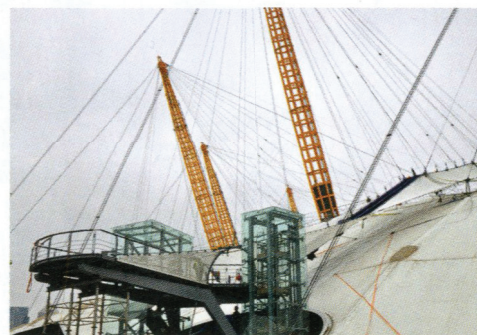




LEFT: The new walkway had to take full account of the existing dome structure and integrate with it.

BELOW: On the south side the walkway meets the steel access deck, situated 7.5m up, at the dome's perimeter.



UP AT THE O2

One-time controversial white elephant, the O2's enormous success now has a real regenerative influence on North Greenwich. But it can do better still – now a raised walkway lets the public walk over its famous roof

MOUNTING TENSION

Words Jan Carlos Kucharek | Photos Base Structures

THE RENAMED O2 arena is now acknowledged as one of the world's leading entertainment venues – a turn around in the fortunes for a venue that was seen as a white elephant 10 years ago. However, not content with the money spinning going on beneath its PTFE-coated glass fibre cloth dome, owner AEG has worked out another angle to market its venue – this time using the structure itself. 'Up at the O2' opened in June – a 370m long walkway that takes the paying public up and over Richard Rogers' iconic design, with the offer of some great views from the top. Rogers Stirk Harbour and Partners and Buro Happold, engineer of the original building, helped to devise a way to get harnessed-up punters including the disabled, latched to a central handrail, to the top of the structure without puncturing its fabric roof on the way.

As Happold's Matthew Birchall, design team leader for the project, explains, adding the new structure to the existing one had to allow for working wind and snow loadings, and the original 'Tensyl' 3D structural model was used to ascertain possible loading implications. Initial concept designs considered using FSC timber

– good from a sustainability angle, but the more team members looked at the idea, the more they were drawn to simply walking on the actual tent fabric itself. From this, the idea to suspend a new PVC coated polyester fabric walkway over the dome from the O2's existing pylons was born. Cables and clamp plates run along the edges of the 2.3m wide walkway, which is connected back to the top of the 100m high masts by pre-tensioned 15–25mm steel cables that depend on positioning and requisite tensional forces.

'The more team members looked at the idea, the more they were drawn to simply walking on the actual tent fabric itself'

Holding the walkway down, additional cables attach from the scalloped fabric edge back to the domes' concentric ring of steel spigots. This gives horizontal stability to the new structure and improves the stiffness of the system – the fabric effectively distributing the walkway's load. Nearly 3000m² of fabric is used in total and 4km of new cable holds it in place.

Non dome

Birchall points out that the O2 is not actually a dome in the structural sense of the word, but formed from six radial circumferential steel rings, pulled back along with the attached polyester fabric to the steel masts to create the dome shape in tension. The outer layer of double-skinned roof is connected back to the main mast cables via a steel cable 'wishbone' detail. These turn out to be perfect fixings for the new walkway to be attached back to. Strangely, the asymmetric wind loads imposed on the structure by the walkway, which cause a suction effect, are not a particular concern. The building had extra structural capacity for a heavy snow load. This allows it to safely support people – unless it is already covered in heavy snow as well.

