Volume 60 • November 2022

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Final Words

Sidney Harbour Bridge.
Photo Credit: Creative Commons CC-BY-SA-3.0

Message from the President

David Harvey, P.Eng.
SEABC President

Celebrating Structural Engineers

I'm all for celebrating structural engineers. At SEABC, we do not have an awards program – I'm not exactly sure why, but my guess is that it takes a lot of effort to organize and to ensure that fair and consistent judging occurs. It is important that prize winning is not a popularity contest, but one with supported nominations which are judged on their merits.

EGBC has the President's Awards program which selects winners for different award categories from the broad-based membership. The highest award for engineers – the R.A. McLachlan Memorial Award, has been won three times by structural engineers over the past 15 years. This is disproportionate to our percentage of the EGBC membership, which suggests structural engineering has outstanding leaders, making a strong contribution to engineering across BC and beyond. To help this continue, please remember to nominate your outstanding colleagues. Nominations take place every spring, so look out for EGBC announcements.

IStructE have a broad range of awards for structural engineers which mostly focus on service contributions, but include awards for young members, papers, research, academia, etc., but also includes the prestigious Gold Medal for structural engineering, awarded to a structural engineer who has made a truly outstanding contribution to worldwide engineering practice. The gold medal is rarely awarded – only 55 over the Institution's 113-year history. Paul Fast was the 2021 winner – the first from BC, and only the second Canadian.

Other organizations, notably CSCE, ASCE and EERI have their awards programs, so maybe SEABC does not need one? Well, it is something to ponder.

Looking through past newsletters, I noted that SEABC has celebrated the lives of some prominent structural engineers that have contributed strongly to local and national practice and have influenced us all – Jim Mutrie, Ron DeVall, and recently Bogue Babicki. It is important that we celebrate their contributions, unfortunate perhaps, that maybe we did not say how we felt about them before their passing. Having lost them and given the opportunity, those who knew them well, gathered to show their respect collectively – an important ritual in the collective grieving process. It is heartening to read articles penned by close collaborators, best friends and loved ones telling stories of past exploits, worthy achievements and good times. The different personal experiences are amazing.

And so, it was with the tragic loss of Eytan Fiszman. Eytan was taken from us only recently at the tender age of 31, having touched the lives of many structural engineers in our community, and no doubt many others as well. A prominent figure in the SEABC Young Members Group, he will be sadly missed. Eytan made many friends during his career at Thomas Leung Structural Engineering, RJC Engineers and most recently at Fast + Epp where he managed the Concept Lab. Eytan is described as passionate, committed and energetic. He was a true team player. Loyal and full of laughter, it is hard to imagine a person more 'full of life' than Eytan.

I was honoured to be invited to a gathering in Fast + Epp's Concept Lab to celebrate a life well lived with contributions in many different ways. The Lab was full of Eytan's employers, friends and numerous colleagues. Many stories emerged – some funny, some serious, some delivered tearfully, but all touched the heart. This remarkable young man had enriched the lives of others, and had been taken from this world, way before his time.

Those of us who have lost loved ones close to us will have some idea of the loss being felt by Eytan's family and his many close friends. We hope they find peace in reflecting on the massive force for good that was Eytan Fiszman.

This huge loss reminds us to give extra hugs to loved ones and lots of encouragement to others. Let's celebrate with them while we can.

You will find an article elsewhere in this newsletter authored by Eytan's colleagues and close friends.

Committee Reports

Young Members Group

Lois Tso

E.I.T.

This issue of the YMG report summarizes planning work that has been ongoing in the YMG Committee and upcoming volunteering opportunities for fellow young members.

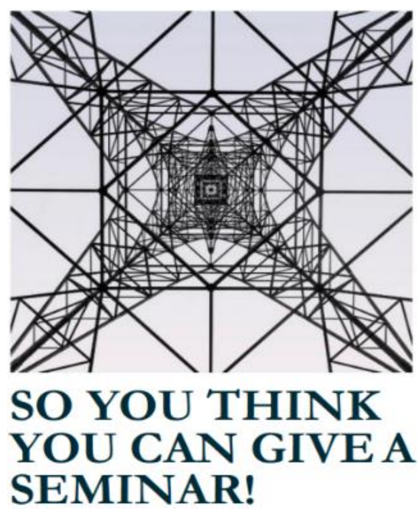
Upcoming Events

The YMG Committee has been working diligently to create social and technical events for the fall and winter season. We're looking forward to providing more opportunities to meet and network with other young members this year and next. Look out for invites to trivia nights, rock climbing, and a variety of other social events! The YMG Committee is also looking to plan for project tours and technical sessions with hands-on learning experiences to provide further insight on the construction process of an engineering design.

The Stack Building Tour

Launched last year, the SEABC YMG Geoguessr Contest is an online quiz game where players are given a photo of a structure and are asked to pinpoint the structure location on a map. Participants are scored based on location accuracy and guess time; the more accurate and faster you guess, the more points are scored. The third season of the Geoguessr event is coming soon, get ready to guess the next collective of structures we have hand picked for you! Anyone who enters has a chance to win a gift card prize!

