AWARDS SPECIAL

Structural Awards 2023

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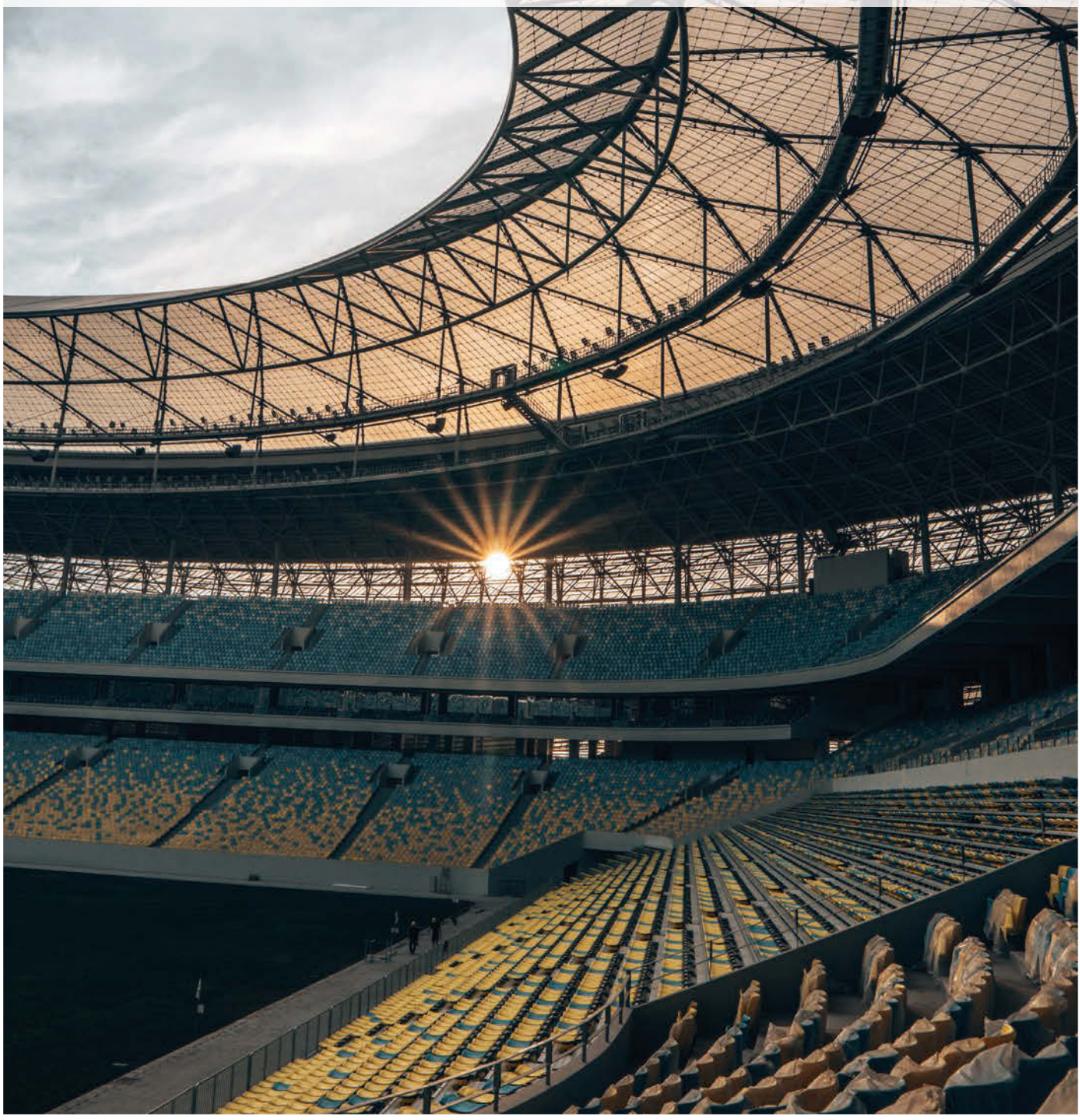

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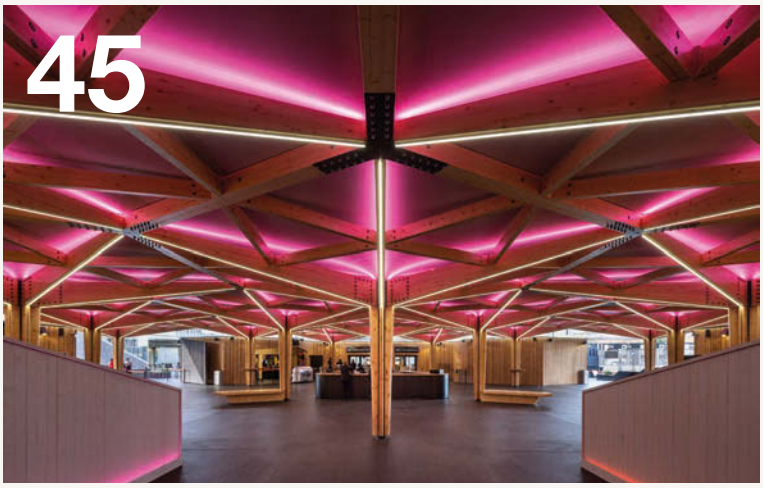


Judging panel

Chair

Prof. John Orr

John is a Professor of Structural Engineering in the Department of Engineering at the University of Cambridge.

Ishan Abeysekera

Ishan is a Senior Engineer in Arup's Advanced Technology and Research Department and an expert in timber engineering.

Will Arnold

Will leads the Institution's response to the climate emergency, bringing this action into all aspects of our work including the publication of best-practice guidance.

Dr Katherine Cashell

Katherine is an Associate Professor in Structural Engineering in the Department of Civil, Environmental & Geomatic Engineering at University College London.

Mike Cook

Mike is a consultant to Buro Happold, having been a partner of the practice since 1994 and Chairman from 2011 to 2017. He is also a visiting professor at Imperial College London.

Kayin Dawoodi

Kayin is co-lead of Tyréns Sweden's Concept Design Department, championing creative design collaboration and education.

Prof. Jiemin Ding

Prof. Ding is the Chief Engineer of Tongji Architectural Design (Group) Co., Ltd. He was awarded the IStructE Gold Medal in 2018.

Ian Firth

Ian is a leading expert in bridge design and construction and a Past President of the Institution of Structural Engineers.

Susan Giahi-Broadbent

Susan is a Senior Divisional Director working with Jacobs since 2016, leading a variety of challenging infrastructure and building projects.

Tanya de Hoog

Tanya is a founding director of Thornton Tomasetti's London office and President-elect of the Institution of Structural Engineers.

Dr Katherine Ibbotson

Katherine is Director for WSP in the UK's Strategic Advisory Net Zero team.

Tim Ibell

Tim was President of the Institution of Structural Engineers in 2015, and is Dean of the Faculty of Engineering & Design at the University of Bath.

Martin Knight

Martin is one of the leading UK architects specialising in the design of bridges and transport infrastructure and is a Fellow of RIBA and the Institution of Civil Engineers and an Honorary Fellow of IStructE.

Eric Kwok

Eric is a Technical Director at Goldwave Steel Structure Engineering and is passionate about structural engineering.

Toby Maclean

Toby established Allt environmental structural engineers in 2020, a firm concentrating on addressing the urgent need to decarbonise the built environment with a particular emphasis on carbon embodied in structures.

Michelle McDowell

Michelle is a consultant with over 35 years' experience of design and delivery of many challenging, innovative and award-winning projects. She was awarded an MBE for services to the construction industry in 2010.

Dr Andrew Minson

Andrew is Director of Concrete and Sustainable Construction at the Global Cement and Concrete Association.

Sam Price

Sam founded Price & Myers with Robert Myers in 1978. He structured many award-winning buildings, with a particular interest in theatres and concert halls.

Roger Ridsdill Smith

Roger is the Head of the Structural Engineering team at Foster + Partners.