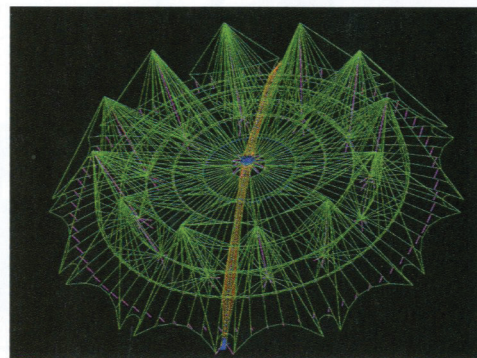
With the design principles decided, Buro Happold asked young practice Bblur Architects to carry out the detail design for the walkway. Built to a tight £6m budget, the scheme was seen by partner Matthew Bedward as a high-profile project that the office wanted to be involved in. Bblur did the detail design for the steel access deck leading to the dome fabric 7.5m up, and four KLH pre-fabricated, cross-laminated timber changing pavilions either side of the walkway, which were erected on site in less than two days. The glazed painted mild steel structure,



LEFT: Constructing the steel viewing platform. Base Structures ran tension cables between the 100m high masts to allow sky hooks to winch the structure into place.

BELOW: The original 'Tensyl' 3D model, modified to include the dome walkway.

BOTTOM: Sleds were used to drag the fabric sections up the O2's roof – some weighed up to 2 tonnes.



with steel gridded decks, was built by contractor ISG. With a limited budget, Bedward says they were keen to get 'more bang for their buck' so contractor PLM lit the soffit, hand railing and balustrading, giving a dramatic nighttime effect.

ISG won the design and build contract for the walkway in September 2011, with fabricator Base Structures, which worked on the Eden Project and Hopkins' Mound stand at Lords, sub-contracted to create the 370m long fabric walkway. At ground level, ISG dealt with the changing pods and the painted mild steel access structure on the south side of the dome, delivering visitors to the edge of the dome's fabric roof. On the north side, the walkway runs straight off the roof to the ground.

Drop and drag

On a venue like this operational 'downtime' is not an option, so construction logistics were a primary consideration – something ISG and Base Structures had to resolve. As demonstrated by the changing pods, having as much as possible delivered complete so that it only required installation was the main goal. To this end, the 25 sections of the 2.3m wide PVC-coated walkway and white polyester mesh side wings, which at widths of up to 3.5m serve as psychological reassurance for climbers, were manufactured in a factory in Basel, Switzerland. PVC fabric ribs were welded to the surface here too, more concentrated where the climb angles are steepest, to ensure a safe foothold under any conditions. Section sides were fitted with clamps and cables and pre-tensioning testing conducted before they were delivered to site.

Base Structures' role covered everything above the dome's surface, down to connecting with ISG's access deck – 30 tonnes of material

