CICE 2023 Rio de Janeiro – Brazil 11TH INTERNATIONAL CONFERENCE ON FRP COMPOSITES IN CIVIL ENGINEERING

ADVANCES IN THE TEXTILE REINFORCED CONCRETE STRUCTURAL DESIGN AND APPLICATIONS

Barzin Mobasher, Arizona State University, Tempe, Arizona, USA, barzin@asu.edu

ABSTRACT

Textile reinforced concrete (TRC) composites have received a significant attention in the past 20 years as emerging lightweight construction materials with strength and ductility that compete and outperform light gage steel and wood products in many applications. These composites offer long-term durability, ductility, high strength and are amenable to continuous production and formability, thus making it highly sustainable. Since the life cycle costs of structural systems is ideally measured in terms of raw materials, labor, energy, environmental impact, serviceability, and durability, the opportunity for the development and use of TRC is attractive since it addresses many of the life cycle cost parameters.

Using effective manufacturing technique such as automated pultrusion process efficient production of TRC structural sections can be attained. A variety of textile types have been studied and characterized for mechanical and durability properties with AR- Glass, Carbon, PVA, Basalt, and polypropylene (PP) fiber based mesh reinforcement. Two-dimensional woven textile reinforcements can be formed into 3-D structural sections such as angles, channels , and W-sections. Test results of flexural and tension specimens are discussed in terms of closed loop tests and Digital Image Correlation (DIC) technique. The overview is extended to the development of structural analysis tools for tension, compression, and elastic plastic for flexural modeling, as well as local stability criterion for compression buckling of these structural sections are addressed. Effects of strain hardening, distributed cracking, connection methodology and failure mechanisms of the structural sections are discussed in detail.

The presentation also addresses the development of generalized design tools for thin section strain hardening composites. Analytical closed form solutions for serviceability based design and analysis of composite systems such as beams, and panels as 1-D and 2D elements are introduced. It is shown that both material and structural design are concurrently accomplished using closed form solutions for momen-curvature response as well as tension stiffening and local compression buckling. Results are further discussed with respect to the section thickness, end conditions, connection geometry, textile type, and volume fraction It is therefore imperative that new design tools, and guidelines be developed for composites with high strength, ductility, and stiffness.

KEYWORDS

Textile reinforced concrete; mechanical properties; structural analysis; moment-curvature; distributed cracking, stress-strain