Kristina Scheibler-Frood

Kristina is an Associate Director within the AECOM London and South East Structures team, leading the design and construction stages of major projects.

SawTeen See

SawTeen is President of See Robertson Structural Engineers and provides consulting design services. She has extensive experience in tall building design and long-span structures.

Albert Williamson-Taylor

Albert is a co-founder of the interdisciplinary engineering practice AKT II and IStructE Gold Medallist in 2023.

Read full biographies of all the judges at www.istructe.org/structural-awards/judges/.

Exciting and inspiring

In his first year as Chair of the Structural Awards Judging Panel, John Orr reflects on the inspirational quality of this year's winners, and shares his thoughts on how the range of entries could continue to develop in the future.

In 2022, the Structural Awards format was updated to reflect the importance that we, as a profession, now place on the impact that our work has – on the climate, on society, and on our profession. Core to this is the need for our profession to take ownership of sustainability, just as we take ownership of safety.

The new-style awards introduced four key attributes of Planet, Process, People and Profession, representing crucial areas that we can all aspire to excel in (Figure 1), and we ask entrants to describe their project's impact in terms of one or more of these areas. Entries are no longer placed into categories, transforming the Structural Awards, making them more inclusive, fairer, and better enabling the judging panel to celebrate all kinds of creative structural engineering.

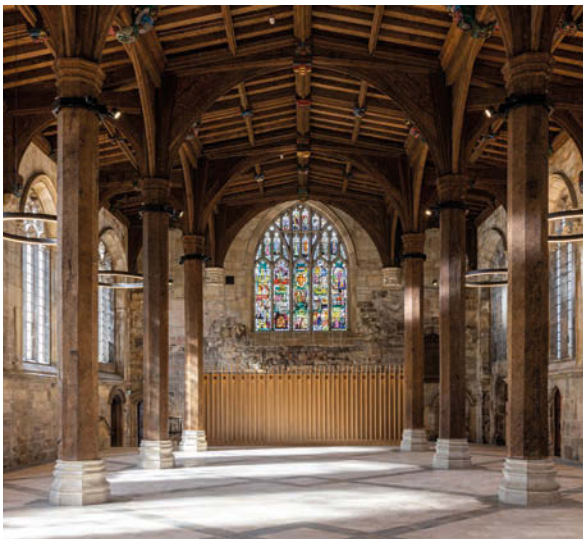
Planet

The importance of sustainability to the Institution is reflected in the requirement that all submissions must address the *Planet* attribute. We ask entrants to consider aspects such as efficiency of design, sustainability, resilience, response to local conditions, regeneration, circular economy principles, and alignment with the UN Sustainable Development Goals.

In addition, all entries are required to submit a quantification of structural embodied carbon, using The Structural Carbon Tool[1]. This reflects one of the key principles of *How to calculate embodied carbon*[2], that we must calculate embodied carbon on all projects, and use this calculation to evaluate and inform design decisions.

In the past year, I have been lucky to visit engineering firms around the

↓FIGURE 2: Shortlisted projects featured bridges, new-build projects, refurbishment projects and stadia



JAMIE RADCLIFFE

MATTHEW MONTGOMERY

TOMONARI SATO

STACIE JACKSON

world, and I have seen first-hand how carbon, and wider sustainability considerations, are driving exciting innovation in design.

Judging

Judging for the awards is a multistage process, and as chair of the panel I am deeply indebted to all the judges for the time and effort they put into reviewing and discussing every entry we received. The process was as follows. Each panel member was first given a selection of submitted projects to review, distributed carefully to remove any potential for conflicts of interest. Each submitted project was reviewed independently by five of our judges, who had the task of identifying which projects demonstrated excellence against one (or more) of the key attributes. Each judge typically marked five or six projects from their allocation as being deserving of shortlisting.

Once all the judges had completed their reviews and made their recommendations for shortlisting, the IStructE team, led by Louise Tingley, collated the data and compiled a list of all the projects, ranked in order of the number of times they had been recommended for shortlisting. This list formed the basis of the panel's first meeting. At this meeting, our task was to collectively decide on a shortlist of projects that we all agreed demonstrated excellence against the key attribute(s).

This task is difficult, but exciting, given the range of projects and quality of the submissions we receive. This year, 35 projects made it to the final shortlist – eight bridges, 12 new-build projects, 11 refurbishment projects, and four stadia **(Figure 2)**. The judges were then asked again to review all the shortlisted projects and identify which they felt deserved to win an award. It's worth remembering that our awards are given for the best projects – there is no quota for structural typologies, or for number of projects aligning with each of the four attributes. We focus solely on identifying which projects we regard as the best.

Votes for winning projects were again collated and this list was used as an indication of the feeling across the panel. Each shortlisted project was discussed in detail by the panel. As chair, I was struck by the range of world-class expertise on the panel, and the wonderful insights that this brought to the judging process.

This year, 11 projects were selected by the panel as winners. Each provides an exciting demonstration of inspiring excellence in structural engineering.

The final stage of the judging process was to select the Supreme Award winner – the best of the best. This year's winner is revealed on **page 54**.

Future

The Structural Awards now have a renewed focus on the impact and influence of our work as engineers. As we look to next year, I offer some thoughts on what I would like to see in future submissions.

We often focus on reducing our impact, particularly when talking about carbon. This can sometimes feel rather negative – we are constantly asking how we can be *less bad*. McDonough and Braungart in *The upcycle*[3] offer a more positive reframing, and instead challenge us to think how we can be *more good*. The journey of being more good doesn't end at zero, but goes on forever, and allows us to address and improve in all aspects of sustainability. The August 2023 issue of *The Structural Engineer* provides insight into ways in which a regenerative approach to design can move us in this direction.

In Design for zero[4], the first step in a hierarchy of improving our carbon impact is to *build nothing*. This apparently obvious statement in fact requires a huge amount of creative thinking to answer – can the brief be met, and the environment made better, by doing nothing? This might make for an interesting submission to the Structural Awards! Will anyone take up the challenge next year?

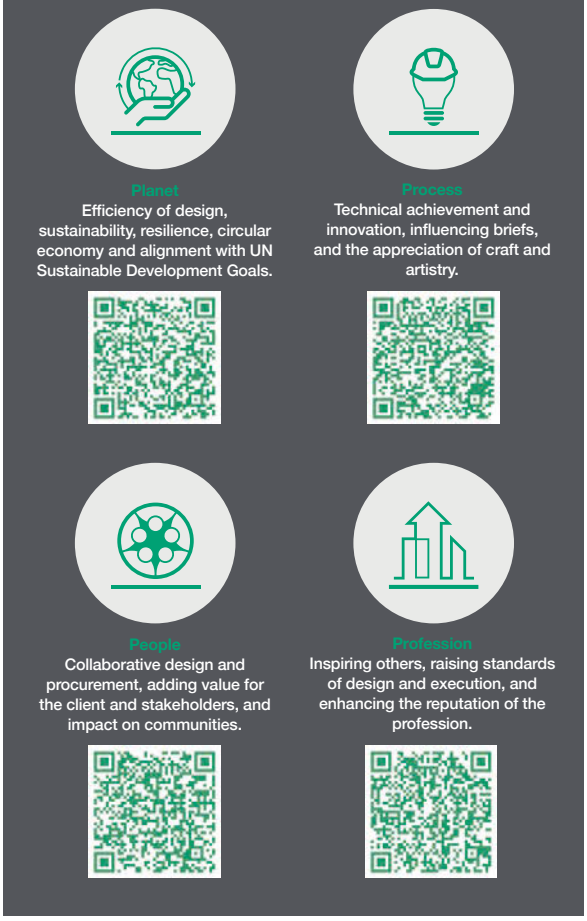
Unlocking this kind of creativity might mean thinking differently about the design problems we face. I'd like to see more submissions where an unconventional team in training and expertise have come together, in a way that celebrates the role and expertise of the chartered structural engineer as an expert designer, to *put the right material, in the right place, at the right time*.

