Structural Steel DESIGN AWARDS 2006

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FOREWORD

Once again the Structural Steel Design Awards provide a focus for us to celebrate a wonderful array of projects which have steel as the structural material of choice. The past year has seen a good level of activity in the industry, and certainly the quality of much of the work has been remarkably high.

I have previously remarked that the number of entries submitted to the SSDA does not necessarily relate to the standard achieved, and this year well illustrates the point. The entries were all good, some were very good and a handful were outstanding. The judges have repeatedly been impressed by the project vision, the structural concepts and the quality of execution.

There has been a slight geographical skew this year towards the South of the UK, both in the entries and the winners, but I do not expect that this is more than temporary. Whilst it has made the logistics of judging a little easier, I look forward to a more “normal” spread in future.

The range of work continues to be enormous. Two major iconic projects at national airports, the home of a national assembly, two (very different) stadia roofs, a sports training centre and a college, a museum and a “temple to technology”, a bus station roof and a tiny café enclosure – what wonderful diversity!

My fellow judges and I, together with the Sponsors, thank all the teams for submitting their schemes to the SSDA. I have no doubt that we will all enjoy the results of the skill and hard work which have made them so successful.

David W Lazenby CBE DIC CEng
Chairman of the Judging Panel

The Judges

Chairman of the Panel
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Representing the Institution of Structural Engineers

C Nash BA DipArch RIBA
Representing the Royal Institute of British Architects





Award

MCLAREN TECHNOLOGY CENTRE

Woking

Architect Foster and Partners **Structural Engineer** Arup **Steelwork Contractor** William Hare Ltd **Main Contractor** Kier Build Ltd **Client** McLaren Group

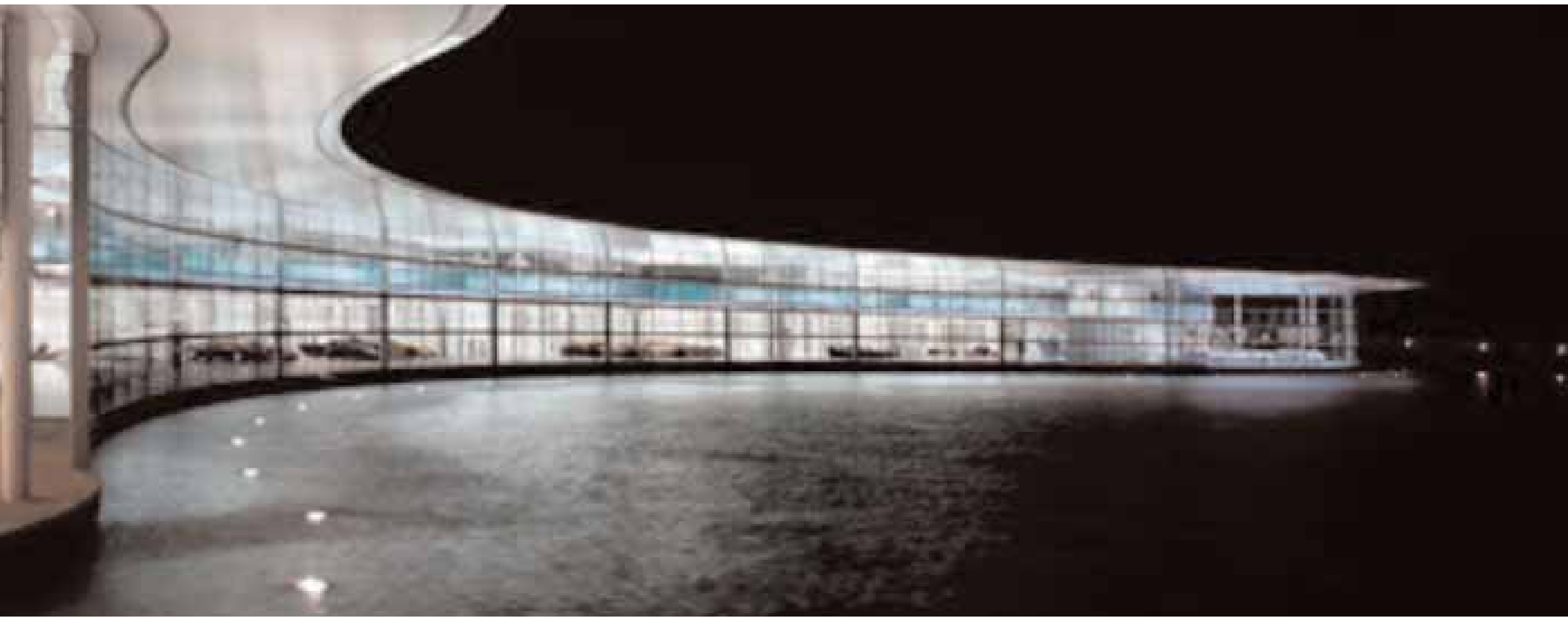
The McLaren Group is a collection of high-tech companies involved in the design and development of Formula 1 cars, high-performance road cars, electronic systems and composite materials. Since McLaren began competing in Formula 1 in 1966, it has established a global reputation as one of the most successful teams in the history of the sport.

The McLaren Technology Centre provides a headquarters for the majority of the group's staff. It includes design studios, laboratories and testing and production facilities, electronics development, machine shops, prototyping and production facilities for Formula 1 and road cars including the Mercedes-Benz SLR McLaren, as well as a 145m long wind tunnel. A Visitor Centre is located in a separate building at the entrance to the complex. It houses educational facilities, a temporary exhibition space and presentation theatre and is linked to the main centre by a subterranean building. This two-storey structure is buried underground - like the rest of the Technology Centre it is designed to make a minimal intervention in the landscape - and is visible only by its circular rooflight.