The YMG Committee is excited to once again be preparing for the SEABC YMG Presentation Competition, an event where students and industry members can participate to present on an engineering topic of their choice and compete for the top title and prize! For the past 2 years, the Presentation Competition has been held successfully online. We are happy to announce that the YMG Committee is planning on holding the twelfth annual competition in-person next year. The Presentation Competition is a great way to learn about a variety of engineering topics and network with industry members!



If you are interested in becoming a volunteer for our upcoming YMG events, feel free to reach out to us through our social media links below! All volunteers of any commitment level are welcome.

LinkedIn- linkedin.com/company/seabc

Instagram- instagram/seabc_social

Email- ymg@seabc.ca

On the Web

Ricardo Ruiz,

B.Sc., M.Sc.

Hope everyone had an enjoyable and relaxing summer!

• Industry event postings:

o Professional Practice Guidelines: Structural Engineering Services For Tall Concrete Building Projects on May 27

o Structural Reliability Predictions using Finite Element Models on Jun 27 to 28

o FEMA P-2091, A Practical Guide to Soil-Structure Interaction on Jun 15

o Operational Modal Analysis: Background, Theory & Practice by the IOMAC conference from Jul 2 to 3

o Future Code Changes Explained: Seismic Analysis and Design of Nonstructural Components and Systems on Aug 3

• Young Members Group Trivia Night event

o YMG hosted a socials event– Trivia Night at a downtown Vancouver pub on Nov 9

o The event details and registration were posted on the website

• SEABC Legacy Awards Application reminder sent on Sept 23. Click on the links below for more details about each award:

o Peter Ridgway Taylor Grant (PRTG) for Structural Engineering Advancement- applications for the 2023-2024 grant close: 17:00 PST 9 January 2023.

o SEABC Young Member Meritorious Achievement Award (YMMAA)- - nominations for the 2023 award close: 17:00 PST, 31 January 2023

• SEABC September 2022 Term Courses

o The term courses started on the week of Sept. 6 and are currently running, and will complete on the week of Dec. 1

• SEABC January 2023 Term Courses o Registration for the next term courses opened on November 7 :

seabc.class-bit

o This term will run from January to April 2023

o For more details and to register go to:

seabc.ca/certificate-program

• SEABC August Newsletter published and posted on the website: SEABC Newsletter

We welcome your comments for improving the SEABC's website and other online services. Please send your suggestions to webmaster@seabc.ca

2023 Subscriptions Renewal

David Harvey, P.Eng., Struct.Eng.

Director SEABC

Log in by December 31st to renew your membership for 2023, or to become an SEABC member. A group renewal option is available to assist firms wanting to bulk-renew their staff memberships. Subscriptions remain unchanged for next year. Go to:

seabc.ca/membership

IStructE News

David Harvey, P.Eng.
Struct.Eng

In 2023 IStructE will be changing the Interim Professional Development interview key competencies from a total of 13 to 11 and updating the requirements. This change will occur during the second half of next year. A significant change will be the introduction of competency in carbon reduction, and in particular, on accounting for embodied carbon as part of structural design.

The Institution is currently developing on-line training material modules which will include learning tests to support the planned changes. Taking and passing the modules will be mandatory for all PRI Interviewers and IPD interview candidates. The Chartered Membership exam questions are currently being redeveloped and will also include an element which tests the candidate on their carbon reduction knowledge and will look for the ability to design sustainably.

Passing the Chartered Membership exam can be used for Struct.Eng. registration with EGBC and in combination with passing the IPD interview, to become a Chartered Structural Engineer by joining IStructE. Readers that are interested in sitting the IStructE. examination should take note of these significant charges.

Naeem Hussein - 2023 Gold Medalist

Gold Medal

The Gold Medal of the Institution of Structural Engineers was recently awarded to Naeem Hussain, Global Bridge Lead at Ove Arup. Naeem is the 55th recipient of this prestigious award.

There have been several previous bridge engineers who have been awarded the Gold Medal, notably Fritz Leonhardt, Oleg Kerensky, and Michel Virlogeux, but it is a relatively rare occurrence. Naeem is the latest prominent bridge designer winner.

Having spent 53 of his 60-year career with Arup, Naeem has covered a lot of ground. Known for his pioneering techniques in marine bridge construction and signature bridges, he is a natural innovator, always striving for improvement. The architectural qualities of his designs are very apparent. Often attributed to his Arup environment, this is clearly also an innate skill.

Naeem is associated with the 30 km long Sultan Haji Omar Ali Saifuddien Bridge in Brunei, and the 55 km long Hong Kong–Zhuhai–Macau Bridge in the Pearl River delta – both marine viaducts on a massive scale. Past notable projects include the UK's Second Severn Crossing; the Oresund Crossing connecting Denmark with Sweden; and the Stonecutters Bridge, Hong Kong, which raised the world's longest cable-stayed span to over 1 km. All of these are milestone projects which bridge engineers can only dream of. Somehow, Naeem has crammed these and many other 'to die for' projects into his glittering career.

Naeem's insight into his art equips him to solve most bridging problems with ease. The touch that I believe best displays his creativity is the adroit use of crossing stay cables to efficiently limit tower displacements in multi-span cable stayed bridges which are inherently vulnerable to sway under unbalanced loading. This elegant approach greatly reduces demands on the towers. This can save significant quantities of substructure materials which is particularly important for long cable-stayed spans. Visual qualities are much enhanced – check out Scotland's elegant Queensferry Bridge which exemplifies the art of cable-stayed bridge design.

