

A strict sequence

A tight schedule and a structure with three distinct framing solutions makes building Big Yellow's storage facility more challenging than it looks

PROJECT REPORT RUBY KITCHING

Project Big Yellow self-storage unit, Chiswick, London

Client Big Yellow Self Storage Company

Architect Mountford Pigott

Main contractor McLaren Construction

Structural engineer Campbell Reith

Steelwork contractor Caunton Engineering



The finished building will attract the attention of around 80,000 people using the M4 daily

Main contractor McLaren is building storage company Big Yellow's flagship building in London – a gleaming seven-storey steel structure which, to meet the tight 40-week construction programme, has to be built simultaneously on all elevations. As a result, a strict construction sequence is required to complete the project safely and on time.

On top of that, special consideration must be given to all site operations, as the work is taking place next to a busy rail line on one side and adjacent to the M4.

The structure is also quite unusual. The steel-framed building is made up of three sections, each with different structural solutions.

The central section is the most straightforward for steelwork contractor Caunton Engineering, being an eight-storey portal frame structure. Adjoining it is a six-storey section to the west, which is hung from a roof truss and 'sits' over a double-height service yard. A third structural solution involves a two-storey simple framed structure, which fills the remaining east end of the plot.

Its prominent location means around 80,000 people pass the structure daily, so Big Yellow was

keen to commission a much more ambitious design than usual in order to catch the eye of all those potential customers.

A Sotherby's auction house warehouse previously occupied the land and was demolished by contractor 777 Demolition prior to McLaren arriving on site in May this year. The new building occupies about half the site, enabling the contractor to have decent-sized storage and loading areas and other site facilities.

The east elevation of the central portal frame section was first to go up, but three full height west elevation columns, which would eventually support the roof trusses, had to be erected almost concurrently. And while the east elevation of the portal frame took

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ANDREW FROST, CAMPBELL REITH

shape, the two-storey building to the east also started to gather pace.

However, the west end of this two-storey building would block access to the east elevation, so it could only be completed once the east elevation had been structurally completed and clad.

Once the central portal frame was up to full height, three 26 m-tall 914 x 409 x 343 section west elevation columns could be erected. These were made up of a 16 m lower section supported off a pilecap spliced on site to a 10 m upper section.

The 26 m-tall column would eventually support the 23 m-long steel roof trusses. Tensioned Tifror wire ropes were used to support the columns during erection while the rest of the structure, including the 23 m vierendeel trusses, were built.

Floors were only constructed on the second and fifth floors, since client Big Yellow would install levels three and four and six and seven using its bespoke mezzanine floor system (see box).

“The final fit-out also includes the installation of staircases and lifts, which has meant we've had



to leave openings in the second and fifth floors,” explains Caunton project manager Gareth Skelton.

Beams at each level provided permanent bracing to the west elevation columns. Three 23 m-long trusses were then connected to the roof level steelwork of the central portal framed building at one end and to the top of the west elevation columns at the other. Side elevation columns were then erected.

Swift programme

The erection of the columns took just one week, while the trusses went up in just one day. These 23 m-long trusses travelled in complete lengths from Caunton's Nottingham fabrication yard to reach the site by 7am on the morning of erection.

Forethought had ensured that the site access ramp from the A4 dual carriageway was wide enough to allow these colossal elements to be turned into the site, rather than having to winch them in from the road.