The building posed the challenge of sensitively accommodating a building as large as Stansted Airport on a 50-hectare green belt site. The required 60,000m^2 of accommodation had to be contained within a 20,000m^2 footprint. The site's constraints, determined by a 10m datum, surrounding flood plains, public footpaths, a river and restricted land, resulted in the low, deep-plan building sunk into the landscape, shielded from view by the planting of 100,000 new trees. Equally, time was an important factor. Steelwork was the most practical solution, as it allowed prefabrication off-site.

A design strategy that would allow for flexibility was an important requirement of the brief. The mix of disciplines and the varying processes involved in each of the specialist industries dictated a structure that could allow for changing needs. Consequently, both the concrete and steel components of the structure have been designed to allow for future additional service penetrations.

High quality finishes are used throughout the complex, while landscape design and sustainability are successfully brought together in the dramatic lake adjacent to the McLaren Technology Centre. The lake is central to the building's environmental strategy - its 50,000 cubic metres of water form a vital part of the cooling infrastructure for the entire complex. The lake also serves to marry the building to the landscape by making the long, curved, transparent façade look directly onto the lake.



All images courtesy of Nigel Young/Foster and Partners

Judges' Comment

This temple to engineering excellence is approached rather in the style of a great country house, set in its orchestrated Surrey idyll. It is the result of a clear synergy between a strong client and an equally strong architect. Both have been fascinated by, and demanded, perfection in this joint endeavour. Only this standard has been good enough, and this is manifest in the building.

The judges were almost stunned into silence by the calm environment and the quality of the construction, which approaches in relative terms, that of a F1 racing car.

Effective, but reasonably straightforward, steelwork has been raised to a level of precision which stretches the horizon of the possible.

In some ways this is a disturbing building for human occupation, but it fascinates the intellect and is destined to become a timeless classic.

In order to emphasise the close relationship between the lake and the building, a minimal structure was needed. To achieve this the architects worked closely with the glass-systems company Schüco International and with McLaren's own engineers, combining aerospace and Formula 1 engineering technology to find the strongest and most transparent solution for the façade. Computer-cut aluminium 'windblades' absorb the windloads, while the vertical loads are supported by stainless-steel tie-rods that are the same as those used to support the bodywork of a Team McLaren Mercedes Formula 1 car. Thus the laminated glass is suspended with almost no visible means of support, creating a virtually uninterrupted dialogue between the landscape and the interior of the building, and creating dramatic views of the lake and the surrounding countryside.

Aside from offering a solution to the challenges of time and planning restrictions posed by the project, the extensive use of steel was also key to articulating McLaren's work. The exposed engineering structure reflects the client's precision engineering industry, and keen eye for quality. The use of steel is key to the functionality of the building and clearly articulates the values of The McLaren Group itself.

Award

GATWICK PIER 6 AIR BRIDGE

North Terminal, Gatwick Airport

Architect Wilkinson Eyre Architects **Structural Engineer** Arup **Steelwork Contractor** Watson Steel Structures Ltd **Construction Manager** Mace Ltd **Client** BAA Gatwick Ltd

This unique air bridge is a key component of Pier 6 at London's Gatwick Airport. The bridge is fully enclosed and provides a permanent link for pedestrians between the North Terminal and the new satellite building. It is the first bridge outside the United States to span an airport taxiway, and caters for much larger aircraft than its predecessor in Denver, Colorado; its scale and construction making it unique in engineering terms.

The bridge forms a major landmark for Gatwick, and provides passengers with a dramatic opportunity for viewing aircraft at close proximity as they pass beneath, thereby enhancing their experience of the airport. These key features, in conjunction with minimal impact on airport operations during its construction, realised the client's design brief.

Architecture and Structural Engineering

The architecture of the bridge has been part of the engineering and vice versa, the form and shape being dictated by the engineering needs of both assembly and completed state. The gentle vertical curve of the structure has been transposed to the cladding and to the interior.

The design of the bridge is elegant yet pragmatic, the main curve of its deck satisfying both airport operational requirements and relating to its structural behaviour. The elegant curved design is integral to the client's vision both for the unique experience of passengers using it and as a major landmark for the airport. The continuously varying and curved form makes a dynamic and interesting space, with visible lines as elegantly smooth curves, thus giving passengers the feeling that the bridge moves along with them. One of the most striking aspects of this interior is the view out. An expansive vista of the airfield is opened up to passengers, who are able to observe the activity of the airport from a completely new perspective.

Great efforts were made to integrate services within the bridge fabric in an unobtrusive yet accessible manner, with air supplied through a high-level spine plenum incorporating the support structure for the central glazed screen, which separates departing and arriving passengers.

The main superstructure and services are contained entirely within the building envelope to minimise long term maintenance. The controlled environment of the bridge interior limits the extent of corrosion protection required to the support piers only. The bridge elements and materials were carefully selected for quality and type, based upon airport requirements for standardisation and maintenance, aircraft safety and the desire to give passengers an exciting distinctive environment.

Aligned along the route of a major airfield road, the bridge has a main span of 128m, which allows for a future widening of the taxiway. The bridge has a minimum vertical clearance across the taxiway of 22m, accommodating the required clearance of the Boeing 747-400 tailfin.

In creating the passenger tube, the concept of the human spine and ribs was adopted. The central spine beam, with a varying depth from 6.0m to 9.3m on a subtle curve, supports the floor and roof rib beams, and the tube is completed by struts between the roof and floor ribs supporting the full-height glazed façade. The façade is inclined inwards by 11 degrees from the constant width roof towards the floor, creating a curved floor deck which narrows at mid-span.

