



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 just 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.