Naeem is indeed a worthy recipient of the 2022 IStructE Gold Medal.

Queensferry Bridge, Scotland

Sultan Haji Omar Ali Saifuddien Bridge, Brunei

Second Severn Crossing, UK

Stonecutters Bridge Hong Kong

Hulme Arch, UK

Queensferry Bridge, Scotland

Hong Kong - Zhuhai Macau Bridge

Stonecutters Bridge Hong Kong

Remembering Eytan Fiszman 1991 – 2022

It is with profound sadness that we announce the sudden passing of Eytan Michael Fiszman on September 22, 2022.

Born March 9, 1991, Eytan was raised in Ottawa by wonderful parents who helped foster his charming curiosity and adventurousness. In recent years, he lived his dream as a structural engineer in Vancouver, B.C., helping design a fledgling research lab and several downtown high-rise structures.

Eytan was both passionate and devoted to our profession. He actively served the SEABC YMG selflessly over the past five years and led many initiatives for the benefits of his peers. He fueled the group with energy and filled the meetings with laughter. He will be dearly missed by the SEABC YMG.

Eytan joined Fast + Epp in August 2021, as Concept Lab Manager, leading the firms new research and development endeavour forward- with herculean effort. He is remembered by his colleagues and friends at Fast + Epp as an incredibly loyal, energetic, and passionate individual and was the ultimate team player. Eytan was the one who always had time to chat, was the first to lend a helping hand and would consistently put others before himself. Eytan built the Fast + Epp Concept Lab from scratch – everything from research grant applications to designing and procuring a structural testing frame and churning through robotics code. It was his positive, forward leaning attitude that made this endeavour a possibility, for which the team at Fast + Epp are forever grateful. The entire staff is deeply saddened by his passing and continues to grieve. He will be forever missed at the Vancouver office, where his legacy lives on.

Before joining Fast + Epp, Eytan worked for 3 years at RJC Engineers. During his time at RJC, he worked on a number of notable projects including several landmark buildings in Vancouver and Kelowna. Eytan made a strong impression on those he worked with in both the Vancouver and Kelowna offices. The positive energy he brought to an office was felt by all those around him. Eytan keenly cared about the work he did and genuinely cared about the people he worked with. He was a true team player. As an Engineer, Eytan was curious, hard-working, and would not give up figuring something out until he was satisfied. He was known to raise questions that made even the most seasoned engineer think twice. As a person, he captivated many of us with attributes that made him shine. Eytan was always there with a big smile, a joke or a funny picture to make you laugh. He will be missed by those he worked with at RJC.

Eytan is remembered as a practical joker who loved to laugh; a loyal son, brother and friend who lived to give; a humble person who cared deeply about righting the world's injustices; a vivacious, unrelenting engineer who brought innovative projects to life with ease; and a bold climber who summited dozens of mountains from Yukon and Peru to Utah and Asia.

Eytan is survived by his beloved parents Sergio and Viviana Fiszman, devoted brothers Sebastian and Alejandro Fiszman, climbing partner and his love Katie Ross, treasured grandmother Sofia Forman and many cousins and relatives in Argentina, Israel, Spain and the United States.

He will be missed by a tight-knit group of friends made at Hillel Academy, Sir Robert Borden High School, Carleton University, the University of British Columbia, the hiking community, and the structural engineering community in Vancouver.

rememberingeytan.com

Fire Engineering of Mass Timber Structures

Felix Weisner, PhD, M.Eng.

Engineered mass timber products continue to increase in popularity for use in structural frames for ever taller and ambitious buildings. This process is driven by multiple perceived and measured benefits of timber: (1) its reduced carbon footprint compared to steel and concrete, (2) its relatively low mass, and (3) the ease of construction that originates from the factory production and accurate sizing of engineered timber elements [1].

Yet timber has one disadvantage – it is combustible. Past mass conflagrations of timber cities still influence both our perception and building codes [2]. Limits on the use of exposed timber and hardened building envelopes contributed markedly to the elimination of accidental building conflagrations in the global north [3]. The renewed increase in both use and ambition for timber structural elements in tall building design is posing numerous challenges for engineers, architects, and fire and emergency services [4]. These require foresight and care as one negative fire incident involving a tall building may result in the abandonment of timber for their construction.

The first key consideration for combustible structural elements must address their contribution to the fire. The full expression of timber surfaces is a desirable architectural feature, due to aesthetics and the costs of non-combustible encapsulation. Fire safety, and especially the concept of fire resistance, rely on the implication that the original fuel load (e.g. chairs, sofas) will 'burnout' and thus limit the duration of fires. The addition of large surfaces of timber will increase the fuel load and can cause fires that continue to be fuelled until the fire compartments are breached [5] – causing the fire to grow and spread through the building; this would usually be considered a failure of the fire safety strategy. This aspect has received significant research attention and engineers have gained greater understanding of the design parameters that can be adapted to maximise the probability of 'burnout' and self-extinction in compartments with expressed timber [6]. If engineering knowledge, skills, and understanding lead to a design that fulfils these criteria, the next requirement for the fire safety design of a timber building will aim to prevent partial or full structural collapse during or after a fire.

