

Award

Bombardier Maintenance Hangar, Biggin Hill

PROJECT TEAM

Architect: **Civils Contracting Ltd**

Structural engineer: **REIDsteel**

Steelwork contractor: **REIDsteel**

Main contractor: **Civils Contracting Ltd**

Client: **Biggin Hill Airport Development Ltd**



London Biggin Hill is the fastest growing business airport in the UK with major investment transforming it into a world-class centre of aviation. The iconic airport's most ambitious and technically challenging development yet is a spectacular dual cantilever 'super-hangar' for aerospace giant Bombardier, which is the largest of its type in the UK.

The client's vision was for an advanced Maintenance, Repair and Overhaul (MRO) hangar with two 160m clear span entrances and underslung cranes for servicing aircraft, along with offices and a VIP lounge.

Early engagement of REIDsteel, as the structural steel design and build fabricator, the hangar door manufacturer and cladding company was essential to the success of the project given the need for elements to be erected and aligned on 45m-long cantilever trusses with requirements to accommodate complex hangar door head gear and underslung cranes – both of which required more stringent deflection criteria than usually found on a large span structure.

After investigating traditional hangar solutions, a cost-saving design was proposed, which was highly efficient in its structural

performance, with a cantilever truss design for the hangar, conventional 'beam and stick' construction for the offices and an elegant, glazed lounge, which has minimal bracing by virtue of a diaphragm within its roof structure.

The value-engineered cantilever design, along with load sharing elements, allowed significant reductions in material use, producing a much lower steel tonnage at 1,600t compared with more conventional designs. The design allowed the roof of the hangar area to safely span without support from internal columns to achieve the client's aspiration for two vast, unobstructed hangar floor spaces of 7,200m² each.

Long span cantilevers are inherently vulnerable to disproportionate collapse due to the nature of the tension connections in the top chord. To alleviate this, and to help meet the stringent deflection criteria, load sharing trusses were used to ensure that each frame could be supported by its adjacent frames and to reduce differential deflections under crane and wind loads.

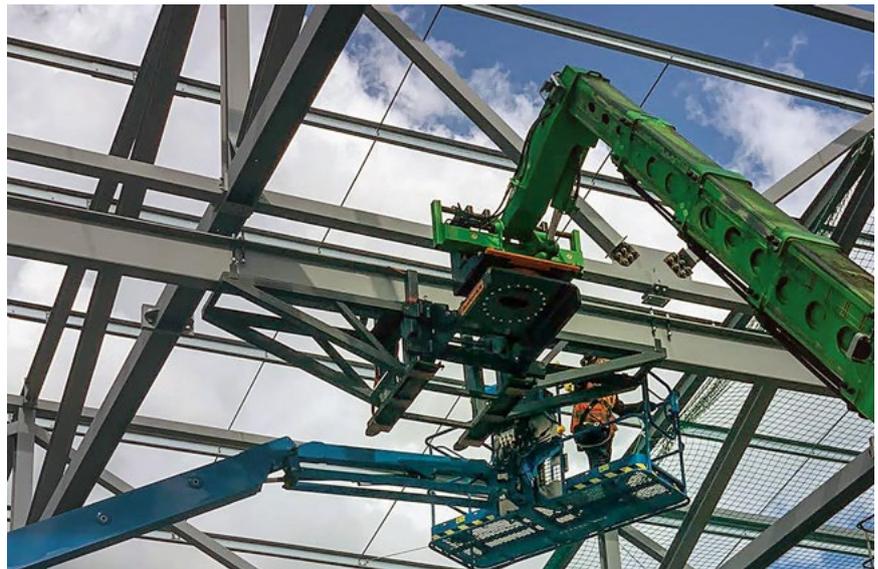
This created a new issue, in that fabrication tolerances could cause a frame sitting higher than its neighbours to attract unacceptably high loads. The solution to this lay in leaving the load sharing trusses 'loose' until all permanent loads were applied and only then tightening up the slotted preloaded bolted connections. In addition, careful planning of the erection sequence and pre-cambering of the trusses was needed to allow for the temporary condition where one side of the hangar was erected but not the other.

Additional floor area above the first-floor offices has been provided which, although not part of the original brief, permitted additional space for all of the M&E equipment, plant and storage. As a result, the mass needed to counterbalance the cantilevers has been used for productive purposes rather than being buried in the ground as part of the foundations.

Another departure from the original brief is that the design caters for 100% coverage of both hangars for the underslung crane, rather than 50% of one, providing the future-proofing required by the end user. The dual cantilever design also means the hangar can be extended to meet changing requirements over its 50-year design life. In addition, with steel providing the primary structure, there is potential for life-extension, recycling or reuse in line with circular economy principles.

Value-engineering through the design process saved on steel, fabrication and erection time as well as reducing the environmental impact of the project. The resulting reduction in steel weight was key to saving 850 tonnes of embodied carbon. The roof is also designed to take solar panels and assuming that the client achieves 50% coverage, this has the potential to save 300 tonnes of operational carbon per year.

Close co-ordination was required between London Biggin Hill, Civils Contracting and REIDsteel to ensure the steelwork was delivered efficiently and safely for assembly, which included the choice of opting for tandem lifts of the 45m rafter trusses to reduce jib heights from that required for a single crane. Other logistical challenges of operating in a live airport environment included consideration of flight schedules and restrictions on lifting during poor visibility.



Whilst the design was innovative, it could be constructed using standard equipment. The tandem lift was achieved with two 55-tonne mobile cranes with a 40-tonne mobile used to infill between frames with the load sharing trusses and cold-rolled steel purlins needed to ensure stability in the temporary condition. While the rafter on one side of the core was being erected, the rafter on the other side was being assembled on trestles, ready to be erected the following day.

The completed structure is outstanding as a statement building; both in terms of its structural steel and sleek appearance with cladding and glazing to create a striking and contemporary development, which sets a new benchmark for the highest quality MRO facilities in the 21st Century.

Judges' comment

Bombardier's new headquarters at Biggin Hill Airport is the UK's largest dual cantilever hangar providing two clear spaces of 7,200m², including 160m clear span openings and full lifting coverage from underslung cranes. The central spine of the building anchors the cantilevers as well as housing the building functional spaces. The structure achieves remarkably good embodied carbon figures, in line with the LETI 2030 aspirational values.