I'd also like to see more projects that demonstrate how design is informed by fabrication (and vice versa), and how both ends of the process have been advanced to improve safety, sustainability, circularity and productivity in our famously slow-to-change sector. Projects that advance in this way could also aim to demonstrate the potential for scalability, ensuring that good ideas can be adopted widely and quickly.

Finally, I was reminded recently that there has only been one female recipient of the IStructE Gold Medal in the past 100 years. I'd like to see more female-led projects, and evidence from project teams that they are addressing the perception among young people that structural engineering is a male-dominated domain.

Read on in the rest of this issue to find out about this year's winning projects. I encourage you to start thinking now about your submissions for the Structural Awards 2024.

FIGURE 1: Four judging attributes for Structural Awards



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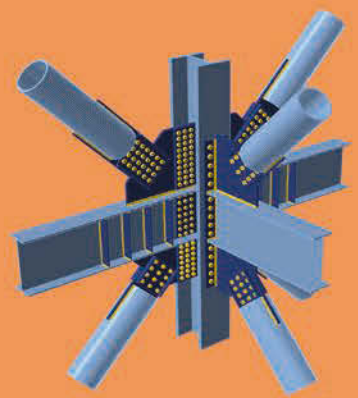
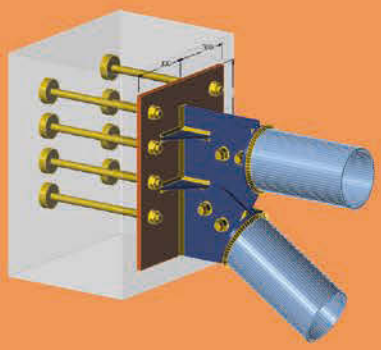
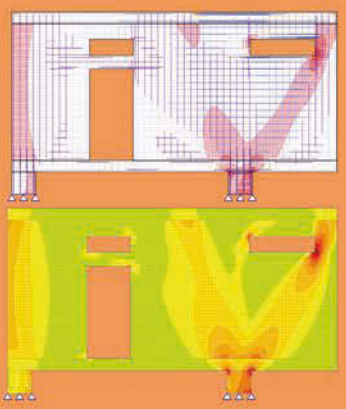
Steel-to-Steel



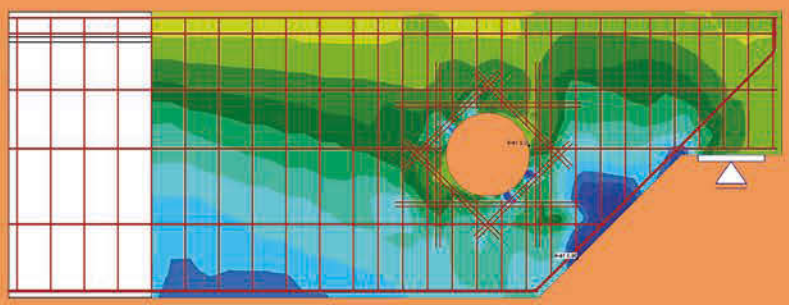
Steel-to-Concrete



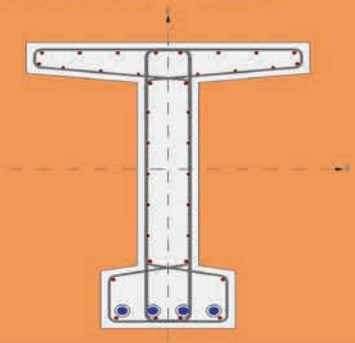
Walls



Concrete & Steel members



Cross sections



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Structural Awards 2023

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Location Amsterdam, The Netherlands

HAUT

Awarded for the development of a novel timber-concrete composite solution in high-rise residential design

PROJECT TEAM

- **Structural engineer:** Arup
- **Client:** Lingotto
- **Principal contractor:** J.P. van Eesteren
- **Architect:** Team V Architectuur
- **Timber specialist:** Brüninghoff
- **Building economics:** Skaal

IN BRIEF...

- Standing 21 floors tall, HAUT is one of the tallest timber hybrid buildings in the world reaching 73m above the river Amstel in Amsterdam's new Amstelkwartier district.
- The design for HAUT, developed in 2016 when timber high-rise was still unexplored territory, proves the viability of large-scale timber residential buildings.
- The foundations, two-level basement, core, and ground and first floor were constructed in concrete – necessary to guarantee a solid and waterproof 'plinth' in wet and windy Amsterdam. For the 20 levels above that, timber was predominantly used.
- The extensive use of timber reduced the embodied carbon of the structure to about half that of a conventional high-rise building and achieved a SCORS A rating.

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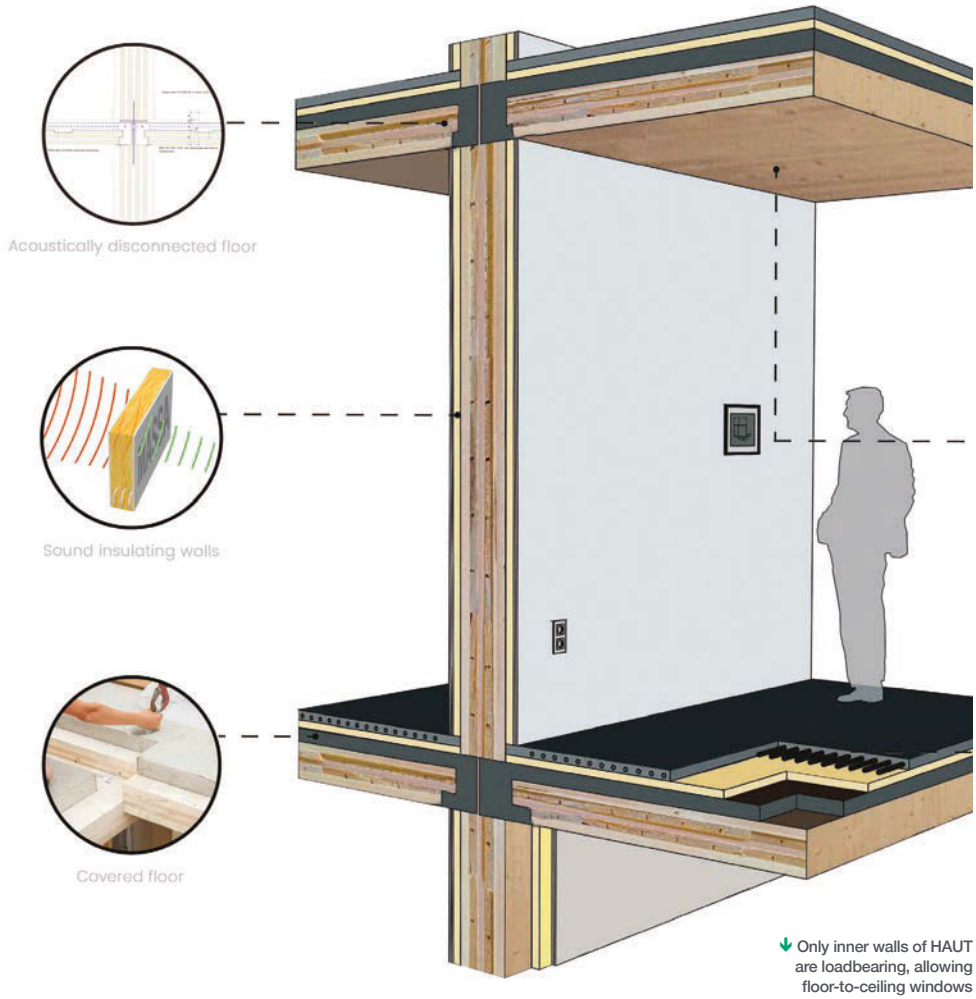

↓ Only inner walls of HAUT are loadbearing, allowing floor-to-ceiling windows

↗ Gravity system consists of loadbearing timber walls supporting timber-concrete composite floors

← HAUT was certified BREEAM Outstanding

JUDGES' COMMENTS

Utilising timber as a main structural material in this 73m high-rise residential building was a strong driver in the reduction of embodied carbon. The use of bespoke precast timber hybrid floorplates is a potentially important step in the normalisation of these techniques and has the potential to benefit timber projects globally.

