Mechanical simulation of the Concrack Benchmark RG8 test with a filament beam model since early ages

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ABSTRACT

The French national research program CEOS.fr - 'Behaviour and assessment of special construction works concerning cracking and shrinkage' - carried out an experimental campaign focused on cracking behaviour. An international benchmark (ConCrack) was organized with the goal of achieving a state of the art on cracking modelling of concrete structures [1].

Two of the structures tested (named RL1 and RG8) were large RC beams specimens loaded in bending after shrinkage. The RL1 beam was free to move in the longitudinal direction, therefore, the stresses were auto-balanced, and in the RG8 beam the shrinkage was restrained, generating normal forces.

The behaviour of the RL1 case was studied with a thermo-mechanical nonlinear filament beam model developed by the authors [2]. In this paper, the simulation of the RG8 case is presented.

The 1D FE model is able to reproduce the strain and stress state of tridimensional reinforced and prestressed concrete frame structures since early ages. The cross-section is discretized into steel filaments and concrete fibres, allowing the consideration of different levels of maturity in each fibre. The model takes into account the interaction between normal and shear stresses.

The RG8 structure is composed by a central thinner part and two massive heads linked by two cylindrical struts that restrained strains due to thermal effects and autogeneous shrinkage occurring in the concrete central part. After 8 weeks, the beam was placed on a bending bench and loaded until near bending limit.

Numerical and experimental results are compared in terms of the development of relative displacement between two points, forces in the struts, strains in the concrete and steel, displacements and cracking pattern.

Focus is made on the influence of the strut temperature on the restraint level of the central part. With the numerical analyses, it is demonstrated how early age stresses developed during cement hydration influence the later cracking behaviour of the structure under load.

The model is conceptually simple and computationally efficient, making it a very interesting option for design and assessment stages of complex structural behaviours.

REFERENCES

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