6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

CONCRETE FATIGUE MODELING BASED ON CUMULATIVE INELASTIC SHEAR STRAINS

A. Baktheer[1], J. Hegger[1] and R. Chudoba[1]

[1] Institute of Structural Concrete - RWTH Aachen University,
Mies Van der rohe Straße 1, 52074 , Aachen, Germany, abaktheer@imb.rwth-aachen.de

Keywords: *Concrete fatigue, Constitutive modeling, Anisotropic damage, Microplane theory*

Characterization of concrete fatigue behavior is a challenging task that has increasingly attracted the attention of researchers during the past decades. Besides extensive experimental investigations, several attempts have been made to develop reliable numerical models. However, for concrete, the underlying microstructural mechanisms governing concrete fatigue damage propagation are still not sufficiently understood. Fatigue damage development and propagation at subcritical load levels includes several interacting mechanisms: development and coalescence of microcracks, repeated opening and closure, internal sliding and friction. Development of a fatigue model that can capture the local dissipative mechanisms such damage and internal frictional sliding on the time-scale of the high-cycle fatigue loading scenario can increase the quality of the description of the concrete fatigue behavior in a wide spectrum of applications.

In this paper, we introduce fatigue damage model for plain concrete within the framework of the microplane models. The key idea of this approach is to relate the fatigue damage to a cumulative measure of inelastic sliding/shear strains at the microplanes that would reflect the fatigue damage accumulation owing to internal friction under fatigue loading. The material model is derived from thermodynamic potential within the microplane theory. A homogenization approach with an algebraic mapping of the projected stiffness terms into the irreducible decomposition of the anisotropic secant stiffness based on the orientation distribution functions (ODFs)[1] has been used and compared with the energy equivalence based approach presented in [2]. As we shall demonstrate, the model can reflect the triaxial behavior of the concrete matrix and the hysteretic loops with the relation to the fatigue damage propagation at the macroscopic scale. The model can be used to simulate the behavior of cylinder test specimens subjected to compression fatigue loading.

REFERENCES

[1] Jian-Ying Wu, An alternative approach to microplane theory. *Mechanics of Materials*,pp. 87105, 2009.

[2] M. Jirásek, Comments on Microplane Theory, *Mechanics of Quasibrittle Materials and Structures*. HermesScience Publications, pp. 5577, 1999.