The superstructure is supported on two Y-shaped piers, which are symmetrical to the centre of the taxiway and the bridge. The way the bridge works is simple and effective. The deck is simply supported during assembly, and the completed bridge is a continuous frame fixed on piled foundations.

Fabrication and Construction

Airports are extremely busy environments and it was essential that there was minimal disruption to airport operations during

Judges' Comment

A landmark structure in one of the world's busiest airports, providing a link for passengers between the North Terminal and the new satellite building.

The bridge, with a span of 198m and incorporating over 2,700 tonnes of steel, posed a major challenge, particularly in fabrication and erection. The main girders were originally started in the North of England, and later moved to the final assembly site 1.5kms away within the airport perimeter. The movement of the complete bridge structure, across taxiways to its final position, was a notable achievement.

The flowing, curved shape of the bridge provides a unique experience for passengers as they pass high above moving aircraft.


Image courtesy of ARUP


Image courtesy of Nick Wood


Image courtesy of Nick Wood


Image courtesy of Nick Wood

the bridge construction. The entire bridge was therefore prefabricated in a yard on the airport boundary, specially equipped with all necessary infrastructure and located 1.5km away from the bridge final location.

The 198m long structure was built in five component parts; the 164m long, 2000 tonne, central deck section; the two support piers; and the two 17m long end deck sections that would connect the bridge with the cores. The challenge was to ensure that these five components would fit perfectly together when brought into their final position, so that the taxiway would become a construction site for only 10 days.

Upon completion of assembly, the central deck section was fitted out with the secondary steel elements, glazing and services equipment before being made ready for the final move. Self-propelled modular transporters were used to manoeuvre each of the components and to place them exactly above the permanent foundations.

Conclusion
On 27 May 2004, exactly 10 days after it closed for the bridge erection, Gatwick's taxiway Lima successfully reopened, and airline staff and passengers alike witnessed the unique spectacle of aircraft taxiing beneath the new structure, a tribute to the accuracy, ingenuity and skill of the design and delivery team. Much of the bridge success lies in the integration of architecture and engineering and the innovative methods of procurement, assembly and erection employed by the design and construction teams.

Award

NATIONAL ASSEMBLY FOR WALES

Cardiff Bay

Architect Richard Rogers Partnership **Structural Engineer** Arup **Steelwork Contractor (Roof Steelwork)** S H Structures Ltd **Steelwork Contractor (Ancillary Steelwork)** Rowecord Engineering Ltd **Main Contractor** Taylor Woodrow Construction Ltd **Client** Welsh Assembly Government

"It's almost impossible to find anyone with a bad word to say about the Senedd," reported the BBC when the new building opened on 7 February 2006 for business. "Almost everyone I've spoken to is gushing with praise."

The NAW's Senedd ("Senate" in English) houses the Members' debating chamber and committee rooms. The building's three levels also provide open and inviting public space, with a café and galleries overlooking the formal business areas and Cardiff Bay.

The brief was to:

- create a landmark building
- signal a new style of government and a turning point in Wales' history
- reflect the democratic values of openness and participation

The response is a building whose undulating floating roof, held up with minimal visible effort, is suspended over a transparent enclosure atop a solid plinth. The plinth rises in terraces from the water's edge, encouraging people in.

The plinth is a simple exposed concrete frame, wrapped in slate. Above the tall façades is the sculpted roof, its shape derived from the flow of forces within. This unique roof, with its beautiful cedar-clad soffit and the minimal tie-bars anchoring it to the plinth, will define the National Assembly for Wales for its users and electors.

As well as triumphantly meeting the client's basic brief, the project has achieved:

- delivery on time - £41M fixed-price Design and Build contract
- unique architecture – "a great example of inspired and intelligent design"
- maximum durability and flexibility for its minimum 100 year life
- exemplary integrated and sustainable design, driven by low energy systems
- a showcase for steel construction
- a model for constructor/designer dialogue in maximizing economy and buildability
- elegant steelwork detailing combined with fine workmanship

Steel showcase

Apart from the roof, exposed structural steelwork is used to exciting effect throughout: in the Members' Gallery, stairs, internal bridges, glazed lift towers, bridge links to the adjacent office building, internal and external canopies and in the main façade's mullions and transoms, in which steel's strength and ductility ensure blast resistance, as they do in the roof, which could not sensibly have been built with any other material.

Fine detailing and workmanship is evident in connections such as the column end castings and tie bar anchorages.

Value and buildability

The roof is divided into six repeating domed bays. An early meeting between client, contractor and designers led to refinements which reduced structural weight and improved buildability and services runs without compromising the architect's vision. Kalzip roofing sits directly on the structure, eliminating secondary steelwork.

The steelwork contractor pre-assembled the roof in the shop, minimizing space-take by building one bay at a time and using the common valley beams to ensure fit between bays. The roof comprises mostly short members, enabling the steelwork contractor to optimize sizes of prefabricated

Judges' Comment

Located in a prime position overlooking Cardiff Bay, this impressive building attains the quality and grandeur that is to be expected of a National Assembly. Yet it is the transparency and lightness that bring the local public closer to their elected delegates.

The roof appears to hover over the chamber, in an impressive display of steel structure and cedar cladding. These create a feeling of generous soaring space, with a sense of minimum structural effort.

Through the combination of excellent design, local materials and high construction skills, this landmark building is something of which the Welsh people can be justly proud.




sections for transport and then to combine these on site at ground level into the heaviest assemblies suitable for craneage, keeping lifts to a minimum.

