AWARD

LEGACY ROOF, LONDON AQUATICS CENTRE

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CLIENT	OLYMPIC DELIVERY AUTHORITY

The London Aquatics Centre will mark the gateway to the 2012 Olympic Park. The stunning waveform shape of its complex steel roof sweeps dramatically upwards in a smooth curve from the south end and then down again over the northern cantilever, while the western and eastern tips curve upwards at the edges.

The 11,000m^2 structure spans a column free area 160m long and up to 90m wide. It is supported on bearings on two concrete cores 54m apart near its northern end and on a concrete wall at its southern end. The roof contains about 3,200 tonnes of structural steel, of which 2,000 tonnes are fabricated plate girders with the structural connections totalling around 600 tonnes.

The roof structure comprises a series of long span trusses spanning lengthways over the main pool hall from a transverse truss mounted on the southern retaining wall bearings to another transverse truss spanning between the northern concrete cores. The main trusses lie in a fan arrangement to create the plan shape of the roof. The centre fan trusses cantilever northwards beyond the north transverse truss to form an overhanging canopy over the main public entrance plaza of up to 30m.

The centre fan trusses carry load in truss action, spanning between the north and south transverse trusses which carry the load down to the supporting bearings on the concrete structure below. Due to the roof geometry, arches are formed in the wing areas to the west and east of the central area. Under uniform loading the two opposite inclined arches in the wing areas balance each other, forming a compression hoop around the roof perimeter. A tension force arises from the change in geometry of the compression hoop in plan at the kinks which occur at the wing tips, and this is resisted by a tension tie across the centre and a resulting tension force occurs in the central fan trusses.

Due to the arched shape of the northern transfer truss, lateral thrusts are developed. In the final condition these are resisted by tensions in the plaza level slab. However, as this slab could not be cast until some time after completion of roof

erection, it was necessary to install a temporary tie comprising eight high tensile steel bars between the north cores. This was pre-stressed before the roof was lifted off the temporary trestles.

Lateral stability is provided by a system of horizontal and diagonal cross braces in the roof surface between the top chords of the fan trusses. All of the trusses are formed from fabricated H-sections. The plate thicknesses of the sections vary along the length of the trusses to ensure efficient use of material, with plate thicknesses varying between 8mm and 120mm. At site the members were bolted together to produce erectable truss lengths of around 30-40m. The trusses were lifted onto pre-erected lines of temporary trestles and joined together with bolted splices.

In the permanent condition the roof is designed to be fixed on plan at its northern bearings and free to slide longitudinally at the southern end. However, due to site constraints, it was necessary to construct the roof from south to north, starting with erection of the southern transverse truss which weighed just over 70 tonnes. It was necessary to initially restrain the roof in a longitudinal direction with temporary works at the southern end and then, later in the programme, a controlled transfer of restraint to the northern bearings was carried out whilst simultaneously releasing the southern end.

When 50% of the roof had been erected one of the intermediate lines of trestles had to be removed to allow excavation to start for the deep dive pool. This was achieved by jacking the roof up at the trestle positions to relieve the load from them. The remaining two main lines of trestles were left in position until the main roof structure was complete. On completion of the main erection, the roof was lifted using strand jacks mounted on temporary towers at the south end and allowing it to rotate about the northern bearings. Once the roof was clear the strand jacks were locked off while the trestle heads were dismantled before the roof was lowered to its final position.

All of the bolted connections in the primary structure were designed to be non-slip using tension control bolts. In situations where bolt access was limited by geometric constraints, tension control studs were used. The structure contains about 70,000 bolts.

Due to the highly corrosive environment, rather than leaving faying surfaces unpainted they were coated with zinc silicate paint, slip tests having first been carried out to establish that a suitable slip factor could be achieved. The zinc silicate was used as a primer generally and exposed surfaces were over coated with MIO. In the final condition the steelwork is all concealed by upper and lower surface cladding and so no decorative coat needed to be applied.

A network of 600 linear metres of steel walkways installed throughout the roof space will provide access for regular inspection and maintenance of the structure as well as lighting equipment and other plant.

Temporary stands to the west and east of the structure will provide seating for 14,700 of the full complement of 17,500 spectators for the Olympic mode. These will be removed and recycled on completion of the Olympic and Paralympic Games. The final perimeter façade will then be installed for the legacy mode to provide outstanding community facilities for East London's future.

JUDGES' COMMENT

An heroic engineering achievement which has overcome severe programme and constructional problems. A necessarily complex structure delivers the form and shape at the heart of what will become the emblematic and beautiful icon of the London 2012 Olympics.

This is a high profile success for structural steelwork.