The structural capacity of timber in fire is affected by two parameters: (1) the fire intensity and its 'thermal exposure' to the timber structure, and (2) the response of the timber to the imposed heat flux. The 'thermal exposure' in a fire is dependent on the availability of fuel and oxygen. The former is increased by the presence of expressed timber and the latter is a function of the openings into a compartment – both these parameters can be incorporated during the design stage of a building. A larger opening, relative to compartment size, will lead to a hotter, more intense fire, but will result in a shorter burning duration as the available fuel load is consumed faster. Timber that is exposed to heat from a fire will thermally decompose into gases and a residual char, which has no strength or stiffness left. The rate at which timber is converted to char – the charring rate of a timber element – is therefore of importance for the structural calculations of timber in fire. In addition, timber that has not yet charred but is heated above ambient temperatures also reduces in stiffness and strength due to a combination of changes in temperature and increased moisture content [7]. This loss of structural capacity is dependent on loading and heating, both in duration and intensity [8].

As timber and char act as insulators, the thermal gradient in mass timber elements is usually steep. As a consequence, considering the load bearing considerations above, mass timber elements are more likely to maintain their loadbearing function during an intense but relatively short fire, compared to a long fire with relatively lower temperatures [9]. The former would arise for larger ventilation openings, while smaller ventilation openings lead to longer fires as it will take a longer time to consume the available fuel load. As a result, the size of the compartment, its openings and the fuel load, should all be considered to decide whether timber may be exposed or how much encapsulation is required.

Even after a flaming combustion has stopped, it is important to prevent collapse in a large or prestigious timber building. Collapse in the cooling phase may be caused either by ongoing smouldering (i.e. continuous flameless exothermic reactions) or due to the redistribution of heat throughout the timber; meaning previously cool timber may be raised to temperatures that reduce its capacity, while timber that is cooling cannot be assumed to restore its mechanical properties, thus leading to a net reduction in overall load bearing capacity and possible collapse. Longer fires lead to a higher net energy uptake of timber, so they will be more likely to cause collapse after the fire.

The detailed consideration of fire dynamics, self-extinction, and structural fire performance are all interdependent and create complex engineering challenges that go beyond the scope of this article. Overall, this short article summarizes the main challenges (achievement of self-extinction and maintaining structural capacity) and highlights how simple changes in ventilation design will influence the fire intensity and duration and how this will affect likelihood of structural collapse. The references below can help engineers appreciate the issues present if they are involved in timber framed buildings, especially 'assembly' class ones.

[1] Churkina, G., et al., *Buildings as a global carbon sink*. Nature Sustainability, 2020.

[2] Law, A. and Bisby, L., *The rise and rise of fire resistance*. Fire Safety Journal, **116**, 2020, p. 103188.

[3] Frost, L.E. and Jones, E.L., *The fire gap and the greater durability of nineteenth century cities*. Planning Perspectives, **4** (3), 1989, p. 333–347.

[4] Deeny, S., et al., *Fire safety design in modern timber buildings*. The Structural Engineer: journal of the Institution of Structural Engineer, **96** (1), 2018, p. 48–53.

[5] Hadden, R.M., et al., *Effects of exposed cross laminated timber on compartment fire dynamics*. Fire Safety Journal, **91**, 2017, p. 480–489.

[6] Xu, H., et al., *Large-scale compartment fires to develop a self-extinction design framework for mass timber—Part 1: Literature review and methodology*. Fire Safety Journal, **128**, 2022, p. 103523.

[7] Tiemann, H.D., *Effect of moisture upon the strength and stiffness of wood*. US Dept. of Agriculture, Forest Service, 1906.

[8] Wiesner, F., Deeny, S. and Bisby, L.A., *Influence of ply configuration and adhesive type on cross-laminated timber in flexure at elevated temperatures*. Fire Safety Journal, **120**, 2021, p. 103073.

[9] Wiesner, F., et al., *Structural Capacity of One-Way Spanning Large-Scale Cross-Laminated Timber Slabs in Standard and Natural Fires*. Fire Technology, **57** (1), 2021, p. 291–311.

Open Plan Compartment

Small Compartment, Large Opening

Small Compartment, Small Opening

The Use of Recycled Glass in Concrete

Robert Bourdages, P.Eng.

LEED AP

A project I am working on in the Caribbean has a substantial pile of glass accumulated, where islanders have intended to recycle this material. The question was posed: Can this be used in structural concrete, since sand is mainly silica? The glass pile was composed of a coarsely ground and random assembly of various colours and shapes. A 1% of glass in a concrete mix was suggested, as this would amount to a cube of 215mm per cubic meter.

Using recycled glass in concrete is possible, but there are many prerequisites to obtain predictable results.

Glass should be sorted prior to mixing with concrete, as each color can be a different chemical composition with unique physical properties. Sorting glass is difficult and time consuming and may be impractical. Also, recycled glass can be contaminated with hazardous or undesirable materials, such as sugars, unknown chemicals and medicines.