Isometric drawings were created from the CAD model in order to illustrate the erection sequence and convey it to the site staff. Temporary works consisted only of sets of Tirfors. Access from MEWPS for erection was simple because the roof is a single layer structure. Despite apparently complex geometry, careful design and planning resulted in a roof which went together easily.

Durability and adaptability

The minimal internal vertical structure and loose fit design ensured future adaptability. The columns supporting the debating chamber are set back to enable expansion. Natural finishes including timber and slate were chosen for their low life cycle cost, durability and maintenance simplicity. The main enclosure is single glazed, avoiding double glazing systems' short lives.

Structural steel is used at all levels from the undercroft to the roof, with virtually no applied fire protection.

Sustainability and integration

The building, designed to achieve a BREEAM "Excellent" rating, lies on a brownfield site. Natural ventilation is the default mode. Cooling and heating is supplied by earth heat exchangers. Additional heating is provided by a wood-chip boiler. The exposed concrete frame moderates the environment, eliminating applied finishes. The rotating wind cowl ventilates the chamber via the funnel hung from the roof and admits daylight, reflected into the chamber by a conical mirror. The bulk of services are distributed in an undercroft which is roofed over with bespoke steel framed floors.

These systems will reduce running costs by up to 50%.

Conclusion

This building has raised the benchmark for public building procurement and for best practice in environmental design. At its formal opening on 1 March 2006, Her Majesty the Queen said to the Assembly Members: "The skill and imagination of those who've designed and constructed this remarkable example of modern architecture have given you a dramatic setting in which to work."

Award

AIR TRAFFIC CONTROL TOWER

Heathrow Airport

Architect Richard Rogers Partnership **Structural Engineer** Arup **Steelwork Contractor** Watson Steel Structures Ltd **Management Contractor** Mace Ltd **Client** BAA

This new state-of-the-art control tower was designed from the outset to combine functionality with style. At 87m it is more than twice the height of the existing control tower and will become the new 'icon' for Heathrow Airport. The slender mast supports the 18m diameter, 34m high control tower cab which provides the best possible vantage point for the air traffic controllers to manage operations once the new Terminal 5 is complete. Three pairs of 150mm diameter cables are fixed ust below the cab level and are anchored at ground level to restrain the mast.

Construction strategy

The logistical challenge facing the project team was to design and construct the control tower on an island site surrounded by live runways in the centre of one of the world's busiest airports. The solution was to pre-assemble as much of the tower away from the site as possible and then to ensure that the actual onsite installation was as quick as possible by minimising site welding using pre-engineered connections. This construction strategy allowed all the construction to take place at low level and the use of high crane jibs, which would have interfered with the radar operation in the airport, was minimised.

Mast details

The steel mast has a triangular cross section with a 1.4m radius to each corner and incorporates an internal and external lift, an escape stair and service risers all of which, other than the external lift, are squeezed into a cross section just 4.6m across. One of the drivers in the mast design was to keep the cross section within transportable limits to reduce the site assembly work.

Fabrication

The mast sections were fabricated in the Watson factory in Bolton. The decision was made at the outset to avoid site welding wherever possible and the mast joints were designed with internal flanges to be fully site bolted. The complete mast involves eight sections up to 15m long with a maximum individual weight of 85 tonnes. There were very strict tolerances upon straightness, rotational deviation and skin and vertical stiffener alignments which required the flanges on each section to be parallel to within a tolerance of +/- 0.5 across the entire width.

Pre-assembly

A pre-assembly area within the airport but some 1.4km away from the final location was chosen which, whilst still classed as 'airside', had far less operational restrictions than the final location at Terminal 3. The complete Control Tower Cab weighing some 860 tonnes along with the necessary temporary works to maintain stability was assembled here and then moved into position during a night-time closure of the runways

Moving into position

The move took place on the night 29 October 2004 after the last aircraft movements. Three computer-controlled hydraulically–powered flat bed units, each with 48 pneumatic wheels, were used to move the assembly a distance of 1,400m to the final location. The move, which was planned down to the smallest detail, was completed in just two hours.

The next day the assembly was lowered and connected to the first mast section which had already been positioned and was supported upon a series of jacks forming an hydraulic pin for use during the mast erection. Another set of hydraulic jacks, this time positioned to act horizontally, was used to align the mast sections and also provided lateral restraint to the structure during erection.

Judges' Comment

This is an iconic project, planned and executed in an exceptionally demanding environment. The enormous, and growing, scale of operations at Heathrow (the busiest international traffic in the world) required an enlarged and improved control system, involving one of the tallest towers to date.

Steelwork was the material of choice, in terms of space requirement, construction and cost. The tubular plated main core is shaped to accommodate lifts, stairs, services and electronics, and the three stays ensure the rigidity criteria for the radar systems.

The logistics of fabricating the steel off site, and then transporting the elements (particularly the large lantern control pod) to the site across one of the main runways, were daunting. The sequential jacking of the modules into position was innovative and effective.

The challenges for the planning, engineering concept, design, fabrication and erection were exceptional.

Jacking to full height

The jacking operation was one of the most complex ever carried out in the UK. A set of three strand jacks on 20m high temporary towers was used to lift the cab structure into the air while a section of mast was installed below. The jacks were reset and the operation repeated five times until the cab was at its final height of 87m.

During the lifting process three temporary guy cables were required to stabilize the top of the tower. There was a critical relationship between the strand jack lifting cables and the paying out of the temporary guy wires which was complicated by the constantly changing angle of the guy wires as they were paid out.

The temporary guys were then replaced by six permanent 150mm diameter cables and finally the entire 1,150 tonne structure was made secure by tightening the holding down bolts to a predetermined tension to obviate any fatigue loading on the bolts.