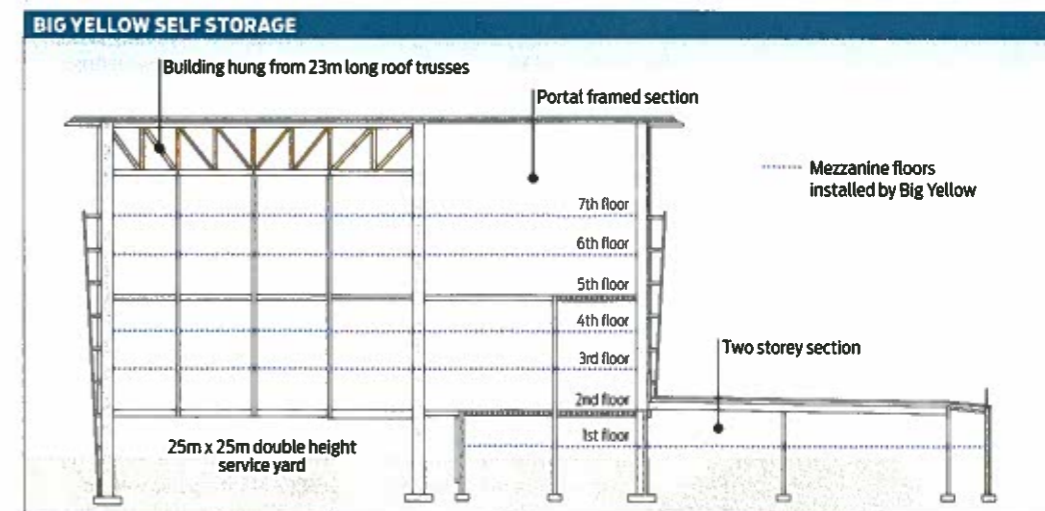
With concurrent critical path

operations on three parts of the site and the entire structure comprising steel elements, mobile cranes were favoured over static tower cranes. McLaren project manager Andy Plail says: “With the amount of hook time needed for all the steelwork and cladding within such a tight programme, we've needed up to four 50-tonne cranes at any one time.”

Mobile cranes could be deployed as and when required and were ideal for the majority of members, which weighed less than 5 tonnes. When Caunton's 20-tonne truss arrived on site, it was lifted into place using a 200-tonne crawler crane. All elements were bolted together on site, since this would be quicker than site-welding. The floor was in-situ concrete on a composite steel deck with a power floated finish.

Each element will be sprayed with intumescent fire protection once the building is sealed, a task which will take eight weeks. This is to prevent any particles becoming airborne and reaching drivers on the M4. It

The 12,000 sq m facility is flanked by a busy rail line and the M4 motorway



was deemed easier to apply the coating after erection to avoid damage during handling.

Another quirk of the project was that the west end suspended building with the service yard could not be clad before levels two and five were concreted. “You

MAINTAINING FLEXIBILITY

For structural engineer Campbell Reith, the main constraint was to design a six-storey building from second floor level which also had to span 25 m across a service yard.

“We looked at various options including installing a bridge deck at the second floor, but it would have been too heavy and too deep, and require [more complicated] plated steel girders,” recalls Campbell Reith project partner Andrew Frost.

The solution was in the roof where the barrel vault shape offered enough space to accommodate a 4 m-deep truss from which all six storeys could be hung. Vierendeel trusses made up of fully welded beams and columns at each floor level running in the same direction as the roof trusses stiffened up the structure. Since these elements, by definition, lack the diagonal element of a truss, circulation space throughout the building was also maintained.

To maintain future flexibility, client Big Yellow required that some levels should be omitted in the main structures. These would be added during the fit-out stage using bespoke steel and timber mezzanine structures which would sit on the

second and fifth floors.

This affected the design in two ways. Firstly, a 6.5 m by 8 m opening had to be left in the steelwork to allow Big Yellow access to install the mezzanine levels. This had to be stiffened with additional steelwork.

Secondly, columns that would eventually support the legs of the mezzanine levels had to be strengthened. Stability of the service yard/six-storey hung structure is achieved via the steel-framed stair and triple lift cores, as well as the vierendeel trusses that also support cantilevered balconies.

“A steel frame was ideal for this job because of the convenience of erection,” says Mr Frost. “The main advantage is that you can leave out floor panels, which can be easily filled in later. Steel provides that kind of flexibility which you couldn't really get with concrete.”

The two-storey structure will be topped by a green/brown roof to alleviate rainwater run-off. Other sustainable features include rainwater harvesting, storm water attenuation tanks and photovoltaic cells, which will help provide some of the building's energy requirements.