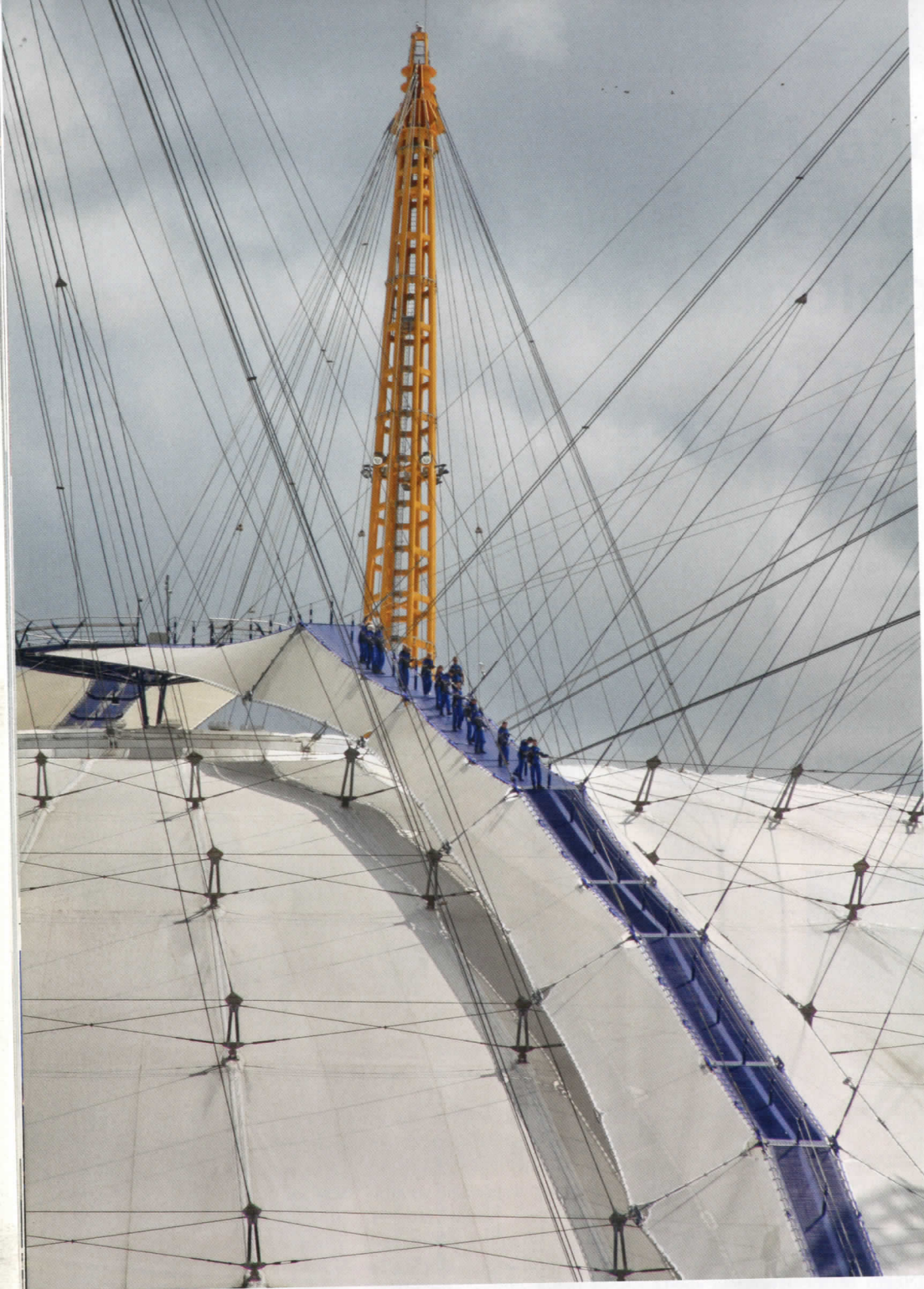


'Sleds sitting on a temporary fabric PVC 'runway' dragged components up with a Tirfor crank to avoid damaging the O2's roof'

in all, which needed to be transported onto and constructed over the dome without damaging it. Given its size, they ruled out a long-reach crane, and instead decided on a sacrificial PVC 'runway' of material on the roof and hauling 2.4m x 4.8m sleds up it to deliver the up to 2-tonne fabric sections and 10 tonnes of steel structure for the viewing platform. All done manually, this was no mean feat; at 50mm per crank, any one sled required over 2,800 'cranks' to get it to the top of the dome.

The first pieces hauled up were the 50 separate steel sections making up the 12m wide viewing platform. The PVC roof meant on-site welding was prohibited, so the whole lot needed to be mechanically fixed in situ. To do that steel lines were slung between any two of the dome's masts to carry sky hooks, which could winch the 16 main sections of the viewing platform into place, before they were bolted together. The platform is held in position by cables running from the tops of the masts and connected to its edge. Final positioning for the walkway was fixed at 3m above the surface of the dome, with both this and the platform cables given final tensioning using Tirfor ratchet straps.