Commendation

ENGLISH INSTITUTE OF SPORT

University of Bath

Architect David Morley Architects
Structural Engineer Buro Happold Engineers
Steelwork Contractor Midland Steel Structures Ltd
Main Contractor Bovis Lend Lease
Client University of Bath

The English Institute of Sport is an elite training facility at the University of Bath – one of four regional centres providing facilities for world-class athletes. It comprises a multi-purpose sports hall, an eight-court tennis hall, a 140m indoor sprint track, a dojo, an indoor athletics hall and fencing sale, in addition to hydrotherapy facilities, fitness suite, sports injuries clinic, human performance centre and other auxiliary facilities. A key aim of the design was to ensure contact between visitors and users, achieved through high levels of visibility and natural ventilation and lighting from roof lights make it a more appealing environment to both groups.

Ged Roddy, Director of Sport at the University of Bath, said of the project 'it puts us at the top of the tree in terms of university sports facilities. There isn't one in the country that can compete.' At the official opening, Tim Henman described the facility as a 'world-class training environment.'

The primary structural challenge of the project was to enclose the large areas in a cost effective and aesthetically appealing manner. Each sports activity has a precisely defined minimum volume requirement which had to be kept free of obstructions. Steel was the obvious choice for a lightweight long span structure.

The tennis hall is bisected by a high level viewing gallery providing clear views to all eight courts. The walkway is supported by three structural 'trees', which also support the primary roof trusses at mid span. The 'trees' are three dimensional lattice columns, constructed from fully welded circular hollow sections. The unique feature of the trees is that they are also the primary element of the stability system for the tennis hall, as they cantilever up from the foundations to provide a row of lateral restraints in the middle of the hall. At 75m long, the primary roof trusses are expected to experience significant variations in length as the temperature varies in the unheated hall. Positioning the lateral restraints centrally allowed this movement to be accommodated without locking significant thermal stress in to the structure. They are detailed to minimise dust, and the design allows nets to hang from the bottom chord of the truss in both halls.

Externally the link between the University park and the new facility was created physically and visually through the colonnade. The 18m long spans, created by the innovative elliptical section steel support columns, give a muscular feel to this reinterpretation of the sporting tradition of ancient Greece and the Roman city of Bath.

Judges' Comment

Sporting achievement is high in public perception. As part of the efforts to raise national performance, this project is one of a small group which nurtures young talent, bringing it through to international competition.

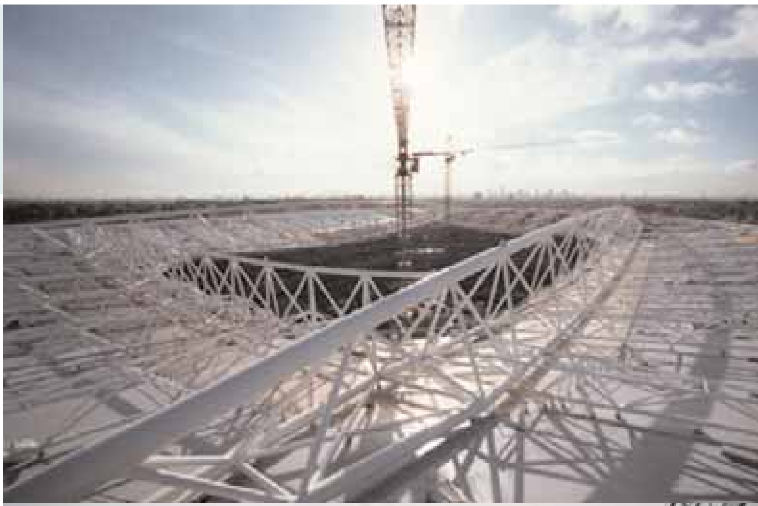
The complex provides a gateway to the University campus, cleverly incorporating some earlier buildings.

The steel structures are well conceived and detailed, and make a strong contribution to the carefully constructed ambience of the institute, which is important for success with the young sportspeople.

Commendation

THE EMIRATES STADIUM

Arsenal Football Club



Architect HOK Sport
Structural Engineer Buro Happold
Steelwork Contractor Watson Steel Structures Ltd
Main Contractor Sir Robert McAlpine
Client AYH plc

Roof Design

The roof has two parallel primary trusses spanning 204m along the length of the stadium. These sit on 11m high tripods at each corner and in turn support two 100m span secondary girders that span East West between them. This framework of main girders supports 32 tertiary trusses which span back to the perimeter of the stadium where they are connected to a continuous ring truss resting on perimeter posts.

The main girders, tertiary trusses and perimeter ring truss are all triangular in cross section and constructed mainly out of tubes. Several costing exercises were carried out during the design development stage and it was found that the tubular sections were the most cost effective because of weight savings, less surface area and the fabrication details are much simpler when using tubes in triangulated girders.

Fabrication

Watson introduced some new and innovative techniques into the fabrication process to ensure that the large complex individual elements were fabricated to the necessary accuracy. This involved using the X-Steel model of the individual components to produce a three-dimensional template-jig of the component, which was then orientated to provide the best build angle and level for the shop floor fabricators. Using this new technique Watson produced complicated fabrications to a high degree of accuracy that fitted perfectly on site.

Erection

The roof girders are 15m deep and 10m wide and were delivered to site as a 'kit of parts'. The assembly was difficult and challenging because of the complicated 3D geometry and temporary works were provided to locate all the individual components until they were site welded. The girders were assembled in halves and then lifted into position using large cranes.

