EMI 2014 Engineering Mechanics Institute Conference August 5-8, 2014 "Mechanics for Sustainable and Resilient Systems" McMaster University - Canada.

Gamma Prediction Models capturing the Long Term Creep Shrinkage Performance of Segmentally-Erected Prestressed Box Girder Bridges

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Abstract:

For creep-sensitive structures like statically in determined large bridges, it is essential to implement an efficient and realistic creep model for example in 3D Finite element considerations. Concrete creep, characterized by the gradual strain growth with time under a unit sustained stress applied at age t', is generally calculated based on the given compliance function $J(t, t')$, where t is the current time. For stress level within the designed service strength, the concrete creep is assumed to follow the constitutive law of ageing linear viscoelasticity. In order to systematically study the main influence factors on bridge deflection measurements, which are known to show large scatter, a probabilistic analysis can be performed. Due to the associated computational costs such investigation are limited. The predictions based on these large-scattering basic variables (model inputs) are fraught with uncertainties and accordingly there is interest in alternative prediction models decoupled from complex analytical and numerical models, using measured structural responses. Gamma process considerations are such alternative methods. These approaches are suitable for capturing the structural behavior, like crack formation, bending, and surface strain, as well as previously mentioned long term creep shrinkage performance (can also be captured by traditional inspection and/or monitoring methods). The objective of this contribution is to illustrate the use of gamma process approaches for the prediction of the creep shrinkage performance of complex pre-stressed concrete bridges that incorporates uncertainties and makes predictions in terms of load rating and system-level more reliable with the help of structural health monitoring (SHM) data. The creep-shrinkage response of a statically in determined three span boxgirder bridge extracted (a) from a complex finite-element (FE) model, which is based on the gradual strain growth concrete creep, and (b) from structural health monitoring data, serves for the calibration and verification of the considered gamma process approaches. Finally, The ability of the Gamma process approaches to capture complex creep shrinkage processes in complex statically in determined will be critically examined.

Keywords: realistic creep model; Gamma process considerations; statically in determined; probability; box girder bridges