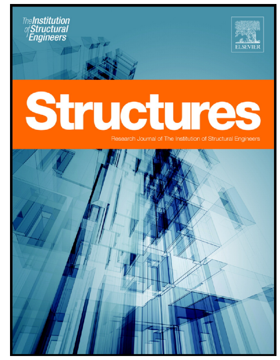

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TENSILE MEMBRANE ACTION OF LIGHTLY-REINFORCED RECTANGULAR COMPOSITE SLABS IN FIRE

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ABSTRACT

A recently developed method of treating tensile membrane action of lightly reinforced concrete slabs, based on a rigorous treatment of the kinematics of movement of the yield-line mechanism, has been developed to consider composite slabs with unprotected downstand steel beams in fire conditions. The fire case differs from the enhancement of load capacity of slabs at ambient temperature in the respect that the applied loading is kept constant at a predetermined value, but the strength of the downstand beams progressively declines as their temperature rises. It is assumed that the concrete slab does not become hot enough in its active levels, within the duration of a fire, to reduce its strength. This extension to the method is derived systematically. It is seen that the yield line mechanisms of these slabs are aligned differently from those of the equivalent concrete slabs, so it is not valid to use the latter as the basis of a design calculation. The advantage of finite deflection due to tensile membrane action manifests itself as an enhancement of the steel beam temperature that can be sustained, above that at which the yield line mechanism forms. The peak enhancement occurs at the point at which reinforcing mesh begins to fracture progressively along diagonal yield lines. This fracture can be delayed and the peak temperature increased if the mesh ductility across the yield line cracks is increased by reducing the bond between bars and concrete, thus facilitating the bar-slip from the crack-faces. The effects of using meshes of different ductility classes, and both plain and deformed bars, are considered for composite slabs of different aspect ratios.

Key Words: *composite slabs*, *fire*, *tensile membrane action*, *yield line theory*