The designers had to account for the stresses induced by the dead weight deflection of each half and the temporary trestles were kept in place until the entire roof including the perimeter ring truss was complete.

Conclusion

This successful project is an excellent example of how a major project should be managed. The key factors that have contributed to its success are:

- a clear vision from the client
- well considered, detailed designs integrating the client's requirements in a visually striking structure
- early involvement of the main contractor and key subcontractors allowed construction issues and design requirements to be fully coordinated and the best value solutions achieved
- application of leading edge technology into the design and fabrication process
- proactive and positive attitude from all parties.

Judges' Comment

Floating above this 60,000 seat stadium, the design of the roof structure posed major challenges to the team, being within a constrained site and with restrictions on its height.

The intelligent steelwork solution involves a "dished" roof profile, hung from the main structure, enabling the main truss and secondary girder depths to be well accommodated. For spectators, the uninterrupted sweep and clear lines of the roof draw the eye towards the pitch.

There have been many stadium roofs constructed in recent years, and this development represents an interesting step forward.

Commendation

NATIONAL WATERFRONT MUSEUM

Swansea

Architect Wilkinson Eyre Architects
Structural Engineer Arup
Steelwork Contractor Billington Structures Ltd
Main Contractor Mowlem Building
Client National Waterfront Museum Swansea

Forming a key element in Swansea's regenerated Maritime Quarter, the design for this landmark museum was driven by the site's historical narrative and the need to achieve coherence between a refurbished existing building and extensive new gallery space. Steel was used in the construction of these new galleries, enabling the team to create the sweeping, column-free interiors necessary for large exhibits with a considerable lightness of touch.

The design is a response to a broad-ranging brief, the main objective of which was to underpin local regeneration. The consideration of sustainability issues were an integral part of the design process, ensuring the best value was obtained environmentally as well as economically, and the widest possible measures were employed to minimise the negative impact of the construction process.

The project involved the refurbishment of a Grade II listed warehouse on the dockside, and the construction of a series of new-build gallery spaces alongside. The refurbishment of the existing building included extensive repairs to badly corroded perimeter steelwork and sympathetic changes to the interior, opening up the exhibition spaces within. The existing steel roof trusses were retained, their triangular geometry emphasising the airiness of the space and providing good distribution routes for ductwork and cabling.

Connected to the warehouse by an expansive atrium, a series of new galleries form an arc of interlocking, double-height volumes. The decision to use steel for the structure of these new galleries enabled large, column-free interior spaces to be achieved with the lightest possible structure, the steel being easily integrated into the glazed elevations. The team established the principles of the design early on, refining them to create a steel structure that was simple and elegant, with a clear hierarchy of parts in those elements that remain visible. The use of steel enabled structure, services and architecture to be successfully integrated, and allowed the significant areas of roof and upper floor cantilevers to be achieved in the new galleries. For these new galleries the steel was fabricated while the substructure was being constructed, then delivered to site and rapidly erected to ensure the earliest possible watertight construction.

The roof structure is geometrically complex, and close collaboration with the steelwork contractor helped determine the most practicable way of reviewing the connections. Rather than reviewing hundreds of steel fabrication drawings, the designers simply viewed a three-dimensional computer model of the entire structure, created by the steelwork contractors. Together they swiftly 'flew' around the structure looking at critical aspects of the detailing, saving many weeks within the overall construction programme.

Judges' Comment

This museum complex creates an excellent result with the minimum of fuss and ostentation.

It skilfully links old and new, into a sequence of effective spaces. Crisp steelwork and glazed curtain walling play a crucially important part.

The project has a simple, clean design that is logical in its detailing and uncompromising in its execution. The result is a classic of its type.

Commendation

THE OCS STAND

at the Brit Oval

Architect The Miller Partnership
Structural Engineer SKM Anthony Hunts
Steelwork Contractor Severfield-Reeve Structures Ltd
Main Contractor Taylor Woodrow Construction Ltd
Client Surrey County Cricket Club

The Oval Cricket Ground in South East London was upgraded in 2004/5. The run-down Vauxhall end stands were replaced with a modern steel framed building. The new seating, spread over five storeys, and a feature curved steel roof have provided an increased ground capacity and upgraded facilities appropriate to the calibre of matches hosted at the ground. The main multi-storey building houses various hospitality facilities such as restaurants, concessions, conference suites and viewing areas.

The building is designed as a braced steel frame with dedicated stability bracing and portalisation in areas where bracing would interfere with views to the pitch. The seating terraces are formed from precast concrete units supported by reinforced concrete walls and raking steel beams in the lower tier and fabricated tapered steel cantilever beams in the upper terraces. The suspended floors are constructed from lightweight concrete on profile steel decking acting compositely with the primary steel support beams.

All terrace units were designed with a vertical natural frequency of 6Hz. This was achieved economically by adopting a semi composite action between the terrace units and the cantilever raking steel support beams which increased their stiffness in the dynamic analysis without incurring any weight penalties.

To achieve a clear column free space at ground floor, two of the central support columns were omitted between ground and second floor level. Two deep fabricated plate girders at first floor level support the floor at that level with a storey high transfer truss, located between third and fourth floor supporting second, third and fourth floors.

The roof is supported by circular hollow section columns branching out at high level with four arms to support the curved primary support beams. As these members are external and visible the connections are fabricated to a high architectural/aesthetic standard. Cold formed steel purlins supporting a standing seam metal roof deck and polycarbonate roof covering complete the roof canopy.

