TATA STEEL

Structural Case Study

M8 Footbridge, Harthill

Product: Celsius® 355 Circular Hollow Section

Client: Transport Scotland

Main contractor: Raynesway Construction

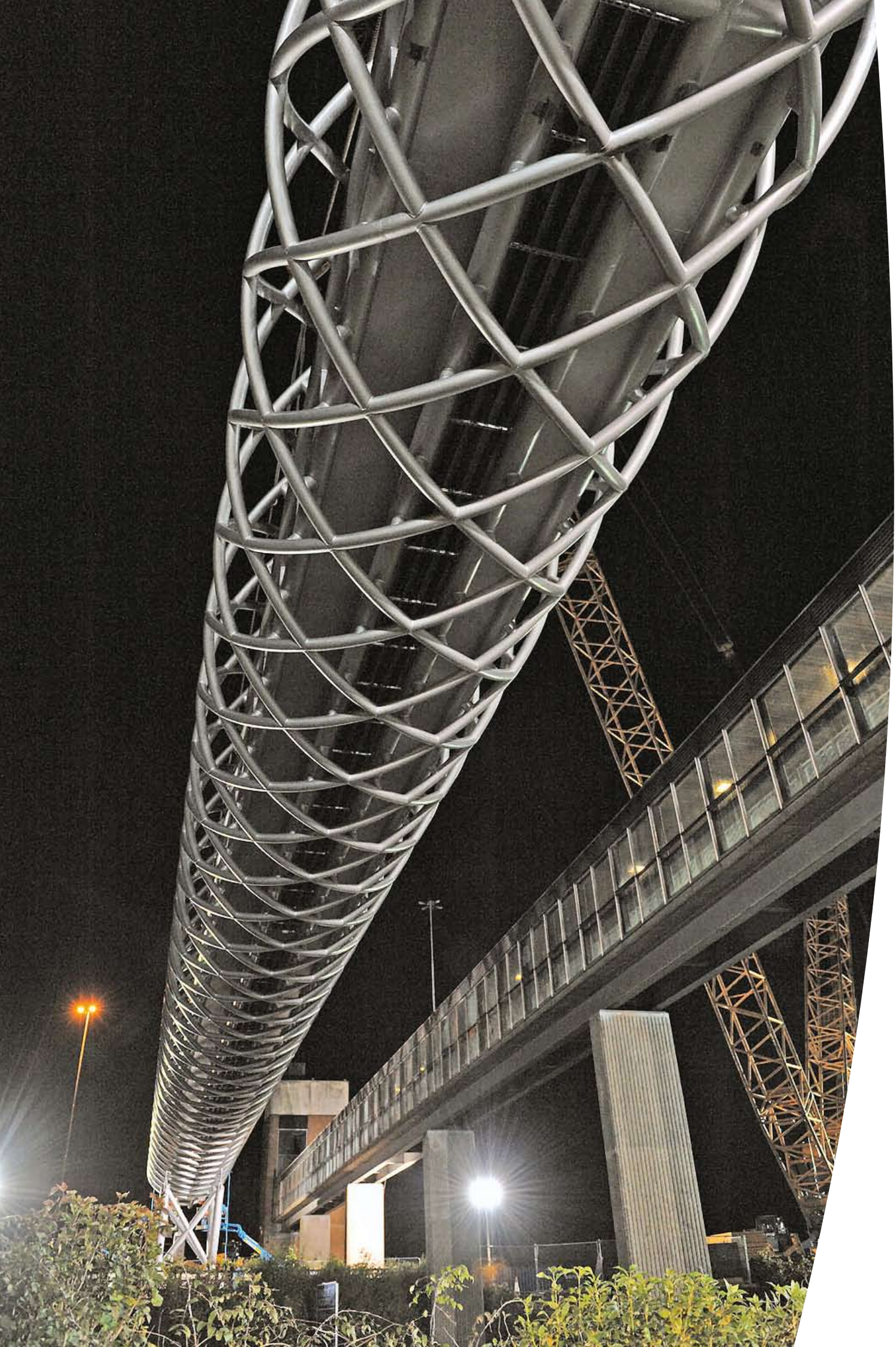
Concept designers: Scott Wilson

Steelwork contractor: SH Structures

Structural Engineer: Buro Happold

Project value: £5 million

Bridges are an essential part of the transport infrastructure. There are more than 15,000 highway bridges in the UK, with approximately 300 new or replacement structures being built each year. Steel comprises one of the principal structural elements in any new-build bridge with, on average, approximately 35,000 tonnes of structural steel being used annually for the construction of highway and railway bridges in Britain.



Knowledge of the physical benefits of steel in construction is continually increasing amongst clients, developers, specifiers, designers and contractors working across the construction industry – with the UK construction market itself being one of the most steel-intensive in the world. The ability to build very rapidly has underpinned steel's large market share in private sector construction. Particular areas of growth over the last few years have been the retail and warehousing sectors where a big increase in the use of prefabricated or modular sections has added to the steel's attractions. Similarly, the off-site manufacturing benefits associated with structural steel are encouraging its successful exploitation for the construction of bridges – specifically by the Highways Agency – to ensure the smooth operation of the UK road system.

Steel offers many advantages, not only from the material itself, but also from its broad architectural possibilities. Modern steel bridges therefore take advantage of the latest advances in automated fabrication and construction techniques to provide economic solutions to the demands for safety, rapid construction, aesthetic appearance, minimal maintenance and flexibility in future use.

One project that realises the benefits of structural steel hollow section is the £5 million footbridge in North Lanarkshire. Delivered on behalf of Transport Scotland, the new bridge spans the M8, replacing an existing footbridge that was originally built at the Harthill services after the completion of the motorway in 1965.