HAUT was certified BREEAM Outstanding – an acknowledgement awarded to only a handful of high-rise residential buildings globally, and the first residential project in the Netherlands to achieve this sustainability certification. The successful construction of this project has demonstrated the feasibility of a timber hybrid high-rise, benefiting timber structure industries globally.

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Location London, UK

9 Millbank

Awarded for diligence and rigour in maximising reuse

PROJECT TEAM

- ➜ **Structural engineer:** Walsh
- ➜ **Client:** St Edward Homes
- ➜ **Principal contractors:**
  FDL Contractors
  St Edward Homes
- ➜ **Architect:** Scott Brownrigg

IN BRIEF…

- →| 9 Millbank is a complex development in the heart of a conservation area in Westminster, London, consisting of three buildings: the refurbishment of an existing Grade II-listed building; a smaller building to be retained and refurbished; and Millbank Quarter, a 10-storey building to replace an existing office building.
- →| The previous engineer's scheme had recommended full demolition and removal of existing basement structure. The team adopted a circular economy approach to reuse and repurpose all of the existing building instead of just retaining the facade.
- →| Reusing existing foundations on both buildings saved on the breaking out of approx. 23 700t of concrete and 3555t of embodied carbon – the equivalent carbon produced by heating 1000 homes per year.

JUDGES' COMMENTS

The team fully embraced the circular economy approach by reusing and repurposing all of the existing 9 Millbank building instead of just retaining the facade. They respected, retained and reused ground structures of historical engineering significance, including the superstructure and power station substructure, documenting these for generations to come.

Thorough research yielded impactful outcomes. The project team have demonstrated excellence in research and site investigation, which minimised risks, reduced costs, reduced programme and deliver a more sustainable approach.

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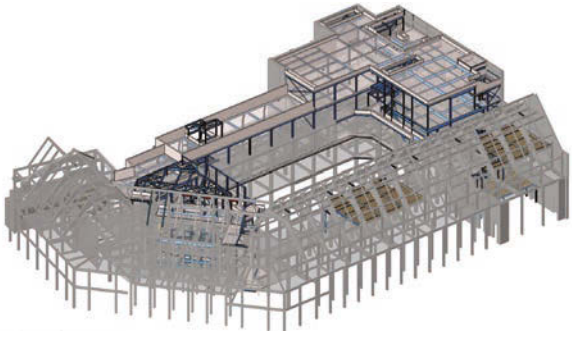
↗ Former Imperial Chemical House Building exterior

> **THE TEAM FULLY EMBRACED THE CIRCULAR ECONOMY APPROACH**



↓ Upwards extension used steel frame and lightweight composite concrete slabs

↑ Historic raft foundations of former power station

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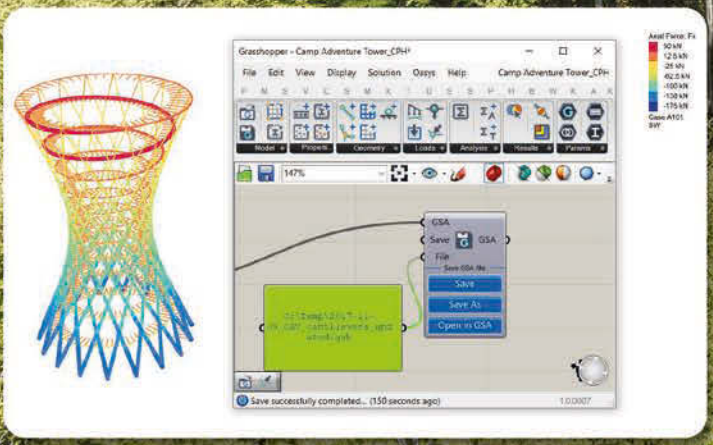

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Location Banff, Alberta, Canada

Nancy Pauw Bridge

Awarded for engineering artistry in the creation of a light-touch, low-profile timber bridge

PROJECT TEAM

- **Structural engineer:** StructureCraft
- **Client:** Town of Banff
- **Principal contractor:** StructureCraft
- **Geotechnical engineer:** Thurber Engineering Ltd
- **Landscape architect and lighting designer:** Ground Cubed
- **Environmental consultants:** Avens, Ram Consulting

IN BRIEF…

- Nancy Pauw Bridge over the Bow River in Banff was designed to be graceful, unobtrusive and natural, fitting in with both the beautiful surroundings and the Rocky Mountains.
- The timber arch bridge needed to be a low-profile design with a maximum slope of 5% and give clearance for flood conditions but not alter the paths of ever-present elk passing across the river.
- The team analysed and designed a special tuned mass damper, involving a simple carriage with weathering steel plates suspended by splayed cables from the bridge.
- StructureCraft engaged both a wildlife ecologist and an environmental engineer to create a site-specific environmental protection plan. The decision was made to not only clear span, but slightly over-span, to reduce the impact footprint to negligible.

© JORDAN KIRYLCHUK

↑ Bridge was designed to fit in with natural surroundings

© JORDAN KIRYLCHUK

→ Erection of bridge sections was carried out in matter of hours

↓ Central pin locks two bridge sections together

© JORDAN KIRYLCHUK

> **“A FANTASTIC EXAMPLE OF TECHNICALLY ADEPT ‘LIGHT-TOUCH’ ENGINEERING**

JUDGES’ COMMENTS

This spectacular timber arch bridge has an 80m clear span. The technical challenges of the incredibly shallow arch were expertly overcome by the engineers. Vibration damping was well considered, and an innovative tuned mass damper installed.

The project team has responded to the considerable structural, environmental and ecological challenges to deliver a bridge that celebrates the natural environment of Banff through the use of natural materials. A fantastic example of technically adept ‘light touch’ engineering.

Location Hunan Province, China

Youshui Bridge

Awarded for pushing the boundaries of asymmetric long-span bridge design

PROJECT TEAM

- **Structural engineer:** China Railway Siyuan Survey and Design Group Co. Ltd
- **Client:** China Railway Siyuan Survey and Design Group Co. Ltd
- **Principal contractor:** China Railway Siyuan Survey and Design Group Co. Ltd
- **Architect:** Wen Wangqing
- **Project owner:** Huai-Shao-Heng Railway Co. Ltd
- **Contractor:** China Construction Fifth Engineering Division Corp. Ltd

IN BRIEF…

- Spanning 292m across the Youshui river valley, the Youshui high-speed railway bridge is the world's longest-span asymmetric arch bridge.
- The concrete-filled steel tube (CFST) arch structure reduces mountain excavation and vegetation destruction and protects the ecological environment in the mountainous area.
- Prefabricating and assembling the arch rib, columns and the main girder shortened the construction period and minimised the environmental impact.
- The opening of the Zhangjiajie-Jishou to Huaihua high-speed railway has cut the travel time from Changsha to Furong Town from six to 2.5 hours.

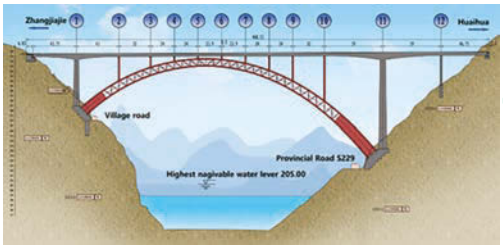
JUDGES' COMMENTS

With the topography, geology, and existing road conditions fully considered, this bridge is designed with an innovative large-span concrete-filled steel tube trussed arch, providing safety and comfort for high-speed train rides. Representing an important milestone in the history of bridge engineering in China, it exemplifies the construction of high-speed railway arch bridges in mountainous areas.

The arch feet were carefully placed to avoid unnecessary construction infrastructure and to also protect the natural environment, while the erection process involved an impressive catenary hoist system.