High quality paint finish was specified to areas of exposed external steelwork to increase the life to first maintenance period which was a key concern to the client. The project was programmed into two distinct construction phases to suit key international matches mid-way through construction. Phase I consisted of demolition of the existing stands, piling and sub structure, erecting the steelwork frame and lower precast concrete seating. Extensive use of prefabrication enabled these works to be completed on time to allow for a temporary handover during the summer of 2004. Phase II consisted of completing the superstructure, M&E services, fitting out and external works.

The new stand at The Oval was delivered on time and to the client's budget. The completed building is an elegant and aesthetically pleasing structure that has, in combination with the success of the England Cricket team during the last test match of the Ashes series held there in the summer of 2005, lifted the profile of the ground and Surrey County Cricket Club immensely.

Judges' Comment

The new stand at the Vauxhall end of this historic cricket ground is covered by a single roof surface, which sweeps up from the ends to the centre, where the greatest height is required.

The roof is supported on a regular grid by "tree" columns, which spring out of the seating structure below. At lower levels the spectator deck is supported by a plate girder cantilever structure. The whole relates cleverly to the integration of the various functions of the ground, the seating and the site.

This is a most appropriate use of steel, in a geometrically complex arrangement, which adds drama and visual excitement to a famous venue.

Certificate of Merit

VAUXHALL CROSS BUS STATION

London

Architect Arup Associates
Structural Engineer Arup Associates
Steelwork Contractor Hawk Engineering & Construction Ltd
Main Contractor Norwest Holst Ltd
Client Transport for London

The new £4.5M modular steel framed, stainless steel clad, bus station designed by Arup Associates at Vauxhall Cross, South London, is a symbol of regeneration in a run down area previously notorious for its domination by traffic. The project was commissioned through Transport for London (TfL) to create a coherent and efficient interchange for Bus, Rail, and Underground users - thus growing the use of public transport in accordance with the Mayor of London's policies - and be a landmark structure to enhance the local environment and amenity. The bus station is now the second busiest in London after Victoria, and its presence has stimulated local business and planning development, and brought forward the upgrading of other transport facilities in the area

Design Principles

The bus station has been realised as a 200m long, 12m wide, undulating stainless steel 'ribbon', which rises as a 'super-long' cantilever at its northern nodal end. The development of this as an idea is a functional response to the aspirations and constraints of the brief and the site conditions.

The undulations along the length of the canopy reflect the frequency of bus stands. Each dip of the canopy provides a seating refuge and raking support for the canopy above, which rises over the height of double-decker buses. The folds in the layered ribbon also echo London's iconic bus and Tube route maps, dating back to the 1930s. The open canopy, rather than an enclosed building, offers free and safe access through permeability and visibility, not obstruction. The emphasis along the concourse is on movement rather than occupation. Equally, the undulating structure has minimal contact with the ground and potential obstructions, remaining from the former highway use which included a significant presence of buried mains services and sewers.

The principal intermodal circulation and the key operational accommodation are at the canopy's northern end, the accommodation structure being used as a springing point to launch the ribbon's dramatic elevating twin cantilevers. These over-sail the circulation area and underground obstructions, and project over the most prominent vista of the site to demark the interchange location.

The cantilevers combine their urban role with a functional purpose. The arms are at a 20° inclination facing south and covered with a photovoltaic array to generate power for the building operation, and to actively display the application of the Mayor's Energy Strategy policies to a new public building. By day, the ribbon allows daylight to enter throughout the circulation area and displays itself in its bold choice of material and sculptural form. By night it becomes an animated floodlit beacon, offering both visual excitement and a well-lit safe environment.

Steel Structure and Fabric

Steel construction was the obvious choice as it offered off site prefabrication of components and convenient erection of modules within the confines of the 'island' site. Stainless steel cladding was selected as the most appropriate material to deal with the exposed conditions and durability requirements. Steel is also fully sustainable as it offers end of life recyclability.

Judges' Comment

This important, but modest, scheme develops an iconic structure which has helped to regenerate a rather forbidding urban traffic junction.

The bus station elegantly gathers together all the elements of public transport - control room, shelter, wayfinding, seating, lighting, etc., within an overall umbrella surface which weaves its way overhead. The steelwork and cladding are relatively straightforward but effective, and the detailing at street level is rugged.

Particularly interesting is that the shape of the roof reflects the graphic of the bus route map.

Certificate of Merit

SOUTH EAST ESSEX COLLEGE

Southend-on-Sea

Architect KSS Design Group Ltd
Structural Engineer Adams Kara Taylor Ltd
Steelwork Contractors DGT Steel & Cladding Ltd and William Hare Ltd
Main Contractor Laing O'Rourke
Client South East Essex College

The new Campus Building for South East Essex College of Art and Technology demonstrates the many benefits that steel can bring to a project. In this building steelwork was used to build an economic, quick and imaginative building exploiting the strength and flexibility of structural steel. It was used to produce a quick, economic frame, a very light and dramatic atrium and dealt with the complex forms of the pod and the dining decks.

When the SEEC decided to relocate within Southend it was keen to exploit the opportunity to expand on its open teaching techniques. The building achieved this through the use of longspan precast planks which were supported on a steelwork frame. This solution allowed column areas of 14.5m x 30m to be formed. The project was procured as a design and build project and AKT worked with the main contractor Laing O'Rourke to develop a steel framed solution that achieved the aspirations of the College whilst satisfying the demanding programme.

A large lean-to atrium structure clad in ETFE standing 36m high and with a maximum span of 34m was formed using tied arches to produce a dramatic airy structure.

Within the atrium is a bright red pod which houses a 250 seat lecture theatre. The pod was formed by using a number of steel frames to achieve the complex geometry. A sprayed concrete cladding was applied to the frame to dramatic effect. Also within the atrium us two levels of dining decks. These mushroom like forms were achieved by using cantilevered steel frames stabilised at the head by a concrete diaphragm.

