Numerical testing of prestressed reinforced concrete structures with PRECON3D material model

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ABSTRACT

Some time ago, we have developed a computer programme called PRECON3D for a three-dimensional non-linear analysis of reinforced and prestressed concrete structures [1, 2] where the structures are discretized by three-dimensional finite elements with an embedded one-dimensional element of reinforcement and prestressed tendons. Non-linear triaxial behaviour of concrete is involved in the material model, including all dominant influences in concrete (yielding in compression, fracture in tension, softening and hardening). The non-linear behaviour of reinforcement and prestressed tendons is described by the one-dimensional elasto-viscoplastic model. The tendon element geometry is described by the second order space function which is determined by its projections [3]. Programme PRECON3D can be used very simple because the material model is defined by elementary material parameters (Young's modulus, Poisson's coefficient, maximal uniaxial tensile and compression stresses, coefficient of tensile correction, maximal tensile and maximal compression strains). Furthermore, the developed model makes it possible to compute prestressing structures in phases including losses caused by friction and the losses which result from the concrete deformation.

In the described analyses we have performed the numerical testing of the prestressed concrete girders from the engineering practice (prefabricated element) [4-6], which were reinforced with various cross-sectional area of prestressed reinforcement and various tendons geometry. During analyses next parameters were observed: deflections of the girders, concrete stresses and strains at the top and bottom of the girders, compressive and tensile strains of the reinforcement.

The paper will present the structural validation of developed numerical model, PRECON3D, on a few examples and the obtained results will be compared with the known numerical and experimental ones. It is concluded that the presented programme and numerical model can be effectively used in nonlinear analysis of reinforced and prestressed concrete structures.

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