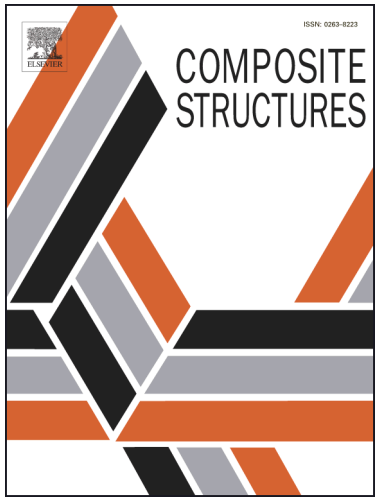

Experimental study of concrete beams prestressed with basalt fiber reinforced polymers. Part II: Stress relaxation phenomenon

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Experimental study of concrete beams prestressed with basalt fiber reinforced polymers. Part II: Stress relaxation phenomenon

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Abstract. In a previous paper experimental results on tests of PC beams with basalt fiber reinforced polymer (BFRP) tendons having several degree of prestressing level were reported. In particular, details of experimental program from problem statement to manufacturing and testing performance was presented. This part of the general research provides theoretical and experimental analysis in regard to stress relaxation phenomenon. Based on current development FRP have excellent resistance to creep, but for a prestressing tendon, relaxation is more important than creep, since relaxation reduces the available prestressing force. Estimation of the prestress loss over time requires that stress relaxation of the tensile element shall be known. Matrix resins are viscoelastic materials and thus exhibit stress relaxation. BFRP is not yet clearly included in design guidelines, thus none of the codes provide significant information to determine the prestress losses due stress relaxation and mechanical properties belong to scientist's interpretation and various prognosis. Taking proper advantage of FRP materials should involve getting away from the paradigm of replacing steel with FRR and toward the development of innovative reinforcing schemes which would make both FRP materials and concrete construction more cost effective. Due to lack of standard and experimental results the critical priority is to establish parameters for short-term and long-term performance of stress relaxation characteristics for new FRP reinforcing materials. Identified priorities reflected to this research work that there is a need to target specific, promising applications where BFRP reinforcing may find innovative use, such as internal and linear prestressing.

Keywords: Beams, Basalt FRP; Bridges; Composite Structures; Creep; Prestressed concrete; Prestress losses; Linear viscoelasticity; Relaxation; Mechanical testing

1. Introduction and background

Lack of durability may address to cracking, corrosion, excessive deflection and in special cases, failure of the structural member. Prestressing method of reinforcement itself improves durability by preventing cracking which minimizes the penetration of water and air. FRPs might be a great alternative of conventional reinforcement of the concrete for industrial facilities (Fig. 1) [1, 2]. Surely, further research is required to observe confidence of long–term properties to fulfil ultimate and serviceability requirements of prestressed concrete (PC) structures. Until about 25 years ago, a pilot knowledge and research contained little coverage of prestressing polymers and composites for concrete and other structures [3, 4]. In case of the losses prediction methods for FRPs have been developed over the last years, but simple practical solutions for accurate estimation of prestress losses have proved difficulties due to lack of successful experimental work results on different kind of