3D Finite Element Simulations of Reinforced Concrete Elements Exposed to Fire

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ABSTRACT

Fire could dramatically reduce strength of reinforced concrete elements and it is considered one of the major threats for the structural safety of buildings: structural members may even collapse due to intensity and duration of fire. In this study, 3D finite element simulations of reinforced concrete elements under fire loading are presented. A quasi static one-way-coupled thermo-mechanical analysis is carried out, in which a heat transfer simulation is conducted first and then internal forces are computed. A phenomenological constitutive model based on damage-plasticity is used for concrete at high temperature. Transient creep strains are included in the model for elevated temperature. Extended Leon model is used for yield function and isotropic damage is assumed. Numerical results are compared with experimental data found in the literature, showing good agreement.

REFERENCES

[1] J. Lee, G.L. Fenves, "Plastic-damage model for cyclic loading of concrete structures", *J. Eng. Mech. ASCE*, **124** , 892-900 (1998).

[2] P. Grassl, M. Jirasek, "Damage-plastic model for concrete failure", *Int. J. Solids Struct.*, **43**, 7166-7196 (2006).

[3] V.K.R.Kodur, T.Wang, F.Cheng, "Predicting the fire resistance behaviour of high strength concrete columns", *Cem.Concr.Compos.*, **26**(2), 141-153 (2004)

[4] T. Gernay, A. Millard, J.M. Franssen, "A multiaxial constitutive model for concrete in the fire situation: Theoretical formulation.", *Int. J. Solids Struct.*, **50**, 3659-3673, (2013).

[5] J.V. Aguado, V. Albero, A. Espinos, A. Hospitaler, M. L. Romero "A 3D finite element model for predicting the fire behavior of hollow-core slabs", *Engineering Structures*, **108,** 12-27,(2016).