COMPRESSIVE STRENGTH OF POLYMER CONCRETE AT DIFFERENT STRAIN RATES

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Abstract: Polymer concrete (PC) is a composite material consisted of mineral filler, foundry sand, and a polymer binder, unsaturated polyester resin. Understanding the behavior of this kind of composite at different strain rates is of critical importance in a range of applications. The present paper is focused on the study of the strain rate sensitivity of cylindrical polymer concrete specimens in monotonic and cyclic compression tests. Monotonic tests were performed at three different prescribed strain rates (\(1.25 \times 10^{-3} \text{ s}^{-1}\), \(1.25 \times 10^{-2} \text{ s}^{-1}\) and \(1.25 \times 10^{-1} \text{ s}^{-1}\)) and cyclic tests with prescribed force were performed at two different frequencies (\(6.25 \times 10^{-3} \text{ Hz}\) and \(62.5 \times 10^{-3} \text{ Hz}\)). The experimental results indicate an elasto-viscoplastic behaviour: the load-carrying capacity of the polymer concrete increase significantly with strain rate while the modulus of elasticity remains practically constant. The proportional limit increases 77% from the lower to the highest strain rate level and the ultimate compressive strength is 27% higher at a strain rate of \(1.25 \times 10^{-1} \text{ s}^{-1}\) when compared to \(1.25 \times 10^{-3} \text{ s}^{-1}\). It is also proposed a one-dimensional phenomenological model, as simple as possible, able to perform a physically realistic description of strain hardening and strain rate sensitivity observed in monotonic and cyclic compression tests performed at different strain rates. Examples concerning the modelling of compression tests at different strain rates are presented and analyzed. They show a very good agreement between experimental results and model prediction.

Key words: Polymer Concrete, Compressive Strength, Strain Rate, Experimental Results, Modelling.