

9 THE CHANGING FACE OF ENGINEERING

The role of the engineer had changed in response to new architectural requirements and as high-profile projects demanded a multidisciplinary engineering service. This would now include engineering of facade performance and energy use, fire and safety issues, all types of mechanical services and infrastructure construction as well as structural engineering. Tony Hunt was in a position to accept the new challenge.

Particularly with energy systems, but also with many other areas of building technology, architects at this stage were relying upon technological developments that were outside their own control and in many cases completely outside their sphere of influence. Their expertise and design processes now centred upon understanding advanced technology before including the appropriate equipment or systems into their building designs. It had become unrealistic for an individual architect to fully understand all aspects of building technology. A multidisciplinary team with each member contributing his or her own speciality to the design replaced the older methods that relied upon individual endeavour.

Parallels can be drawn with the advanced engineering of the aerospace industry. However, the integration of technologically-advanced systems into building shells that have changed very little over the decades indicate a lack of progress towards the ideals of the Modern or early High-Tech Movements. Acquiescence by architects to the conservatism of clients, patrons and funding organisations have restricted technological advance. Whereas nearly all of the parts may show technological advances, these advances are not necessarily evident in the design of the whole building. This has ultimately led to the hermetic sealing of buildings, with reliance upon mechanical services instead of natural ventilation.

Architectural design was now concerned with how a building looked instead of how it worked or – sometimes – even how it was built. Technology from outside sources could ensure any building would work. This change was partly due to the absence of distinctive functions for buildings – desk based activities, storage or display covered most spatial requirements. Processes have become more compact and activities have become less onerous as far as design is concerned. It was no longer easy to discern the function of a building from its design. Indeed, the function was no longer the critical factor of design. The changing face of engineering was to support the evolution of a series of new iconic monumental buildings, giving landmark buildings and enhanced status to client organisations.

The Museum of Scotland designed by architects Benson and Forsyth in Edinburgh was just such a project. Complex, intricately planned, and multi-levelled, with a towering atrium and glazed roof, the stone-clad concrete structure needed to be tailored to a steeply-sloping site in the heart of Edinburgh. Benson and Forsyth had won the competition for the design. It is said that they researched the project more thoroughly than their competitors, even to the extent that they identified which quarry they would source the stone from and that there was sufficient stone there for the project. Tony Hunt worked on several of the entries for the design competition held to appoint architects for the National Museum of Scotland. Apart from the much acclaimed winning scheme by Benson and Forsyth, Hunt recalls another by David Chipperfield that he felt would have been a worthy winner. David Chipperfield was another architect who had worked for Foster Associates before establishing his own



[Above] The complex intricately-planned and multi-levelled National Museum of Scotland in Edinburgh. (Image courtesy of Mason Taylor)

[Opposite] The distinctive round tower of the National Museum of Scotland.



practice. That Hunt was able to work on several entries for any one design competition bears testament to his versatility and his willingness to adapt his engineering skills to suit all types of architecture: the ‘unseen hand’ as he likes to call his design influence. Even with the most complicated design brief, he has been able to focus on developing designs for a given set of circumstances (that is differing structural systems for differing architects), without any preferences he may hold impacting upon other architects’ designs. He would rarely say which design he preferred other than that he favoured component-based designs. Similarly, the Lloyds Register of Shipping building by Richard Rogers Partnership (a building that was shortlisted for the 2002 Stirling Prize), was another challenging brief. Here, steel and glass towers were introduced into the existing street frontages in the heart of the City of London. In addition, the Sackler Galleries project – part of the Royal Academy in London – required complex multi-storey steelwork to be introduced into an existing building layout.

In the 1990s a renewed building type emerged: sports stadia (mainly due to improvements for spectator safety, made necessary as a result of the Hillsborough and Bradford stadium disasters). Stadia gave more scope for the highly visible, sophisticated steel structures from which Tony Hunt had made his name. The Don Valley Stadium in Sheffield – a tented grandstand structure built for the 1991 student games – was engineered by Hunt for the Sheffield City Council’s Design and Building Services Department. The design represented an advance on the cable stayed steelwork designs of Schlumberger several years earlier. For the McAlpine Stadium in Huddersfield completed in 1994, Hunt designed enormous arched lattice steel trusses to span the length of the spectator stands parallel to the pitch, affording unobstructed views to the terraced seating. Urgent reviews of safety standards in stadium design became necessary in the 1980s following a grandstand fire at Bradford, a wall collapse at Heysel in Germany, and a football match where spectators were trapped by security fences at Hillsborough, Sheffield in 1989. After looking at crowd safety, the Taylor





[Above] Splayed structural supports at all levels, this photograph is taken at basement level.