YAN AIGUO

↗ Arch rib of bridge is two-segment double-tube CFST truss horizontally



YAN AIGUO

↖ Feet of arches were positioned to avoid steep mountains

YAN AIGUO

➔ Journey times were cut from six to 2.5 hours between Changsha and Furong Town

Location London, UK

Battersea Power Station

Awarded for raising the standard for retrofit and facade retention at scale

PROJECT TEAM

- **Structural engineer:** Buro Happold
- **Client:** Battersea Power Station Development Company
- **Principal contractor:** Mace
- **Lead architect:** Wilkinson Ayre
- **Heritage architect:** Purcell
- **Building services:** chapmanbdsp
- **Project manager:** Turner & Townsend
- **Cost consultant:** Gardiner & Theobald
- **Temporary works designer:** RKD
- **Steel contractor:** William Hare
- **Concrete contractor:** Mitchellson
- **Piling contractor:** BAUER Technologies
- **Brickwork contractor:** PAYE

IN BRIEF…

- The Grade II* listed Battersea Power Station has been sympathetically transformed from a much-loved industrial relic into a vibrant 21st century destination. The visionary redevelopment of the 2 495 000sq.ft building was carried out as Phase 2 of an eight-phase, 42-acre regeneration of this former brownfield site.
- A key driver for the project was to maximise the conservation of the original fabric, especially as previous failed regeneration attempts included significant elements of demolition.
- In some instances – such as the dismantling and reconstruction of geometrically identical chimneys – light touch conservation was not possible. This was necessary to protect the public from the risk of ongoing spalling, which could not be remediated with certainty.
- Two vast tree-shaped steel structures each support 30m × 30m of office floorplate over eight storeys, while also serving as architectural focal points within the column-free atrium.

↙ Transformed Battersea Power Station is open to public

↗ Boiler House's tree-shaped steel structure supports

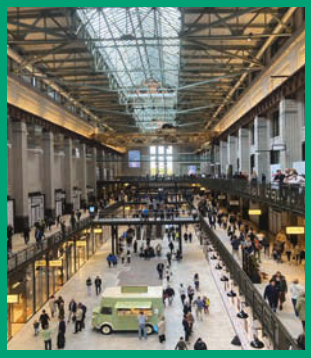
JUDGES' COMMENTS

An impressive retrofit of a derelict, complex structure, requiring careful planning, inspection and testing of the existing foundation and structural frame. The existing foundations and structure have been strengthened and retained where possible, while featuring excellent construction detailing to satisfy current building codes and to meet the building's new requirements.

> "AN IMPRESSIVE RETROFIT OF A DERELICT, COMPLEX STRUCTURE

Find out more

Read more about this project in the October 2023 issue of *The Structural Engineer*: https://doi.org/10.56330/ZBEO8463



↑ Shopping centre was developed in Turbine Hall

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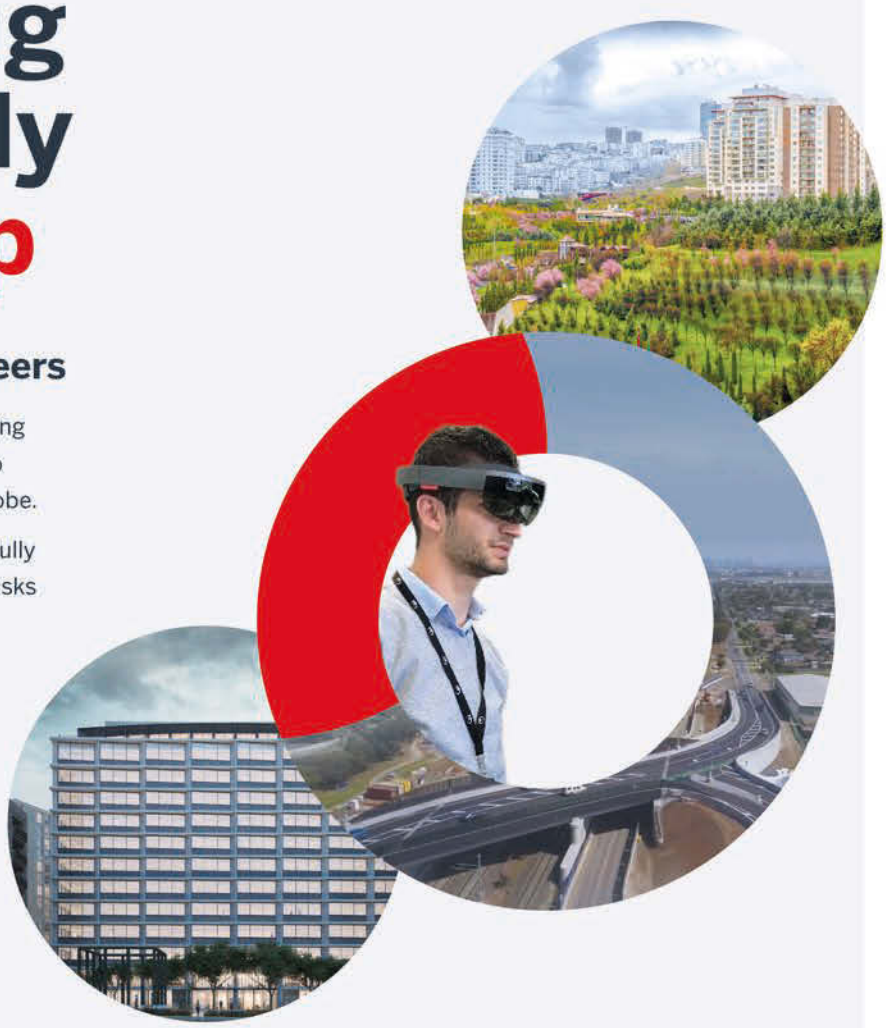

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Trimble

Location London, UK

Holbein Gardens

Awarded for advancing industry knowledge of steel reuse in buildings

PROJECT TEAM

- **Structural engineer:** Heyne Tillett Steel
- **Client:** Grosvenor
- **Principal contractor:** Blenheim House Construction
- **Architect:** Barr Gazetas
- **Consultants and contractors:**
  Gerald Eve
  HDR
  TFT Consultants
  Todd Longstaffe-Gowan

IN BRIEF…

- Holbein Gardens is a retained and extended 1980s concrete-framed commercial building with a modern sustainable workplace and increased floor area.
- The building includes a two-storey upward extension, with a roof terrace over an existing four-storey building plus basement.
- The development reused most of the existing building fabric, paired with low-carbon engineered timber extensions, and reused 25t of reclaimed steel, including 9t from other Grosvenor sites.
- The new structure at Holbein Gardens used low-carbon materials, such as cross-laminated timber for the floors and walls and Cemfree concrete.

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↗ Completed building used 25t of reclaimed steel

↙ Combination of reclaimed steel and cross-laminated timber was used

DESIGNED WITH CIRCULAR ECONOMY AND SUSTAINABILITY THINKING FROM THE START

JUDGES' COMMENTS

The project was designed with circular economy and sustainability thinking from the start, prioritising retention over demolition, reuse, recycling and trialling innovations such as material passports, and procurement and waste management.

The project is a pioneer and exemplar for the direct reuse of structural steel in London. Over 25t of steel was reused in the construction, which has led to further research into reusing pre-1970 steel and has inspired others in the industry to go further.

