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AN IMPROVED CREEP AND SHRINKAGE MODEL FOR MODERN CONCRETE

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Abstract

The most prominent phenomena in the time dependent-behavior take place on the micro- andnano-scales and yet they matter most for the macro-scale, since they must be captured on a structural level by a prediction formula required to design orevaluate the world's largest structures. The mechanisms occurring on the micro-and nano-scales that must be considered include diffusion, capillary stresses, disjoining pressures and the stresses in the solid skeleton of hydrated cement balancing these pressures. The B3 model, which became a standard recommendation of RILEMin 1995, was developed at Northwestern University in the early 1990s by Bažantand Baweja to describe the compliance and shrinkage functions of concrete ingeneral and to predict them from the composition and environmental parameters,using optimal empirical data fitting aided by understanding some underlying the oretical trends and the relevant mechanisms. Recent deflection data collected from manylarge-span bridges around the world confirm that model B3 still has the theoretically most correct form and gives the most realistic shapes of the creep and shrinkage curves. However, these deflection data also show that the multi-decade form of the creep curves (or compliance function) requires updating, by which the terminal asymptotic slope of the creep curves in semi-logarithmic plots is significantly increased by the rescaling of the flow term and the aging viscoelastic term in the compliance function. The improved model B3.1 is statistically based on a combination of a new world-wide Northwestern laboratory creep andshrinkage database, which greatly expands the previous RILEM database, and the aggregate of collected data on excessive deflections of large-span prestressedc oncrete segmental bridges, which are structures particularly sensitive to multi-decade creep. The ranges of the input composition and environmental parameters are expanded to include newer cements that contain admixtures and reach higher strengths.