The whole project ran to programme and was taken from Stage D+ to completion in less than eight months. Birchall sees it as being on the cusp of engineering as entertainment, where a sense of danger is 'built into' the design. 'It's designed to be "lively", and is supposed to feel like a climb', he says, and while not quite an Olympic discipline, for the 90 people who will be on the walkway at any one time, the experience is intended to be a physical challenge, he adds. 'By the time you get to the other side, you'll have burned 350 calories. It's a real workout.' ■



Up at the O2

The building formerly known as the Dome was always impressive – the entire structure weighs less than the air it contains – but was somewhat unfairly maligned by association with the ill-conceived fin-de-siècle Millennium Experience that it was built to house. Its rehabilitation has been aided by a 2005 reconfiguration as The O2, now ‘the world’s most popular music venue’, and the incremental consolidation of the surrounding Greenwich Peninsula, and this biggest of tents has now settled in as part of the east London landscape. Despite the rather glitzy interior interventions, little has been done to alter the exterior until now, with the addition of the ‘Up at the O2’ visitor experience. Happily, a rather zany idea has been sympathetically realised with great elegance by a team that brought together, among others, the key participants in the original design team of Richard Rogers & Partners and Buro Happold.

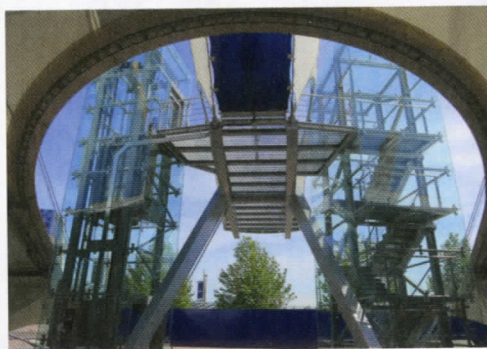
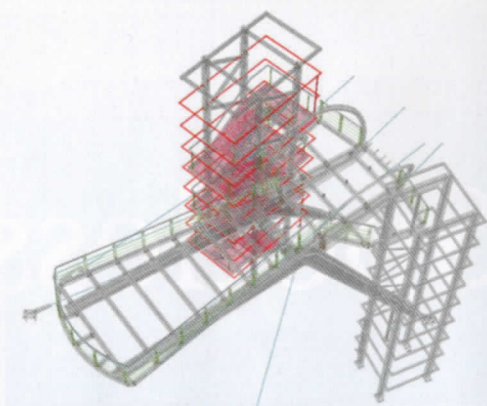
Inspired by the walkway over Sydney Harbour Bridge, a preliminary design by Buro Happold and Rogers Stirk Harbour & Partners was developed with Bblur Architecture and Base Structures. The cable-supported ‘bridge’ spans the 350-metre ‘equator’, suspended from and restrained by the existing pylons, and consisting of a fabric walkway with a central handrail and cable to which ‘climbers’ are secured by a neat fall-arrest system. A circular viewing platform marks the apex, with induction and changing pavilions at each end.

The walkway and supports are designed as a pure tensile structure, pre-tensioned against the



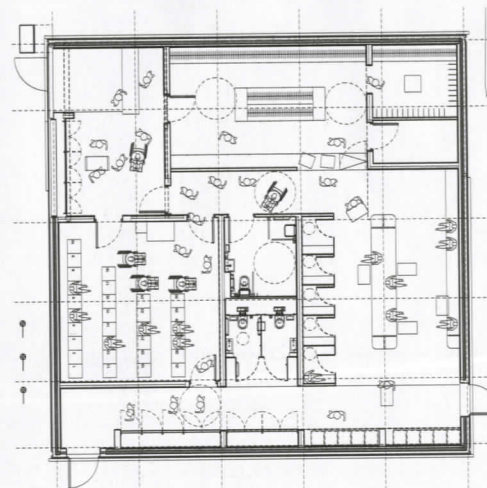
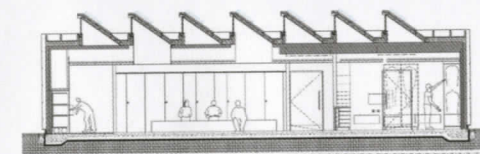
Above The fabric walkway is suspended above the existing structure and runs to its apex with a lanyard cable and handrail running full length. At the top, 53 metres above the ground, is a 12-metre diameter viewing platform. The walkway then extends down to ground level and the exit pavilion on the north side (phs: Bblur/Richard Seymour).