Glass can be used as a natural pozzolan when ground to a powder, providing improved workability, resistance to chloride ion penetration, improved strength, improved freeze-thaw resistance, improve sulfate resistance, and a decrease of drying shrinkage. Glass powder can also be used as a replacement to Portland cement (10-30%). However, the energy and mechanical equipment required to sort and grind glass to powder is not available and may defeat any energy savings from recycling. Also, glass dust is a health hazard therefore adequate respiratory protection is required.

When glass is used as a replacement to sand, there can be a reduction in compressive strength.

When glass is used to replace aggregate, there is diminished fire resistance, as glass will melt when exposed to high temperatures. There will also be a reduction in compressive strength (10-20%).

There is also a risk of potential alkali-silica reaction, which can degrade concrete significantly. The silica in glass can react with the calcium hydroxide in Portland cement and form a siliceous gel, absorbing water, swelling and causing cracking and concrete deterioration.

In lieu of providing glass in the concrete mix, it was decided to supplement the native fill material with the glass, rather than mix with concrete. In this attempt to recycle glass to supplement the concrete mix, the energy and equipment required to achieve the desired results outweighed the effort.

Further reading:

concretedecor.net/advantages-and-disadvantages/

concretedecor.net/things-to-know-about-alkali-silica-reaction/

Deposited glass for recycling

Call for Abstracts

The organizers of the 2023 Northwest Conference are seeking presenters for the upcoming 14th and 15th September event, at the Bellevue Hilton. The conference theme is *Innovations in Structural Engineering*. Interested presenters will need to:

1. Return the Abstract Submittal form by January 10th to:

2023 SEA Northwest Conference Call for Abstracts (constantcontact.com)

2. Email their abstract to Katie Bohocky, SEAW Executive Director at: *Info@SEAW.org*
3. Include a hi-res business head-shot jpeg file and brief bio with the abstract.

Speakers will be notified of abstract acceptance by February 1st, 2023.

Certificate in Structural Engineering Program

Shannon Remillong,
CSE Program
Co-ordinator

Courses return to UBC Robson & Live Webcast January 2023!

We look forward to welcoming students into the classroom at UBC Robson Square this January, while simultaneously offering the online format.

Registration is NOW OPEN through the SEABC website: seabc.ca/certificate-program

Six courses will be offered with classes running ***Tuesdays through Thursdays*** from **4:00-6:00pm** and **6:30-8:30pm**, beginning the week of January 10th and ending the week of April 6, 2023.

Four of the six courses will be online format ONLY, while the remaining two will be both online and in-person simultaneously.

The following courses will be offered in the January 2023 term:

- **C1** Analytical Methods in Structural Engineering (ONLINE only)
- **C4-2** Advanced Concepts in Earthquake Engineering & Seismicity (ONLINE only)
- **C11** Timber Design of Light Res/Comm. Buildings (ONLINE only)
- **C50** Highway Bridge Design Loadings and Load Ratings
- **E12** Design of Steel Structures for Seismic Resistance
- **E13** Computer Software Applications in Structural Engineering **(On-line only)**

Outlines for the six courses are available on the SEABC website and Classbit:

seabc.ca/certificate-program

Course delivery:

- Three courses will be offered LIVE webcast; select courses will be simultaneously offered in-person at the UBC Robson campus.
- Courses are once a week, 2 hours in the evening, either 4:00-6:00pm or 6:30-8:30pm PST.
- Courses are 13 consecutive weeks.

Course fees:

- Classroom: $500 + GST
- Live Webcast: $700 + GST

Discounts

- SEABC members: $50 per course reduction in tuition.
- "Early Bird" registration: $50 per course reduction in tuition for registrations received and mail-in cheques postmarked on or by Friday, December 16, 2022.

Important Dates:

Registration open: Monday, November 7, 2022

Early-bird deadline: Friday, December 16, 2022

Registration close: Monday, January 9, 2023

First lecture: Week of Tuesday, January 10, 2023

Last lecture: Week of Tuesday, April 4, 2023

Withdrawal Deadline: Monday, January 23, 2023

Courses fill up fast so make sure to register early and take advantage of the savings!

Registration Inquiries and Requests/Suggestions: Please contact Shannon Remillong, Certificate Program Administrative Assistant, at email: courses@seabc.ca

2022 Structural Awards

David Harvey, P.Eng.
Struct.Eng

Hot off the press! The Institution of Structural Engineers has just announced the winners of this year's prestigious competition. The judging panel of 24 world-class structural engineers (including Fast + Epp President, Paul Fast) was faced with the unenviable task of teasing out the winners from a record number of top-drawer projects from across the world. And as in several previous years, there was a BC project in the list of winners- congratulations! New this year was the submission of entries without category, instead, all entries were judged on these four attributes:

People - Projects that have had a positive impact on local communities through creative problem solving or transferring knowledge or skills may also be considered here. The judges will be looking to understand how the project benefits its end users and society more widely.

Planet - Circular economy principles and alignment with the United Nations Sustainable Development Goals are also considered here. All entries must quantify the embodied carbon footprint of the structure (not the whole project) using the IStructE carbon calculator tool.

Process - If your project is technically challenging, innovative, or the brief has been influenced to achieve or enhance desired outcomes, it may be considered against this attribute. Likewise, original solutions; application of new and improved technologies and processes in the structural design. Innovations resulting in greater efficiency and economy in the solution are particularly welcome. Appreciation of craft and artistry are also considered here.