Find out more

Read more about this project in the March 2023 issue of *The Structural Engineer*: https://doi.org/10.56330/CRPP8446

↑ 93% of existing structure was retained

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Location London, UK

ABBA Arena

Awarded for celebrating modular, demountable timber at scale

PROJECT TEAM

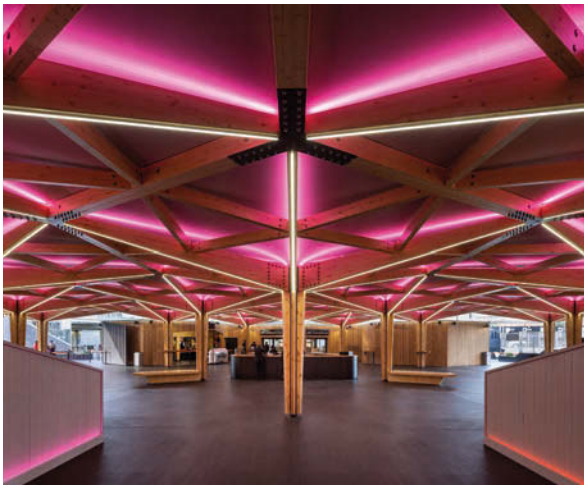
- **Structural engineer:** Atelier One
- **Client:** Pre-stage 4: Stufish; Post-stage 4: ES Global
- **Principal contractor:** ES Global
- **Architect:** Stufish
- **Project manager and quantity surveyor:** Gardiner & Theobald
- **Acoustic consultant:** Charcoalblue
- **Planning consultant:** Quod
- **Transport planning consultant:** i-Transport
- **Landscape consultant:** Jonathan Cook Landscape Architects Ltd
- **Timber specialist contractor:** Xylotek Ltd with Corbett & Tasker
- **Front-of-house contractor:** Stage One

IN BRIEF…

- The ABBA Arena has a 3000 capacity and 70m column-free span. The theatre, as well as its internal and front-of-house structures, will remain on the London site for several years and are fully demountable and transportable to offer full reuse of the building at a new location.
- Timber was considered for the primary structure, but the required member sizes would result in significantly higher transport emissions, so steel was chosen with the added benefits of robustness for repeated assembly and disassembly. Efforts were made to maximise use of timber in the remainder of the development.
- The use of modular construction and prefabricated components on shallow foundations reduced the amount of waste and disruption associated with traditional construction methods. High acoustic performance of the cladding systems ensured minimum disruption to the surrounding neighbourhoods.
- The efforts to utilise timber throughout the project, where the material lends itself to it, were recognised with the project winning a 2022 Wood Award.

DIRK LINDNER COURTESY OF STUFISH

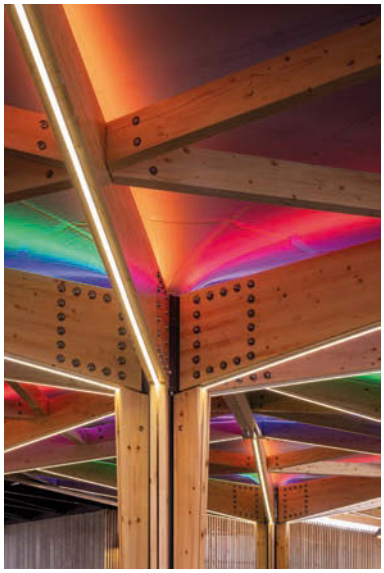
← ABBA Arena became landmark for previously remote and isolated Pudding Mill Lane in London



DIRK LINDNER COURTESY OF STUFISH

↑ Idea of large-scale reuse is at heart of ABBA Arena

↓ Demountable cross-laminated timber detailing



DIRK LINDNER COURTESY OF STUFISH

JUDGES' COMMENTS

ABBA Arena is a new type of building responding to the need to address the issue of sustainability within the entertainment industry. The idea of redeployable structures at this scale is new and offers huge potential in terms of the future reuse of buildings.

Every aspect of low carbon was considered and optimised for the structure, and timber is used extensively in the development for a lower embodied carbon when compared with similar projects. The access deck and show grid was utilised as a tie resisting the horizontal thrust of a light steel dome which was chosen for the roof, with the added benefits of robustness for repeated assembly and disassembly. The perimeter structure was designed to keep the number of elements required to a minimum, utilising the rainscreen support structure for stiffness under out-of-plane loads.

An exemplar for reusable design and whole-life low-carbon considerations. It is rare to see a project that marries so many good ideas together.

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Location Wellington, New Zealand

8 Willis Street

Awarded for **innovation in seismic retrofit for improved resilience**

PROJECT TEAM

- ➜ **Structural engineer:** Beca
- ➜ **Client:** Argosy Property
- ➜ **Principal contractor:** McKee Fehl
- ➜ **Architect:** Architecture+
- ➜ **Mechanical engineer:** CORA
- ➜ **Electrical engineer:** BlackYARD
- ➜ **Hydraulics:** Stretton Michael
- ➜ **Fire engineering:** Cognition

IN BRIEF…

- →| 8 Willis Street's structure is typical of New Zealand buildings from the 1980s and 1990s, with a ductile reinforced concrete frame with shear walls, precast concrete floors and shallow pad foundations.
- →| Assessment found the building's seismic rating was around 40%NBS – marginally above the threshold for triggering an 'earthquake-prone building' notice, and well below the acceptable standard for commercial tenants.
- →| The team's revolutionary structural design process strengthened the building to 130%NBS with a highly efficient retrofit that added a dozen 4000kN fluid viscous dampers to the reinforced concrete frame – reducing inter-storey drift without creating additional foundation loads.
- →| The existing building's size was increased by five storeys and its footprint expanded – transforming the project's commercial viability for our client.

© MATTHEW PLUMMER

↑ Building front was extended to Willis Street boundary

➔ Twelve 4000kN fluid viscous dampers were used

↓ Design allowed for full-height atrium through existing floors to create feature staircase

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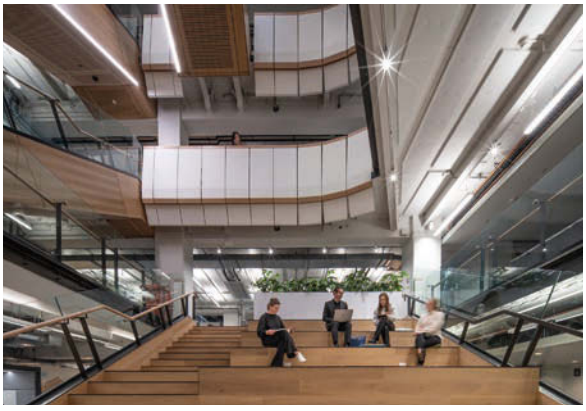

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JUDGES' COMMENTS

A well-considered project highlighting the value that the structural engineer brought to the project. Fluid viscous dampers have been used in a technical and elegant way to significantly improve earthquake resistance to the building. The thoughtful placement of the dampers has maintained open spaces, uninhibited by the structure, unlike other highly resilient seismic retrofits and new builds, where primary structural components tend to dominate the interior.

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Location Chengdu, China

Chengdu Phoenix Mountain Football Stadium

Awarded for innovation in the design and testing of cable-dome structures

PROJECT TEAM

- ➜ **Structural engineer:** China Southwest Architectural Design and Research Institute Co. Ltd
- ➜ **Client:** Chengdu Urban Investment Co. Ltd
- ➜ **Principal contractor:** China Construction Eighth Engineering Bureau Co. Ltd
- ➜ **Architect:** China Southwest Architectural Design and Research Institute Co. Ltd
- ➜ **Manufacturers:** Guizhou Steel Wire Rope Co. Ltd Sanxin Membrane Structure Company
- ➜ **Consultant:** HKS Architects (China)

IN BRIEF…

- →| Chengdu Phoenix Mountain Sports Center consists of a professional football stadium with a capacity of 60 000 spectators, a sports arena with a capacity of 18 000 spectators, and a club connecting the two. The stadium has a one-storey basement and six floors, with a roof height of approx. 64m.
- →| The Phoenix Mountain Sports Center separates the stadium, club and sports arena into three independent structural units with structural anti-seismic joints.
- →| The size of the structural unit of the football stadium is 322m × 285m, and it adopts a reinforced concrete frame-shear wall structure as the main structure.
- →| The inner transparent part of the roof canopy, covered by an ETFE membrane, forms a cable-dome structure with a large opening. Two loops of ring cables are arranged in the circumferential direction of the cable-dome, and 80 sunflower-shaped diagonal cables are arranged in the radial direction.

JUDGES' COMMENTS

This project demonstrates developments in design and construction methods for large cable-supported domes with central openings. The design team carefully considered the flow of forces around the asymmetric roof, using an inner ring steel truss and prestressed sunflower configuration cable layout to create an efficient structural form.