Left The entrance/changing pavilion, glazed staircase and lift enclosures, and assembly platform nestle into the existing canopy on the south side of the O2.



Above/right Access to the walkway is by way of a lift or stairs to an assembly platform where 'climbers' are attached to the cable harness system (phs: Buro Happold, Bblur Architecture/Richard Seymour).

Below The entrance pavilion houses ticketing, induction and changing facilities. The simple structure, designed by Bblur Architecture and built in cross-laminated timber panels sheathed in metal cladding, features a saw-tooth roof with rooflights and photovoltaic arrays. Visitors' possessions not taken on the climb are placed in lockers and wheeled to the corresponding exit pavilion on the north side of the O2 for collection.



Once upon a time...
...walking at height on tourist attractions
was impossible!



existing structure. The system of new and existing elements works as a complete structure to jointly resist wind and snow loads and the weight of up to 30 visitors. The original structure had been designed for a full imposed snow load on the entire roof, and the new walkway makes use of this allowance so the existing structure is not adversely affected. The pavilions were initially envisaged as prefabricated pods, but their design evolved into modular pavilions of metal-clad cross-laminated timber with roof-integrated photovoltaic arrays.

The blue walkway fabric and white fabric 'wings' (added to help avoid vertigo), together with the gateway towers and cantilever access platforms, were designed

to enhance the O2 at both night and daytime. The walkway surface is inherently 'lively', with a 30 degree gradient at each end. Accessibility was key from the

outset, and an inclusive design strategy enables ambulant disabled people to experience the climb. The PVC-coated polyester fabric membrane, selected for

robustness, strength and grip, with the steepest runs enhanced by ribbed bands, was selected following detailed study and tests before and during installation.



Project team

Design team: Rogers Stirk Harbour & Partners (concept design), Buro Happold (lead designer), Bblur Architecture (detailed design), Base Structures (tensile fabric specialist); structural, ground and civil engineering, inclusive design, MEP, sustainability, facade, lighting: Buro Happold; fire strategy: Design Fire Consultants; client: Anso Roofwalk (AEC); photos: Richard Seymour.

Selected suppliers and subcontractors

Contractor: ISG (Base Structures for walkway); piling: GTL; groundworks: O'Keefe; cross-laminated timber pavilions: KLH; lift, stair, training platform: Lee Warren; envelope, glazing: Colorminium; photovoltaics: Rayotec; cladding: Bailey; m&e: Trilectric; FF&E: Raphael; paving: AT Knott; fit-out: PD3; floor: Loughton Contracts; av: Cisco; media: Scanlite; ironmongery: Allgoods; access equipment: Guldman; lifts: Crown Lifts; safety line: Latchways; ceilings: SAS; lighting: PLN; graphics: Rebecca Elliott.



TIMES HAVE CHANGED

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Up at the O2

The O2 Arena, Millennium Way, Royal Greenwich, SE10

Completion:

June 2012

Value:

£3.8 million

Client:

AEG (Anso

Roofwalk Limited)

Main contractor

Project Manager and

Quantity Surveyor:

Bartlett Projects Ltd

Architect:

Bblur (original concept

Rogers Stirk Harbour

+ Partners)

Structural, M&E

Engineer and

Inclusive Design:

Buro Happold

Specialist Fabric

Subcontractor:

Base Structures

Finishes to pavilion:

O2 with PD3

Attraction operator:

AEG with Wire

and Sky

This project comprises the creation of a walkway visitor attraction on the roof of The O2 on Greenwich Peninsula. Conceived by architects Rogers Stirk Harbour + Partners alongside Buro Happold, it features a tensile cable and fabric walkway, with a viewing platform above the corona of the iconic structure. Capable of holding 90 people at one time, the walkway is a distinct feature, elegant and simple in its own right, but does not overwhelm or detract from the original structure. The highly accessible and inclusive attraction – some 200m long and 60m above the ground at its highest point – is suspended from two of the former Millennium Dome's yellow masts.