Profession - If your project or project team has inspired others, raised standards of design and execution, or maybe enhanced the reputation it may be considered here. If novel materials or technologies have been used, how will the wider profession benefit from your experiences? Disseminating the design, sharing knowledge with others outside of the immediate project team; or using learnings educationally are reviewed against this attribute.

A notable shift in the shortlisted and winning projects resulted, with more focus on small projects, sustainability, repurposing and renewal. The impression created is that the Structural Awards are more relevant to today's practices, and more accessible; however, to be shortlisted, a project will need to be of a very high standard – well crafted, with some novel aspects. And for the second year in a row, there were two supreme award winners, as the judges were unable to separate them in the voting. When I read the project descriptions and achievements, I could see how two markedly different projects could tie.

I enjoyed reading the attributes of each of the ten winning projects – particularly the supreme award winners. For the Hylo project, a 13-storey building was built on top of an existing 16-story building, and by infilling an atrium, the leasable space was doubled. Only essential strengthening work was carried out on the existing structure. This remarkable achievement was achieved with a very low carbon content.

The Ark Gymnasium is a complete contrast, being a brand-new facility, showcasing structural bamboo. Built entirely from local materials by a master craftsman, the Ark is a creative demonstration of artistry and technology, aimed at achieving net zero construction. What caught my eye was the way the bamboo arches featured in the roof shaping. The arches were arranged to replicate the branch patterns in the palm trees surrounding the gymnasium – a clever way for the new structure to harmonize with its environment.

To read up on these amazing short-listed and winning projects, go to this link:

2022- The Institution of Structural Engineers (istructe.org)

List of Winning Projects

Supreme Award Winner – Hylo. A transformative retrofit project providing modern workspace and affordable housing on the fringe of the City of London.

Structural Designer – AKT II

Location - London, UK

Supreme Award Winner- The Arc, Green School. This school gymnasium in Bali is an ambitious demonstration of the structural use of bamboo, utilising the material's unique combination of strength and flexibility.

Structural Designer – Atelier One

Location – Bali, Indonesia

2022 Winner- 1 Triton Square

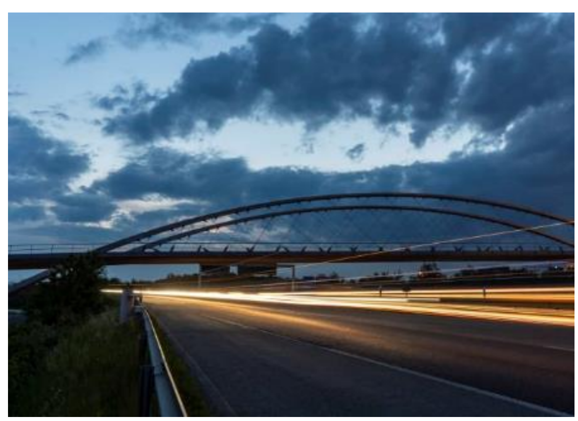
Structural Designer – Arup

Location – London UK

2022 Winner – Rankine Brown Library

Structural Designer – Beca

Location – Wellington, New Zealand



2022 Winner- Stadtbahnbrücke

Structural Designer- Schlaich Bergermann Partner

Location- Stuttgart, Germany

2022 Winner – The Gramophone Works

Structural Designer – Heyne Tillett Steel

Location – London, UK

2022 Winner – Expo 2020 Dubai Sunshades

Structural Designer – Webb Yates Engineers

Location – Dubai, United Arab Emirates

2022 Winner – Tianfu Agricultural Expo Main Hall

Structural Designer – StructureCraft and China Architecture Design and Research Group

Location – Chengdu, China

2022 Winner – United Nations New Office Building

Structural Designer – Skidmore, Owings & Merrill (SOM) and INGENI INGENIERIE STRUCTURALE

Location – Geneva, Switzerland

2022 Winner – London South Bank University – London Road Building

Structural Designer – Eckersley O'Callaghan

Location – London, UK

Opinion

Editorial Comment

We were delighted to receive an opinion piece recently from member Robert Wills on a subject that Robert holds dear. Robert is deeply concerned on the apparent divergence of requirements under BCBC for Part 4 and Part 9 structures, as well as workmanship standards. In his article, Robert states his view on where the Part 9 building requirements should be changed. He urges us to consider each item and state our opinion when the proposed changes are released for public comment.

Robert has agreed to his opinion being published and we are pleased to do so. SEABC strives for balanced reporting and sought out a complementary viewpoint to publish alongside Robert's. We were very pleased when SEABC Director, Professor Perry Adebar stepped forward and presented his take on what has motivated these proposed changes.

In Perry's view, the proposed changes improve the picture for Part 9 buildings as they reflect the improved knowledge that is now available in the lateral design of wood-frame structures. Perry acknowledges that the Part 9 seismic hazard is out of step with NBC 2020, but points out that this misalignment is temporary, and will be corrected by a second planned mid-cycle code update.

We thank both Robert and Perry for bringing this important matter to our attention and for taking the time to prepare their contributions. We urge you to read the articles that follow.

Note that if you are passionate about some aspect of structural engineering and would like to share your views with us, we urge you to submit an article for publication in the SEABC Newsletter.

