



**TATA STEEL**



## Structural Case Study

### Paradise Street, Liverpool

**Product:** Celsius® 355 Elliptical Hollow Section

**Client:** Grosvener Estates

**Operator:** Odeon Cinemas

**Main contractor:** Laing O'Rourke

**Architect:** BDP

**Steelwork contractor:** William Hare

**Structural engineer:** Waterman Structures

**Glazing:** English Architectural Glazing

#### The aesthetic solution

Site 13A at Paradise Street, Liverpool is an ambitious building; a cinema complex with a two storey section sitting above offices and shops in Europe's largest retail development. BDP wanted to preserve city views to retain a sense of the city when looking out from the building. This clean and unobstructed glass facade was made possible by the use of elliptical steel hollow sections.







**Structural Case Study:** Grosvenor Estates



The Paradise Street Cinema forms an integral part of the Grosvenor Estate's £900 million 'Liverpool One' regeneration scheme – a 42 acre retail-led project that transformed the heart of the city. Providing new shops, leisure and living facilities, 'Liverpool One' was an ambitious project intent on bringing the city into the 21st Century whilst maintaining the heritage and character of the past.

The central leisure facility situated on Paradise Street comprises a 25 metre high, three storey steel-framed Odeon cinema, clad in copper and stainless steel, constructed on a terracotta-clad 15 metre high retail base. One of the key design

criteria for the structure was to move away from the traditional 'black box' appearance and in contrast to ensure a clear open space for the building's three level foyer. This allows for maximum natural light, creating a spacious and airy atmosphere, offering an attractive view from both inside and out.

This design called for a structurally inventive solution that would meet both the aesthetic vision of the designers and the essential strength and fire requirements. Celsius® elliptical sections were deemed as having the necessary credentials to fulfil these requirements.

## Why Celsius® Ellipticals?



Celsius® ellipticals were chosen for their aesthetic appeal and because the elliptical shape saves on width to maximise space and light. Using round sections would have meant at least double the width giving a more bulky look to the overall façade.

Elliptical hollow sections were set at 8m centres, horizontal struts and ties at 5m and 10m heights and smaller secondary columns at 2m centres. These were all orientated so that the long cross sectional dimension is perpendicular to the glass, creating the impression of slenderness to the observer.

An elliptical hollow section performs structurally in much the same way as a rectangular hollow section, but has the advantage of curves. When restrained laterally about the minor axis, the comprehensive strength of an elliptical hollow section is on par with that of a circular hollow section, which has a wider diameter.

The 15 metre high, three storey façade of the cinema measures 65 metres long and intermediate 500mm x 250mm x 16mm elliptical hollow sections were set at 8 metre centres, with 300mm x 150mm x 12.5mm

elliptical hollow section horizontal beams at 5 metre and 10 metre heights. Meanwhile, secondary vertical members spaced at 2 metre centres of 200mm x 100mm x 8mm elliptical hollow sections provide direct fixing for the glazing.

### Fire Testing

Elliptical hollow sections clearly met the aesthetic criteria but it was equally essential to meet the required fire rating. During the testing, Tata Steel, in conjunction with intumescent paint producer Nullifire, conducted a series of tests, first with unfilled, and then with concrete filled, elliptical sections.

During the fire testing a column was filled with concrete and coated with intumescent paint, a process also undertaken for square, rectangular and circular sections.

The concrete inside the elliptical hollow section acts as a heat sink, drawing heat away from the steel and allowing the paint thickness to be kept to a minimum. This ensured that the ellipticals could provide the optimal sleek appearance while surpassing the two hour fire rating.

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