This is innovative engineering design, and the judges admired how the team used scale model testing and ETFE testing to verify their findings and prove it worked in order to achieve the successful completion of the project.

↘ Stadium is venue for World University Games in 2023

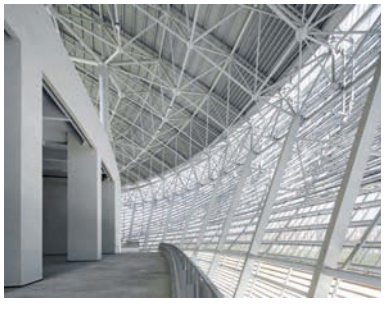
TIAN QIU

TIAN QIU

↑ Transparent and lightweight roof is conducive to sunlight exposure

➜ Outer facade of stadium uses steel-framed structure

> **THE DESIGN TEAM CAREFULLY CONSIDERED THE FLOW OF FORCES AROUND THE ASYMMETRIC ROOF**



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Location Niamey, Niger

Collège Hampaté Bâ

Awarded for using sustainable local materials and enabling positive social impact

PROJECT TEAM

- **Structural engineer:** MHA Structural Design
- **Client:** Article 25 on behalf of Collège Amadou Hampaté Bâ
- **Principal contractor:** Afrique Univers Niger
- **Architect:** Article 25
- **Mechanical, electrical and plumbing engineer:** Max Fordham

IN BRIEF…

- The college provides subsidised education for children from low-income families. The project involved the refurbishment of existing classrooms and provision of new classrooms, administrative facilities and bathrooms along with upgrades to water and electrical supplies.
- Research into local materials and skills led to the adoption of laterite as the primary material for loadbearing walls and barrel-vaulted roofs. Laterite is a cheap and, significantly, sustainable building material quarried locally.
- The soil for cement-stabilised earth blocks (CSEBs) was sourced directly from site excavations and mixed with 6–8% of cement to improve resistance and durability. The local masons set up an open-air workshop on site for mixing the components, pressing it into the mould, and curing the adobes.
- The double-roof system provides shading and forms an air curtain to reduce the temperature of the ceiling. Mono-pitch steel trusses are oriented so that the prevailing winds enhance cooling effects.

JUDGES' COMMENTS

The design team overcame challenges of the extreme Sahelian climate and limited construction skills and materials to create a functional yet inspiring space for learning, with the exposed structure celebrated as a learning tool. The structure utilises locally sourced materials to reduce the building's carbon footprint and promote the use of sustainable building practices.

The project had a major impact on the local community and the students that it serves. An important target was to keep female students in the education system. During construction, female students attended courses on construction skills and were exposed to postulates of architecture, engineering and construction. The students were encouraged to consider continued education and careers in the construction industry.

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↑ Roofs overhang walls to shade and protect from heavy rains

← During construction, female students attended courses on construction skills

↓ Low-carbon CSEBs were built on site by expert local mason

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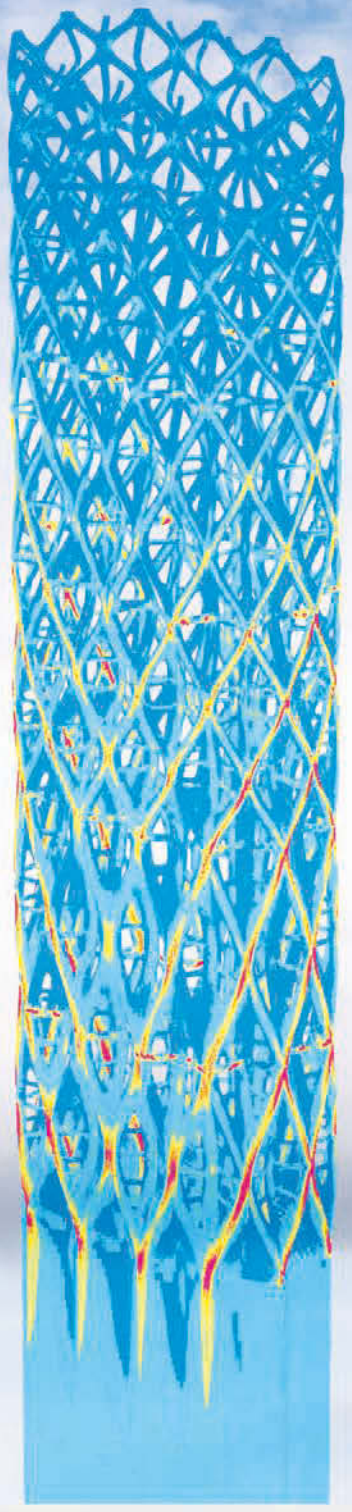

The Tower of Light, Manchester, UK
Photo credit: David Valinsky

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Location London, UK

Cody Dock Rolling Bridge

Awarded for the bold design of a transformative structure

PROJECT TEAM

- **Structural engineer:** Price & Myers
- **Client:** Gasworks Dock Partnership
- **Principal contractor:** Gasworks Dock Partnership & Cake Industries
- **Architect:** Thomas Randall-Page

IN BRIEF…

- Cody Dock has been brought back into use following years of dereliction. This new steel bridge spans over the dock mouth, allowing the passage of vessels into the dock by rolling along a track such that the deck turns upside down.
- The bridge is carefully counterweighted so that the centre of gravity is level, allowing the 13t bridge to roll using only a hand-cranked winch.
- The footbridge is a simply supported structure with a monocoque steel deck spanning 7m over the dock mouth and tapering in depth from 400mm to 550mm at mid-span.
- The bridge aims to be understated when resting but playful in its movement, creating a spectacle when operated. Part of the ambitious footpath and cycleway project along the length of the Lea River, the hope is that this rolling bridge will become an important landmark and a symbol for the dynamic community growing here.

JUDGES' COMMENTS

This technically innovative and intriguing bridge showcases the application of advanced mathematics to develop an elegant and stable geometric design that is understated when stationery but playful in its movement, creating a spectacle when operated. The engineers have implemented a clever mechanical engineering solution by adding a counterweight to raise the centre of gravity to the midpoint of the frame, to facilitate its hand-operated movement.

The unique design necessitated a passionately collaborative team.

JIM STEPHENSON

↑ Bridge is rolled using pair of manual winches

→ Undulating concrete abutments are cast into existing masonry walls

> "UNDERSTATED WHEN STATIONERY BUT PLAYFUL IN ITS MOVEMENT

Each role extended past typical scope boundaries, with everyone having to adopt a holistic understanding of the structure, mechanics, geometry, architecture and fabrication.

The project signifies collaboration between, not only the design team, but the local community as a contemporary piece of industrial architecture/functional sculpture that will endure for generations to come.

JIM STEPHENSON

↙ Bridge will allow boats through for first time in over 50 years

JIM STEPHENSON

Location Banff, Alberta, Canada

Nancy Pauw Bridge

Supreme Award for Structural Engineering Excellence

PROJECT TEAM

- **Structural engineer:** StructureCraft
- **Client:** Town of Banff
- **Principal contractor:** StructureCraft
- **Geotechnical engineer:** Thurber Engineering
- **Landscape architect and lighting designer:** Ground Cubed
- **Environmental consultants:** Avens, Ram Consulting