Part 9 Housing: Caveat Emptor – Buyer Beware

Robert Wills, P.Eng.

Struct. Eng.

During the past five years I have been intimately involved with large buildings up to 600 sq. m. footprint as allowed by the current NBCC Part 9 2015. In low seismic zones, including Yukon, a major deficiency exists in that buildings are NOT required to have any walls whatsoever, other than what may be left over after all windows and doors are placed. Lateral resistance to wind and earthquake through a competent load path is often negligible and local AHJs admit they have NO authority to question the building code and demand safer buildings. Professional Engineers have helped in the past, when asked. I summarize the proposed changes to Part 9 for BCBC 2023, with noted issues as follows:

1. Design to only 50% of climatic wind and seismic data: shake table tests with equal lengths of wood-clad shear panels and gypsum-clad shear panels show excess capacity over theoretical capacity from non-structural walls, cupboards, door and window lintel frame action and wood siding. Unfortunately, open concepts in some large and small homes may have none of these heavily relied-upon features for lateral restraint. A Part 9 design EQ level of 10 in 50 years is substantially lower than the Part 4 design standard of 2% in 50 years, creating increased liability for any Professional Engineers designing components or attempting to confirm general Part 9 compliance for a municipal AHJ. Workmanship also varies wildly.

2. Shear panels are tabulated in Part 9 to be modified upwards and downwards depending on heavy construction or building size other than standard 7600 mm square. It is misleading to suggest only two studs with

a spacer could be a shearwall or suggest accuracy to the nearest 10mm.

3. Keep minimum 600 mm wide shear panel returns but without doubling of end studs for direct hold-downs. Allow Rd-2.0 R0=1.7 for gypsum shear panels, but without blocking. Do not require a dedicated continuous load path floor to floor to floor as for engineered buildings.

4. Maintain anchorage to concrete foundations 300 mm from a panel end, at centre of a 600mm return from a side wall. This is very poor if one return restrains a whole house from collapse!

5. Allow 100% GYPSUM WALLS in low seismic zones Smax<0.47 and q 1/50 < 0.6 kPa up to 600 sq.m. footprint. Three stories at 3.1 m height plus 2 m crawlspace plus 8 m sloped roof height to 20 m total building height possible versus common 10 m zoning height.

6. Allow unlimited amounts of unblocked gypsum walls in high seismic zones without a prescriptive minimum amount of traditional wood-clad shear panels. Widths sufficient to withstand shear and overturning forces are not required. Accompanying dead weight not required for stability.

Discussion:

The increasing disparity between Part 9 and Part 4 of the National Building Code of Canada is unacceptable and dangerous in my opinion. Although it is necessary to implement a minimum requirement in BCBC 2023 that residential and commercial buildings up to 600 sq.m. footprint should have SOME walls to resist lateral loads, it is unacceptable to reduce building resiliency and established minimum percentages of wood sheathed walls in moderate and high seismic zones, avoid hold-downs and not check foundation weight for stability. In Yukon, cribbing and strip foundations are used with NO concrete basement walls of any height for stability.

Climate change is leading to increased occurrence of localized extremes and requires more ductile buildings, not less ductile and more susceptible buildings.

Long multi-tenant buildings up to 60 m in lengths should be constructed with **rated interior wood-sheathed walls for safety**, not just exterior wood sheathed end walls 4 to 6 building lots apart and unrated gypsum firewall separations between units. Slender floor diaphragms 6:1 cannot deliver load to stiffer end walls from weaker interior walls. Furthermore, interior walls do not get sheathed until all building services are complete, sometimes 6 to 12 months later.

Inland Canada may construct residential buildings with exterior rigid insulation sheathing only, combined with interior gypsum sheathing only. This anomaly will need to be tempered with SOME durable wood-sheathed shear panels for safe construction. Extreme events such as falling trees, vehicle impact and loss of ground during flooding would likely cause collapse. Prolonged wetting of interior gypsum walls during overland flooding and prolonged immersion may also result in complete loss of gypsum lateral load capacity. Atmospheric river storms in BC highlighted this danger recently for houses and businesses with walls soaked for many months.

My professional observation over the past five years has been to note many deficient buildings relying on inadequate stapling of narrow wood clad panels and interior gypsum only walls of negligible capacity. Narrow duplex and triplex units on common building lots often have no exterior walls (just windows) and an interior gypsum wall, transverse beneath the stairs, proves inadequate to resist lateral loads, within even the lowest seismic category. AHJs feel helpless.

I do hope professional members may consider the proposed changes to **Part 9 NBCC and BCBC 2023** to be aware of the consequences of possible weaker, less resilient residential construction in all seismic zones in the future. I further hope that municipal AHJs do NOT embrace the proposed Part 9 section alone, with its dangerous safety flaws, to supersede the current practice of requesting reliable Part 4 NBCC design with professional field review. Please review the proposed changes to 2023 BCBC Part 9 when released for public comment and express any concerns you may have with regards to resiliency and safety.