Judges' Comment

This unusual structure has added great value to the process of consolidating the college from three sites onto one central location.

The main building is L-shaped, and houses teaching and administration functions. In the angle of the block, the team have created a large, light atrium by the use of slender arches with glazing and ETFE pillows on the roof. The space covers galleries at various levels of the college, as well as "mushrooms" used for meeting and refreshment areas.

The quality of this space has had the beneficial effect of greatly increasing the number of applications from students to join the college and share in the excitement of the new environment.

Certificate of Merit

BULLRING SPIRAL CAFÉ

Birmingham

Architect Marks Barfield
Structural Engineer Price & Myers 3D Engineering
Steelwork Contractor Sheetfabs Ltd
Main Contractor Thomas Vale Construction
Client Birmingham Alliance

The brief for the Spiral Café was to design a small café for St Martin's Square, the main public space in the £500m Bullring development in Birmingham's city centre. The purpose of this café was to create a landmark structure, which would be part sculpture and part revenue generator, while at the same time helping to animate the terraces of the hard landscape in which it sits.

The form of the café is derived from sweeping a Fibonacci spiral to create a shell-like canopy. The structure is contained between the inner and outer curved surfaces of the canopy; it both supports the cantilevering roof and provides accurate formwork from which the rest of the construction can take its shape.

The eight structural ribs are arranged radially in plan and each tilts up relative to its neighbour to create the shell-like form. A series of CHSs are set diagonally between the ribs; together they act as a cantilevering shell structure. The ribs are supported at points under the roof of the servery and at the roof level of the rear annexe. Further stiffness is generated by the CHS braces between the ribs, which together act as a cantilevered truss supported at the outer tips of the first three ribs.

To simplify fabrication as much as possible, the structure was made from mild-steel plate ribs cut on a computer-controlled plasma cutting machine. This meant that the form of the building could be manufactured easily, with a number of curved ribs defining its shape. Obviously three-dimensional modelling was critical to the design. A product design program was used to develop a parametric three-dimensional model. The program was used to model all structural elements and many architectural elements, such as cladding profiles and glazing interfaces. As part of the design process, the architect and the structural engineer worked together on the same three-dimensional model, taking sections and profiles from it to develop further details that were not modelled three-dimensionally.

Drawings generated from the three-dimensional model included a set of true plans of each component. This allowed the steelwork contractor to take the profiles and add additional information, such as bolt holes and splice locations, before cutting the metal. A very high degree of fabrication accuracy was achieved in this way. The level of accuracy in the steelwork allowed us to use the frame as a building-wide template for production for other information later in the programme. Elements such as capping pieces could be designed on the three-dimensional model with full confidence that they could fit to what was on site.

Judges' Comment

The constantly varying curved envelope of this small building provides a fascinating sculptural landmark, which sits well in this major city-centre retail area.

The cantilevered structural form, based on rigorous geometrical parameters, is ingenious. Its execution and reflects a high degree of cooperation between the team. The finished structure was achieved by the skill of the steelwork contractor who made a full trial assembly in his shop, and incorporated sufficient bolted connections to enable the dismantling, transport and final re-assembly on site.

This small "gem" is a testament to craftsmanship in steel.

The Structural Steel Design Awards Scheme 2007 Entry Form

Entries are restricted to steel based structures situated in the United Kingdom or overseas that have been built by UK steelwork contractors using steel predominantly sourced from Corus.

They must have been substantially completed and ready for occupation or use during the calendar years 2005 and 2006 – previous entries are not eligible.

The following must be fully completed (block capitals please)

Name of building or structure:

....

....

Location: ....

....

Programme of Construction: ....

....

....

Completion date: ....

Total tonnage: ....

Approximate total cost (£): ....

Cost of steelwork (£): ....

A description of the building/structure (including type of construction, purpose and brief) of about 1,000 words should be included with your Entry, also drawings and photographs (see Conditions below).

Conditions

This form is to be completed in block capitals or typewritten and sent to "Design Awards", BCSA, 4 Whitehall Court, London SW1A 2ES to arrive not later than Friday 15th December 2006.

1. A description of the outstanding features of the structure, addressing the **key criteria**, together with the relevant cost data if this is available.
2. Not more than six unmounted drawings (eg plans, sections, elevations, isometrics) illustrating the essential features of significance in relation to the use of steel.
3. Not less than six different unmounted glossy original colour photographs (approx size 8" x 10").
4. Images also to be supplied as digital files at 300dpi A5 size minimum.

Please ensure that all parties have been informed of this Entry.

Please complete all sections below in full:

Architects

....

Address: ....

....

....

Person who should be contacted: ....

Tel: .... email: ....

Structural Engineers responsible for the design

....

Address: ....

....

....

Person who should be contacted: ....

Tel: .... email: ....

Steelwork Contractor

....

Address: ....

....

....

Person who should be contacted: ....

Tel: .... email: ....

Main Contractor

....

Address: ....

....

....

Person who should be contacted: ....

Tel: .... email: ....

Client

....

Address: ....

....

....

Person who should be contacted: ....

Tel: .... email: ....

Person submitting this entry: ....

Tel: .... email: ....

DECLARATION OF ELIGIBILITY

As the representative of the organisation entering this structure in the Structural Steel Design Awards 2007, I declare that this steel based structure is eligible for consideration as it has been fabricated by a UK steelwork contractor and built using steel predominantly sourced from Corus. It was completed and ready for occupation or use during the calendar years 2005 and 2006. It has not been previously entered for this Awards Scheme.

Signed: .... Date: .... On behalf of: ....