Award ~

# Merchants Bridge, Castlefield, Manchester

*Owner: Central Manchester Development Corporation*

***Structural Engineer:*** Whitby & Bird

***Steelwork Contractor:*** Watson Steel Ltd

***Main Contractor:*** P Casey (Civil Engineering) Ltd

Built over the Bridgewater Canal at its junction with the Rochdale Canal, Merchants Bridge at Castlefield - Britain's first industrial heritage site - is set among 15 other bridges and has been designed to represent the 20th century's engineering advancements. Use of computer design and analysis has made previously impractical or even impossible interdependent structural systems feasible. This bridge is an example of both craftsmanship and contemporary engineering possibilities.

The brief called for full disabled access. This required ramps which, given the strict canal clearance requirements, meant that for every 100mm of thickness, the bridge length would increase by 4m. A design was adopted with as thin a deck structure as possible (400mm). Site constraints and desired pedestrian movement lines suggested a curved route which, combined with the client's brief and the desire to retain a sense of openness as pedestrians cross the space, led to a design that is the first of its kind.

Using the deck as a torsional structure, the bridge is supported from a single arch, which is itself supported by the deck - two mutually compatible structural systems. Inclining the arch away from the deck counterbalanced the deck, which curves in an opposite direction, and developed a sculptural quality to what is essentially a functional structure. The desired image was that the public were lightly cradled, as if on the fingertips of an upturned hand, rather than contained within the bridge's structural framework.

The simple form of the 65m bridge, which has a 38.2m clear span, belies the fact that it structurally relies on several separate but interrelated actions:

- The curve on plan through a total of 62° produces torsion in the deck which, with its top and bottom plates and tubes in the leading and trailing edges, is a closed torsion box.

- Resolving vertical forces into the plane of the hangers produces horizontal bending in the main span deck.

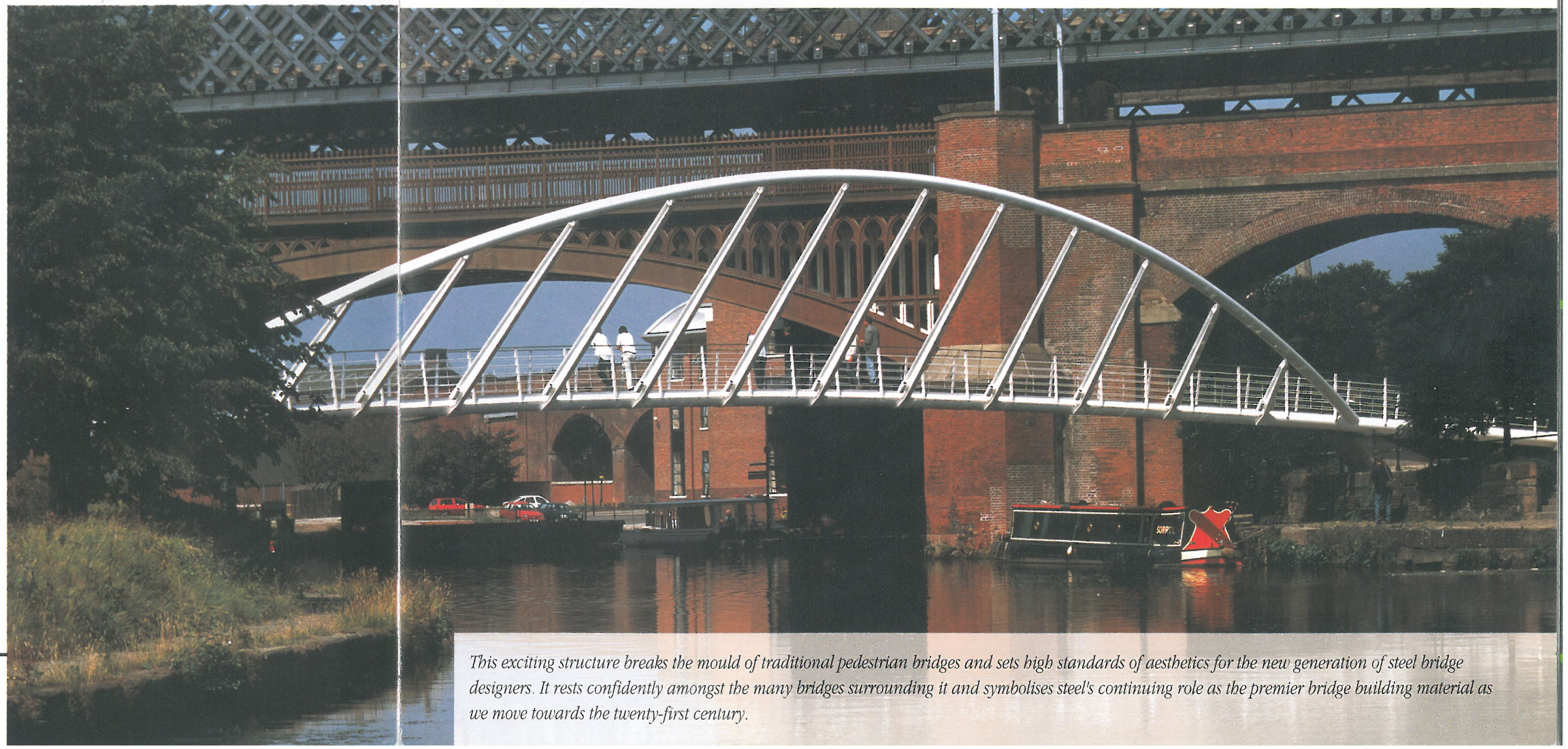
- Resolving forces in the hangers' plane into the plane of the arch produces bending in the hangers and additional torsions in the deck, hence the tapered hangers.

- The curved deck acts as a tie to the main arch, creating a crescent shape which responds more favourably to uneven loads than a simple tied arch. The arch tube is restrained from out-of-plane buckling by the hangers' bending stiffness and the deck's torsional stiffness.

- The deck's stiffness means that, in the main span, it contributes in the carrying of the vertical loads (approx 30%) by normal bending action.

It was seen that this interaction would make the structure's natural frequency susceptible to vibrations, so anti-vibration absorbers were installed to prevent this.

The west support is a vertical support which is required under the arch. Aesthetic requirements dictated the need to carry on the form of the arch, achieved in a steel cantilever. The base of this returns below the arch. The slender cast steel prop carries most of the vertical load and limits deflections in the cantilever arm. The handrails are simple flat bars, set in panels and clipped to the structure. The continuous stainless steel top rail was welded on site.



*This exciting structure breaks the mould of traditional pedestrian bridges and sets high standards of aesthetics for the new generation of steel bridge designers. It rests confidently amongst the many bridges surrounding it and symbolises steel's continuing role as the premier bridge building material as we move towards the twenty-first century.*