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Numerical Analysis of Unbonded Post-tensioned Concrete Slab under Fire Using Spring and Contact Models

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ABSTRACT

Finite element analysis for unbonded post-tensioned concrete structures under high temperatures employ a multi-physics approach, incorporating friction and heat transfer between tendons and concrete within 3D elements, as discussed by Ellobody and Bailey (2009). However, these methods often demand significant computational resources, as highlighted by Yi and Kang (2023). In response to this challenge, alternative finite element models have been developed, employing spring and contact methods to assess unbonded post-tensioned concrete slabs under fire conditions, with validation against experimental findings by the second author. The spring models demonstrated exceptional accuracy in predicting mid-span deflection and strand stress, while the contact model exhibited instability due to its limited capability in accounting for material property degradation under high temperatures (Fig. 1). Parametric analyses using the spring models, considering variations in tendon configuration and concrete cover thickness, were conducted in accordance with Eurocode 2 (EN 1992-1-2 2004). Results indicate that current fire design standards ensure the safety of unbonded post-tensioned concrete structures, while configurations with higher heat transfer resistance in tendons may allow for reduced concrete cover thicknesses.

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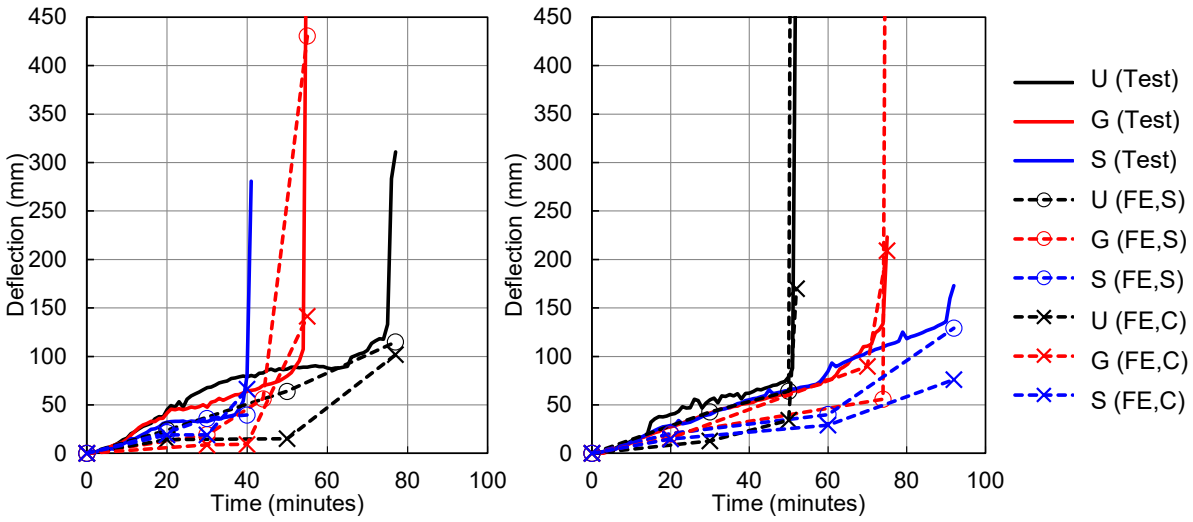

(a) 2-hour tests (b) 3-hour tests

Fig. 1 Test and FEA results

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REFERENCES

Ellobody, E., and Bailey, C. G. (2009), "Modelling of unbonded post-tensioned concrete slabs under fire conditions", *Fire Safety J.,* **44**(2), 159-167.

EN 1992-1-2 (2004), "Eurocode 2: Design of concrete structures - Part 1-2: General rules - Structural fire design", The European Union, Brussels, Belgium.

Yi, K., and Kang, T. H.-K. (2023), "Review on numerical analysis of fire performance in RC, PSC, and PT concrete structures", *Proceedings of the 2023 World Congress on Advances in Structural Engineering and Mechanics (ASEM 23)*, Seoul, Korea.