Stadia crash barriers alert. (Feb 01)

Bulging and splitting of hollow steel section of a crush barrier. (Photo: by kind permission of Shepherd Gilmour)

The Standing Committee on Structural Safety (SCOSS) has recently received a report of bulging and splitting of the tubular steel posts of crush barriers at a sports ground.

The reported inspection showed that the posts had filled with water that had caused the damage on freezing in winter. The barrier structures are only 4-5 years old and made of rectangular hollow steel sections with fully welded joints and end plates. Visual inspection of the barriers showed no sign of any openings that would allow ingress of water (see photo).

It appears that water can be drawn into tubular steel structures of this type by capillary action. This phenomenon has been experienced in other structures; such as roof trusses made from hollow steel sections, and welded box girders.

Although the structural elements are manufactured as 'sealed units', continuous welding does not necessarily produce a complete seal and water may accumulate inside where the units are exposed to the weather.

Research into the phenomenon in Canada has shown that a partial vacuum caused when a relatively warm, imperfectly sealed steel tube is rapidly cooled by rainwater, can draw in water through very small cracks and holes. Over a period of time this can result in a considerable build-up of water trapped inside.

Where such a steel tube forms, a structural element that is exposed to the weather, the trapped water may freeze in winter. The element may thus be damaged as it fails to restrain the expansive action of ice formation. The resulting bulging and/or splitting may reduce the load-carrying capacity of the element substantially, thereby undermining the safety of the structure.

SCOSS draws attention to this reported experience because tubular or other 'sealed' steel elements in crush barriers; bridge parapets and other structures may be similarly affected. The phenomenon may exist elsewhere even though it has not yet progressed to the point where bulging and/or splitting has become visible. The presence of water cannot be detected merely by visual inspection until damage occurs. Inspecting engineers should be aware of this possibility and, where appropriate, consider specific investigation.

For the damaged crush barriers, the reported remedy was to repair and replace damaged posts and to make drain holes just above ground level to allow water to escape. A boroscope inspection through the drain holes enabled the internal condition of the posts to be checked for corrosion. More generally for tubular steel structures exposed to the weather and in unheated buildings, the report on the Canadian research advised either complete weld seals free from porosity or, the provision of some form of drainage with periodic inspection of drain holes to ensure they do not become blocked. Provision of holes also prevents the development of partial vacuum in the units and can also enable beneficial ventilation of the internal voids.

SCOSS would welcome more feedback on this hazard (tel: 0207 201 9133; fax: 0207 201 9165, email: scoss@istructe.org.uk).