A NEW FRAMEWORK FOR THE EARLY-AGE ANALYSIS OF MASSIVE CONCRETE STRUCTURES

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This paper presents a new comprehensive framework for the structural analysis of mass concrete. It is developed on the basis of a coupled thermo-chemo-mechanical model, which has been consistently derived from the theory of thermodynamics of reactive porous media. The model considers that cement hydration is exothermic and thermally activated, and considers the evolution of the degree of hydration, a normalized variable that measures the extension of the hydration reaction. The mechanical parameters such as strength, elastic and plastic variables, autogenous shrinkage and creep depends on the degree of hydration and on the temperature. The model was implemented in a 3D Finite Element code featuring high-performance capabilities such as parallel iterative solver based on CSR data structure. This code can be integrated in genetic algorithm procedure that permits the optimization of the variables that determine the construction phase of a real mass concrete structure: height of the lifts, schedule, placing temperature, and type of material. Aiming the utilization of this model, the material can be characterized by means of a new experimental framework that integrates adiabatic calorimetric tests and the evolution of the mechanical parameters. The thermo-chemo-mechanical parameters can also be obtained by a prediction model developed on the basis of data mining techniques. This prediction model uses a data base composed by the results of 30 years of experiments carried out on the most important mass concrete constructions in Brazil..

Keywords: dams; thermo-chemo-mechanical model; experimental analysis; numerical analysis; data analysis.