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Failure of edge and corner composite slab panels in fire conditions

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Research into the behavior of steel-concrete composite structures at elevated temperatures shows that the traditional method of protecting all exposed steel work for fire resistance is excessive. Structural stability can be achieved by unprotecting a large number of floor beams and taking advantage of a mechanism known as tensile membrane action. This is a mechanism that produces increased load-bearing capacity in thin slabs undergoing large vertical displacements, in which induced radial tension in the central area of a slab is balanced by a peripheral ring of compression. Simplified design methods have been developed for slabs at elevated temperatures, but they fail to address the contribution of the grillage of steel beams supporting the composite slabs. To enhance the use of the simplified design methods, a number of failure mechanisms have been developed based on the locations of slab panels in buildings and the extent of fire exposure. This paper builds on this development by further investigating collapse mechanisms for edge and corner slab panels. Four collapse mechanisms are discussed in terms of their formulation, comparisons with numerical simulations and test results. The analytical models address the failure of isolated slab panels, slab panels with reinforcement continuity at opposite edges, slab panels with three continuous edges and slab panels at the corner of a building. The results show good comparisons with the test data and numerical simulations.

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