

Conservation station

Walker Construction recently completed a £2 million contract to install a new platform canopy at Crystal Palace station. **Clint Martin** looks back on the involving project

It's unlikely that many of the two million-or-so passengers who use Crystal Palace station every year give much thought to its heritage. In its heyday, the south London station was one of two that served what was then the country's top visitor attraction. In 1852, the iconic iron-and-glass home of The Great Exhibition of 1851 moved from Hyde Park to Sydenham Hill. So popular was The Crystal Palace, it had two railway stations to bring visitors from London: Crystal Palace (Low Level) and the long-since removed, Crystal Palace (High Level).

The style of the original, Victorian-era station reflected its importance as a destination: a lofty ticket hall with ornate, cast-iron roof supports flanked by towers topped with mansard roofs; a capacious brick train shed with a glazed ridge-and-furrow roof; broad stairways that led to the platforms; and two parallel, 125m-long bowstring roofs that covered the platforms.

Following an incident at Charing Cross station in 1905, when a failed tie rod caused part of its bowstring roof to collapse, the two roofs at Crystal Palace (Low Level) station were removed as a precautionary measure, which left the platforms open to the elements.

London Overground

Owned by Network Rail, Crystal Palace station is managed by London Overground and serves trains running between London Victoria and London Bridge and services terminating at Beckenham Junction and Sutton. In May 2010 the station was made a terminus on London Overground's East London Line and the resulting increase in passenger numbers prompted Network Rail and Transport for London to embark on a substantial redevelopment programme.

As a Grade II listed building, Transport for London, the project's client, was determined to ensure that work on Crystal Palace befitted its status. Supported by a substantial grant from the Railway Heritage Trust, all work carried a strong emphasis on conservation and was overseen by London Borough of Bromley's Conservation Officer.

In anticipation of the new services, the

platforms were rebuilt and reconfigured in 2009 and this was followed in 2012 and 2013 with a series of upgrades: refurbishing the previously mothballed Victorian-era ticket hall; building a new café; improving disabled access; linking the platforms with a footbridge; installing three glass-and-steel lifts; and a major upgrade of the station's GIS, PA and CCTV systems.

Six-platform canopy

Walker Construction's Rail Division was awarded one of the final phases of the upgrade works: a £2 million, ten month, NEC3 contract to install – among other things – a new canopy over six of the station's eight platforms.

The new canopy's structural profile bears a remarkable similarity to its Victorian predecessor, with the new roofline mirroring the visible outline of the original roof – but that's where the similarity ends.

Based on original plans by WSP and John McAslan, Novum Structures, with input from steel fabricators McNealy Brown, developed the design for the 46m-long, 38m-wide canopy, which consists of a circular hollow section (CHS) steel frame that supports Novum Structures' Air Filled Pillow (AFP) System.

Ten columns located along the centreline of the central island platform



Clint Martin, project manager of the Crystal Palace canopy project

form the backbone of the frame and, from the top of each column, the beams arc over the tracks to the top of both flank walls. Clamped in the bays between the beams are 17m long x 4m wide ETFE (ethylene tetrafluoroethylene) air-filled pillows; their internal pressure being constantly monitored and adjusted by a sophisticated air supply system.

Walker Construction took possession of the site on 3rd November 2014. The



The roof in progress



The original roofline in the train shed wall



Platform 5 and 6

company's first task was to establish a compound in which materials could be received, stored and then craned over the 8m-high south flank wall and, possibly, across all six platforms to the north flank wall. The largest lift, one of the 19m-long roof beams, would also be one of the longest: from the compound to the rear of the train shed where it would span platforms 6, 7 and 8. A 220-tonne crane was carefully manoeuvred through the area's narrow residential streets to reach the site where its location (adjacent to the south flank wall) meant that lifts could only be carried out while using radios.

Having cleared the south flank wall of ivy and cut back the trees overhanging the north flank wall, installation of the pendel-bearing base plates along the top of each wall began. Although scaffolding could be built from the unused track bed running the length of the north wall, it had to be cantilevered over the top of the south wall because the track serving Platform 3 was in constant use. The base plates were bolted to concrete pads that were cast into cavities cut into the top of the walls and stabilised with 3m-long Cintec anchors let into the brickwork.

Collaborative effort

Work simultaneously began on the central island, where platforms 5 and 6



The completed roof

are housed. Both platforms had to remain operational but, as services terminated at platform 5, TfL's liaison with LOROL and Southern Trains enabled a temporary car stop to be put in place. This allowed a narrow section of the island to be isolated, creating an incredibly confined working area in which the columns could be installed.

Although the central wall supporting the original roofs was no longer there, the island had been built over its location and there was concern that the stability of the new columns might be compromised by the old foundations. These were soon discovered and, to prevent any risk of the new foundations rocking on top of the old ones, a reinforced-concrete 'saddle' was cast in situ, straddling the old footings and providing a stable location for the column base plates.

Preserving the canopy's smooth lines and curves was an important design consideration and considerable thought was given to hiding the fixings between the key components. The 7m-tall columns, complex, multifunctional column heads, 19m-long beams and pendel-bearing components were fabricated off-site by McNealy Brown. Jigs were used to ensure that the main beams followed the same radius and the various connection points were individually finished.

Although the station remained operational during the 25-week project, very brief windows of 'planned disruptive possession' were necessary to allow the steelwork to be installed: any problems encountered could have had severe consequences. Craned into position, every component had to be an instant, perfect fit if the strict installation timetable was to be adhered to. The tight tolerances of the design and fabrication needed equally accurate setting out and preparation on site.

ETFE air pillows

The ETFE air pillows consist of a single 300µm membrane in the upper skin and two 250µm membranes in the lower skin, with the pillows being held in place by a proprietary clamp system. Once inflated (normally to 250Pa, but up to 500Pa to support heavy snow), the pressure in each pillow is electronically monitored and maintained by air fed from an air supply system, in this case, Novum's eLuft 600



which is located at the base of the south flank wall. ETFE, a development of PTFE, makes an excellent transparent building material as it doesn't degrade through exposure to UV radiation, is self-cleaning and is particularly resistant to tearing.

When inflated, the pillows create enough tension for the structure to be classified as non-fragile. In fact, a structural review undertaken by the project consultants, Waterman Infrastructure & Environment, showed that the five tonnes of tension generated by the first pillow would be more than enough to cause the train shed wall to fail if the canopy was attached directly to it.

Respecting the station's heritage

Commenting on the completed works, Mike Stubbs, director London Overground at TfL, said: 'We have huge respect for our Victorian railway heritage so it was very important to us that the upgrade of Crystal Palace station provided a station that was both fit to meet increasing passenger demand but remained in keeping with its illustrious past. Over the past few years we have undertaken significant improvements to the station, jointly funded by ourselves, Network Rail and the Railway Heritage Trust.

'The original station had a canopy over what are now the London Overground platforms so, as part of the final work to upgrade the station, we thought it only fitting to reinstate this with a modern gull-wing design that respects the heritage of the station whilst also protecting our customers from the elements'

Having drawn on its skills in the construction industry and its long association and experience of the rail industry, Walker Construction is delighted to have played a part in working with TfL to complete the final stage of revitalising this once iconic station. The finished canopy, with its large panels of uninterrupted sky, makes the platform area feel light and spacious. It's a modern – and successful – answer to what the designers and engineers were trying to achieve 160 years ago.

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