforcement can lead to dramatic damage and weakness of existing structures, especially when they are exposed to extreme and hostile environments. In fact, corrosion of steel is the major cause of deterioration of RC structures. Other causes of structural concerns are a consequence of design mistakes, increase in load carrying capacity, change of use, and more stringent requirements of codes, especially in seismic zones. As a result, lifetime and structural integrity of existing RC structures are reduced. This leads to a high cost impact and dangerous implications for structural safety whereby these structures may need to be repaired and rehabilitated.

Fiber Reinforced Polymer (FRP) composites were originally developed for use in the automotive and aerospace sectors. In the last decade, these advanced materials have seen a widespread use as an alternative reinforcement in civil engineering projects, to replace the internal steel reinforcement or as externally bonded materials to repair/strengthen damaged or otherwise weak existing structures. FRP materials are ideal to eliminate the corrosion problems of conventional reinforcing steel. They are extremely light, versatile, and demonstrate high tensile strength, making them ideal materials for reinforcement of concrete.

Despite their good properties, FRP materials present some critical concerns from a structural point of view. For example: their linear elastic stress strain profile up to failure (i.e. the absence of yield plateau, compared to steel), their larger creep sensitivity, their potential susceptibility to alkali attack and to ultraviolet rays. Durability and ductility are thus essential to long-term sustainable service life of FRP materials and concrete structural members with FRP reinforcement.

The wide diffusion of any innovative material in civil engineering, such as FRP reinforcement, needs good confidence of engineers with the materials' characteristics and structural implications of their use for reliable, long-term service. Structural reliability and durability implies not only good performance materials that resist degradation, but also their capacity to avoid structural damage, sudden and brittle collapses and progressive failures caused by unexpected dynamic actions (impact forces, earthquakes, hurricanes, etc.).

Thus, a modern concept of structural integrity for long-term service lifetime implies that civil infrastructures should be designed, constructed and maintained under the vision of a HOLISTIC approach, which integrates materials' properties and structural performance. DURABILITY and DUCTILITY will represent the two faces of the same "coin", and a HOLISTIC design approach will include the two basic concepts of material integrity, structural stability and reliability.

This special publication has contributions from Australia, Canada, China, Europe, Middle East, Japan, and the USA. It will go over recent research works to fill gaps in our understanding of these important areas for FRP materials and concrete with FRP reinforcement.

It was a real pleasure working on this project. We would like to thank the contributing authors, the reviewers who ensured high quality of the papers and Professor Swamy for his vision in setting the tone for this special publication.

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