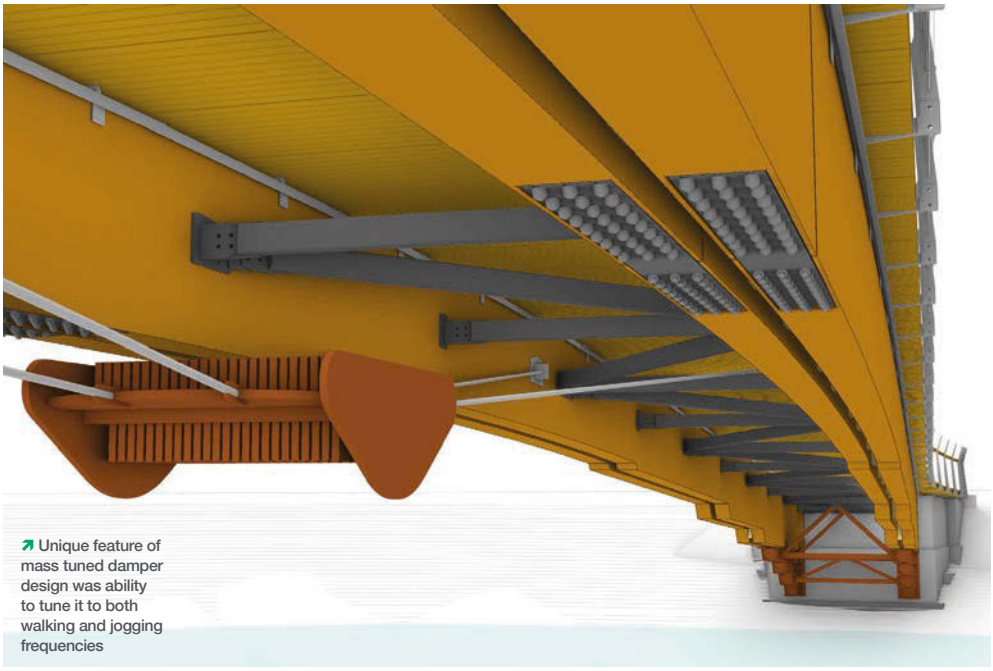
IN BRIEF…

- Nancy Pauw Bridge over the Bow River in Banff was designed to be graceful, unobtrusive and natural, fitting in with both the beautiful surroundings and the Rocky Mountains.
- The timber arch bridge needed to be a low-profile design with a maximum slope of 5% and give clearance for flood conditions but not alter the paths of ever-present elk passing across the river.
- The team analysed and designed a special tuned mass damper, involving a simple carriage with weathering steel plates suspended by splayed cables from the bridge.
- StructureCraft engaged both a wildlife ecologist and an environmental engineer to create a site-specific environmental protection plan. The decision was made to not only clear span, but slightly over-span, to reduce the impact footprint to negligible.

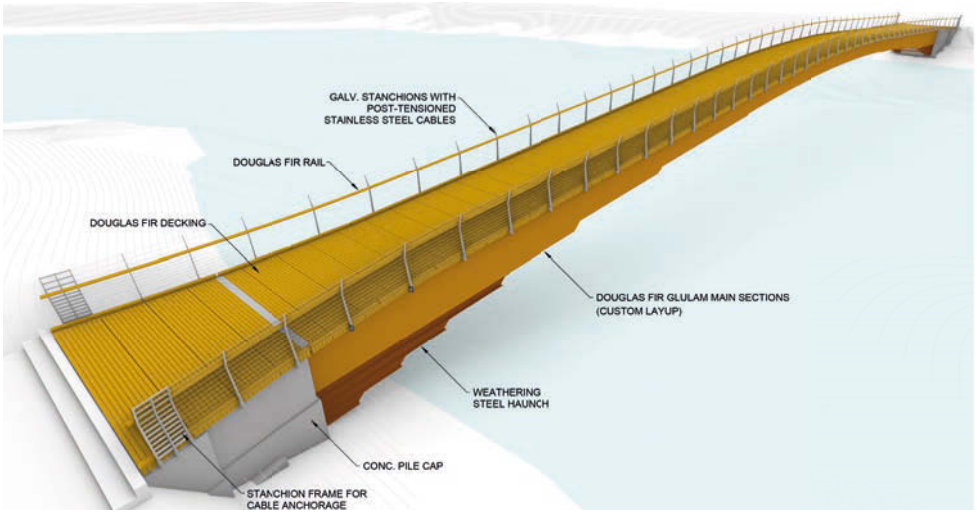
JUDGES' COMMENTS

A massive congratulations to the StructureCraft team. Their work on the Nancy Pauw Bridge, an exceptionally low-profile timber bridge in Banff, not only demonstrates the innovation and technical excellence that contribute to design elegance, but it showcases their unique problem-solving skills and ability to deliver structures which impact positively on social and environmental issues.

They were joined by a host of other impressive winners, recognised for their intelligent use of materials, circular approaches to design, and sustainable construction. Now in its second year, the new attribute-based judging framework is helping to paint a better picture of how structural engineers are supporting a safer and more sustainable built environment.



↗ Unique feature of mass tuned damper design was ability to tune it to both walking and jogging frequencies



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↑ Extensive non-linear soil-structure analysis was conducted to ensure such a shallow structure was achievable

> "SHOWCASES THEIR UNIQUE PROBLEM-SOLVING SKILLS

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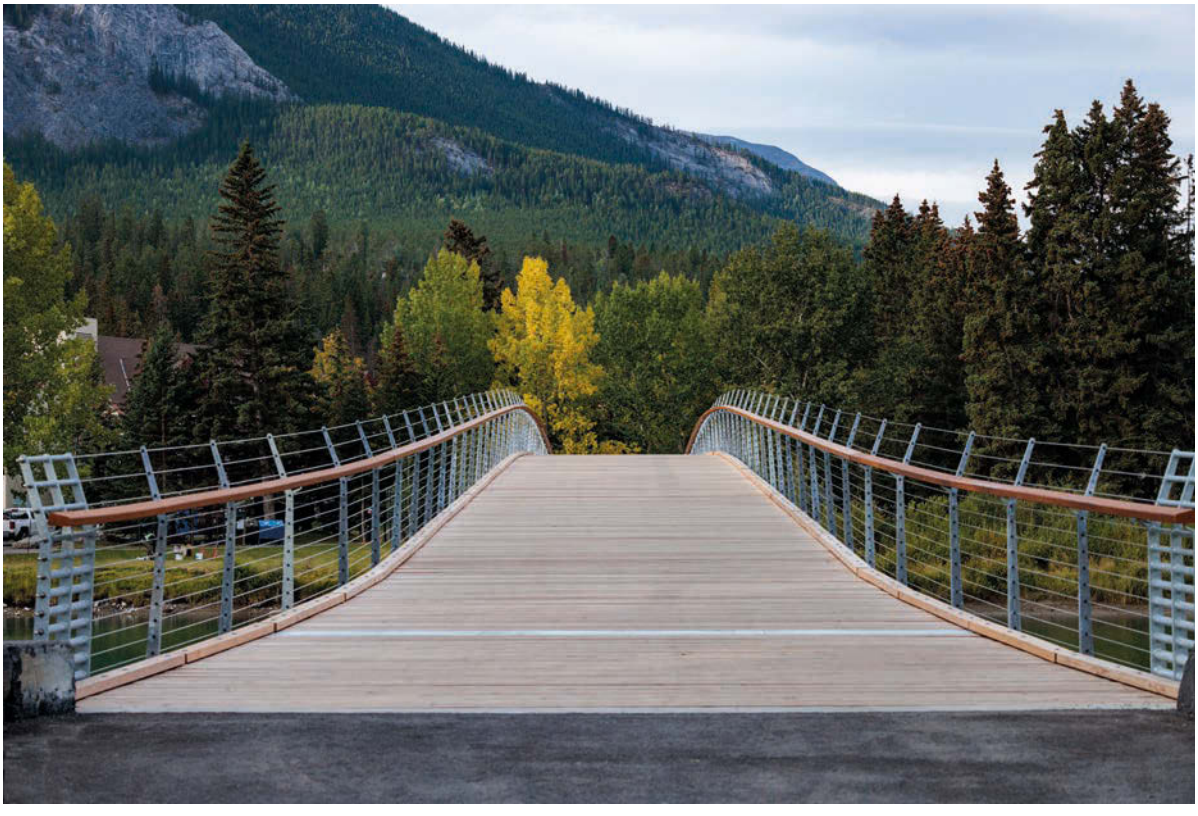

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↑ Unimpeded views for users while crossing were design essential

← Bridge decking consists of spaced uncoated Douglas fir 4×6 timbers prestressed into 1m-wide removable panels