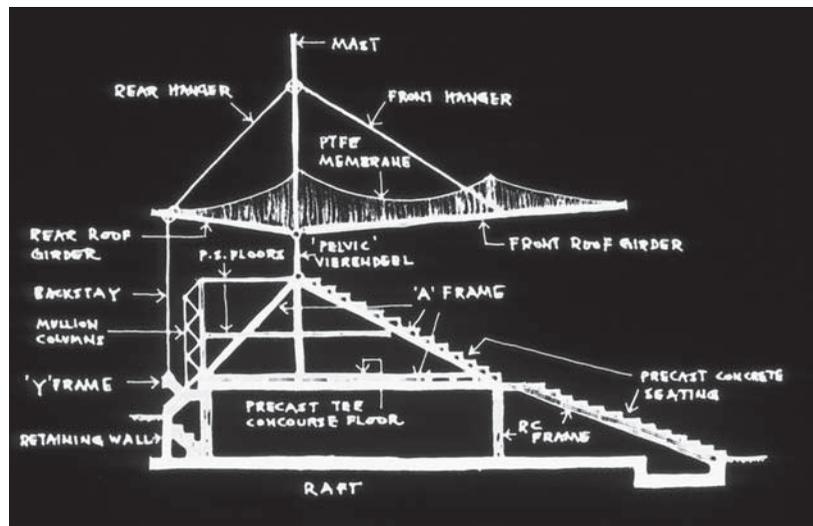
[Opposite] The steel and glass towers of the Lloyds Register of Shipping were introduced into the existing street frontages in the heart of the City of London.

Report called for all-seater stadia and this, together with increases in funding for sports grounds, provided an impetus that was to spawn the programme of the building of many new stadia during the next two decades.

First amongst these was the Kirklees Council's proposal for a new stadium in Huddersfield. Architects the Lobb Partnership anticipated this need with a schematic proposal: 'A Stadium for the Nineties', designs for which evolved in partnership with the Sports Council, and were unveiled at the NEC Birmingham in 1990. Kirklees Council therefore approached the Lobb Partnership and they entered a limited design competition for a 25,000 seat stadium to be built on a 50 hectare reclaimed brown-field site in Huddersfield, bounded by the river Colne on the west side and by Kilner Bank – a picturesque wooded bank – on the east. The Lobb Partnership proposed a stadium of plan form generated by limiting the distance of any spectator to 150 metres from any of the four corners of the pitch, and ensuring that every seat was within a 90 metre arc drawn from the centre of the rectangular playing area. This geometric process led to four steeply-banked segments logically giving a greater

number of seats towards the centre of each stand where spectators prefer to watch from, tailing off to fewer numbers at each corner. This layout has since been criticised for lacking the spectator involvement of a true arena. Lobb recommended that terrace steps should measure a minimum of 800mm. They also created a 3-D computer modelling programme capable of affirming lines of sight and unrestricted visibility from each seat in the stadium. The McAlpine Stadium became the 1995 RIBA 'Building of the year' Prize winner.

Instead of using the accepted cantilevered roof supports radially positioned over spectator stands, the defining feature of the structural design is the use of curved prismatic trusses that support a slender roof of metal decking. Arched in line with edges of the pitch and nicknamed 'banana trusses', the technique for these long-span pin-jointed (in this case two pin) arches was first developed by Anthony Hunt Associates at the Waterloo Station International Terminal. Triangular in section and made from CHS steel tubes, the trusses have two compression boom uppermost. Struts





[Opposite page] *Hunt's sketch of the structural concept for the Don Valley Athletics Stadium.*

[Top of page] *Front elevation of the Don Valley Stadium.*

[Above] *View from underneath the fabric canopy of the grandstand.*

[Left] *Corner shot of the grandstands of the Don Valley Stadium in Sheffield.*

angle down to a single tension boom, from which the roof is suspended. As well as being curved into an arch, the trusses are tapered from maximum dimensions at mid span where the bending moment is greatest, to pin joints – a single one at each end. At each node point on the tension boom, the roof is punctured by connectors which fasten a series of transverse secondary castellated beams to the trusses (this is a fabrication technique where standard hot rolled universal beams are cut along their web to a pattern and re-welded to increase their structural depth and to reduce their weight). From the line of the prismatic trusses, the castellation is tapered into a cantilever to support the innermost edge of the roof. The outermost edge of the secondary beams is supported by the outside walls of the stadium. Cold rolled steel purlins allow fixing of the metal decking roof between the secondary castellated beams. The largest trusses extend to 140 metres and each weigh 78 tonnes. At each end the arched trusses are supported by distinctive concrete thrust blocks, positioned one at each corner of the stadium. These consist of square concrete platforms supported by legs angled outwards and downwards. They also provided support for floodlighting masts. In the north western corner of the ground there is a cylindrical control and security installation, made by cladding the thrust block with glass panels. Each of the four arched trusses are different, having rises in accordance with the depth and height of the stand below and by making use of the natural banking provided by the slope of Kilner Bank. Nonetheless they provide a unified appearance. The main Riverside Stand has two tiers with a row of 26 executive boxes separating them. Opposite, the Kilner Stand is a large single-tiered stand holding over 7,000 seats. The South Stand seats over 4,000 spectators. However, the North Stand is the most recent and the tallest, housing two tiers of seating separated by 16 hospitality boxes and other special viewing areas. In the lower tier, the seating is temporary so that it can be removed for other events such as concerts to take place.

[Right] *The distinctive concrete thrust blocks between stands of the McAlpine Stadium, supported by legs angled outwards and downwards.*

[Opposite] *The two-pin arched prismatic 'banana' truss of the McAlpine Stadium.*