At the time of the project, Harthill was extensively redeveloped to provide two new service stations and a local public transport interchange – providing a vital link between the eastbound and westbound sides of the M8. The aim of the bridge was to encourage people to take advantage of the new improved public transport links into Glasgow and Edinburgh and help to reduce traffic into both cities along with the associated congestion and pollution.

Located between junction 4 and 5 of the M8 – one of the busiest stretches of road in Scotland – steel was an obvious candidate as the construction material for this new structure for a number of reasons, not least to ensure that the chosen design could be effectively realised.

Design

Bridges are significant structures that have the power to add or detract from the landscape. Specifying steel at the conceptual stage of the design is therefore one way in which designers can ensure that their architectural aspirations are realised.

An initial study was undertaken to look at different options for the proposed structure at Harthill. Having considered and evaluated several different design options for the new 90 metre bridge, the recommended solution was for an innovative helical truss design – similar to that used on the Greenside Place link bridge in Edinburgh.

A helical truss form offers many benefits when it comes to bridge design. The open framework results in elements being primarily in tension or compression, to create a very light but stiff form of construction, facilitating a speedier installation programme and, in the instance of the M8 footbridge, an aesthetically pleasing and impressive final structure.

Scott Wilson were employed by Transport Scotland to be the concept designers, the contract having then been let on a Design and Build basis. This was won by Raynesway Construction with SH Structures as the steelwork contractors and Buro Happold as the bridge designer.

The impressive structure at Harthill takes full advantage of the properties and aesthetic qualities of structural hollow sections. Twelve circular hollow sections supplied by Tata Steel are wound around the outside of the structure to create the signature corkscrew-like

appearance, the slender lines of the curved steel tubes and the neat welded joints ensuring the sharp lines of the structure's design could be achieved.

The resultant elliptical structure provides an enclosed crossing which is fully glazed with polycarbonate panels, further ensuring a safe and comfortable environment for pedestrians and cyclists using the bridge to cross the motorway.

"The complex design of the bridge main span meant that dimensional control throughout the fabrication process was critical. Surveys were carried out throughout the shop assembly to ensure that the required accuracy was achieved when the bridge sections were subsequently welded together on site. This critical process was helped by the inherent quality and properties of the steel provided by Tata Steel. This ability to carry out a large amount of fabrication and assembly off-site, is clearly one of the many benefits of using steel and enabled the project to be safely delivered on time with the minimum disruption to the general public and road users."

Tim Burton, SH Structures

The benefits of hollow sections in bridge applications

Crucially this methodology provided significant health and safety benefits on two levels. First, undertaking the majority of the construction process off-site in factory-controlled conditions makes for a far safer working environment that remains unaffected by inclement weather such as rain and high winds, which could potentially have a detrimental effect on the construction programme itself. As a result erection work on site becomes infinitely safer as it involves fewer trades and reduces the amount of man hours worked on site – specifically those hours worked at height.

Limiting the closure of the M8 to one evening reduced the impact of traffic congestion connected with lane closures and the associated increase in risk of accidents. Using alternative construction methods would potentially have increased the construction programme and the associated road closures significantly. The offsite manufacturing associated with steel kept the project delivery schedule to a minimum and also meant that significant economic and safety benefits could be realised.

There is a growing appreciation among those involved in the design and construction of bridges that steel provides benefits that other materials simply cannot, including speed, increased safety on-site, cost-effectiveness, durability, architectural qualities, offsite fabrication and sustainability.

Manufacturing process

By its very nature the steel manufacturing process is inherently off-site, which in itself created significant benefits when it came to the specification of the steelwork in this project. Production of the steel components took place off-site in factory controlled conditions using 3D CAD technology to ensure consistency, quality, reliability and fewer defects. Furthermore, removing the majority of the construction process into the factory creates positive social benefits by reducing noise, pollution and disruption in the vicinity of the construction site.

The components were subject to a rigorous testing regime, first by Tata Steel during manufacture of the steel sections at its Corby mill and then by SH Structures who prefabricated the hollow sections for the bridge in seven sections off-site before they were delivered to Harthill.

SH Structures' highly trained workforce, accustomed to working on complex tubular steelwork, pre-fabricated the sections off-site at its Yorkshire facility, therefore limiting the amount of work that actually took place on site. The relatively low weight of the structural steel components meant that the sections could then be easily transported from Yorkshire to Scotland where, upon arrival, the only work to take place on-site was the welding of the splices to create the complete 90 metre span.

Erection

Erection of the main span was carried out by SH Structures using one of the UK's largest mobile cranes complete with a 90 metre jib and 600 tonnes of superlift counterweight. The crane itself took a week to assemble, having been delivered to site in 45 separate loads.

However, once erected, the crane was able lift the 230 tonne superstructure element of the footbridge into position over the M8 using a single operation commencing at 8.30pm on Friday 03 October 2008. With the new bridge successfully located and secured into the support structure, the lifting slings attaching the bridge to the crane were removed and the motorway was re-opened at 3.00am the following morning – some three hours earlier than planned – ensuring that closure of the M8 was limited to one evening.

"It was a thrill to see the main span lifted into place without a hitch. The elegant structural design is intrinsic to the overall bridge, which also resulted in the majority of steel being fabricated off-site. However, the complex geometry of the design meant that the various parts of the bridge have had to be pieced together very carefully and this has involved close supervision and attention to detail."

Simon Fryer, Associate Director, Buro Happold

Thanks to Stevie Spiers for the use of the cover photography

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