The internal span type 1 option results in each span acting as a double cantilever, with a plastic hinge at midspan. The internal span type 2 option results in a series of continuous spans. The type 1 end span bottom reinforcement can be omitted if sufficient top reinforcement is provided across the whole span to allow the slab to cantilever from the first internal beam to the edge beam.

2.6 Unprotected structural steel

Applied fire protection can be a significant component in the cost of a steel-framed building. Therefore, for reasons of economy, it is desirable to use unprotected steelwork wherever possible. Fire engineering techniques are applied to achieve this objective. Although this manual is not intended to cover such fire-engineered solutions, some general structural design considerations are mentioned below.

Any fire-engineered design must consider the risks inherent in structural failure. Such consideration will often dictate that columns and transfer beams need fire protection, as failure of one member could result in the collapse of a large section of structure or even collapse of the whole building. Nevertheless, there would be instances (for example, in a low-rise building) where partial structural collapse would not represent a significant risk to life as occupants would have vacated the building by the time it collapsed and fire fighting would be from the exterior.

Because the usual sized steel floor beams will reach the critical temperature well within the required fire period, the beams in the ceiling of the floor assumed to have a fire may have limited strength to support the floor through normal bending. Collapse of that floor must be prevented by the slab reinforcement and beams acting as a tension net. The floor will adopt a catenary shape, with the reinforcement protected from the fire by the cover concrete. Anchorage of the tension force may be by stiff fire-protected columns spanning over two storeys and a central core if the catenary action is parallel to the floor beams, or by panels of fire-protected floor and beams if the catenary action is at right angles to the floor beams.

Most fire-engineered designs will rely on containment of the fire to one floor of the building. This will be achieved by the BCA-required floor-to-floor separation details and properly functioning fire sprinklers. In addition, the design may take account of the progressive nature of a real fire where the high-temperature fire front advances, leaving in its wake a less intense fire above which the structural steel may have dropped below, or may not have reached, the critical temperature.

The fire-engineering approach is one requiring an appropriate level of expertise and experience; it should not be attempted by those without these attributes. The advice of specialist consultants should be sought prior to embarking on a fire-engineered building design.

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Table of contents