Updates to NBC 2020 for Seismic Design of Housing and Small Buildings (Part 9)

Perry Adebar, PhD, PEng
Professor of Structural Engineering, UBC Chair, Standing Committee on Earthquake Design
Director of SEABC

Two important updates related to the Seismic Design of Housing and Small Buildings (Part 9) are expected to be published in 2023, as mid-cycle updates to NBC 2020, once they complete the formal approval process. The updates are being hailed as significant improvements by most structural engineers and were endorsed by the Standing Committee on Earthquake Design (SC-ED), which writes the seismic design provisions in Part 4 of NBC.

Developing seismic design provisions for Part 9 buildings is a surprisingly challenging task. While it is necessary to have simple prescriptive procedures that result in affordable housing, the provisions must also be sufficiently grounded in rational engineering principles to provide safe solutions for the more complex building archetypes that fit within the scope of Part 9.

A Joint Task Group on 'Lateral Loads (Seismic and Wind) – Part 9', with membership from the Standing Committee on Housing and Small Buildings and the Standing Committee on Earthquake Design, as well as invited experts, has done a lot of work in recent years to improve the provisions in NBC. The work was not completed in time to update NBC for the 2020 edition, and when the seismic hazard values in NBC increased significantly across most of Canada in the 2020 edition, it was decided that Part 9 of NBC 2020 would continue to use the seismic hazard values given in NBC 2015.

The Joint Task Group on Lateral Loads continued to work hard to develop new provisions for Part 9, and while there is still more work that could be done (and perhaps always will be), there is a strong consensus that what is proposed will be a substantial improvement over what is currently given in Part 9 of NBC 2020. The new provisions offer a significant improvement in affordability in high seismic and high wind locations due to the more efficient determination of braced wall lengths and the increased flexibility of wall construction types. A coordinated second mid-cycle update will change the seismic hazard values for Part 9 to the same values used in Part 4 of NBC 2020. Realigning the seismic hazard values in the two parts of NBC is a laudable outcome. The new provisions also provide lateral bracing requirements for all locations in Canada, in proportion to the wind and seismic loads, which provides for a more uniform level of risk for all locations in Canada and provides AHJ's with minimum requirements they can enforce in low seismic and wind zones, rather than the current absence of requirements in those areas.

The remaining paragraphs present responses to the specific issues raised by Robert Wills. The information presented below was provided by the Structural Engineers at the Canadian Wood Council who were intimately involved in the development of the proposed provisions for lateral loads (seismic and wind) in Part 9 of NBC. Anyone wanting further information about the upcoming changes to Part 9 of NBC or clarification of any information presented below is encouraged to contact Robert Jonkman, P.Eng., Vice President, Codes and Engineering at Canadian Wood Council.

The proposed provisions use a calibrated engineering approach, based on CSA O86, NBC Part 4; but with some exceptions based on decades of performance history relevant to Part 9-sized buildings. Several key assumptions are shared with the methodology used in the International Residential Code (IRC) in the US, including the 50% load redistribution to non-bracing elements (e.g., stairways, perpendicular walls, corner effects on sheathing). The maximum spacing between braced wall bands and placement requirements help to ensure the underlying assumptions are appropriate.

Additionally, modification factors play an important role – the 50% resisted by bracing elements is the bare minimum when features of a building provide the expected redundancies, and modification factors can bring this up to 100%. A benchmarking exercise showed that the proposed provisions give very similar braced wall lengths as the prescriptive solution in IRC for similar wall types and loads.

The minimum total braced wall lengths that are presented in tables are prior to the adjustments for various factors, which can significantly increase the required length. The unadjusted lengths given in the tables include several small values when the lateral loads are small for a particular wall type. It is important to remember that each section of wall must also comply with minimum lengths, which are unchanged from NBC 2010 – 600 mm for wood-sheathed panels at intersections and ends, 750 mm for wood-sheathed panels elsewhere, and 1200 mm for gypsum or diagonal lumber sheathed panels.

Part 9 buildings are usually constructed with a minimum of two studs at openings and three studs at corners. The lack of hold-downs is accounted for by a reduction in resistance for the higher-capacity wood-sheathed walls. The proposed provisions also include additional fastening requirements where braced wall panels intersect.

Anchorage to the foundation requires at least two anchor bolts for each section of braced wall panel. The anchors must be within a certain distance from edges of the panel or foundation as applicable and the intermediate spacing is controlled by capacity of the wall type.

No changes were made to the continuous load path requirements compared to NBC 2010. Braced wall bands are required to be stacked around the building and within the interior, and only minor offsets are permitted as per standard practise for decades. Part 9 has other provisions for ensuring gravity loads have a continuous load path.

The use of gypsum board braced wall panels is new compared to the earlier code editions and was introduced to increase affordability. Gypsum braced walls are unlikely to be used in a high seismic area because of the very long length of wall that would be required; however, where the lateral loads are smaller, it may be possible to have a sufficiently long length of uninterrupted braced wall panels so that wood sheathing would not be required.

A review of test data shows that the shear values assigned to gypsum wall panels are fully applicable to unblocked assemblies.

IStructE Exam Training Resources

David Harvey, P.Eng.
Struct.Eng

For those of you studying to sit the IStructE Chartered Membership Exam, now is an excellent time to hone your exam technique. Many people study by reviewing past papers and the Examiners Report which are published by IStructE. To do so, look no further than the SEABC website which contains more study material than any other site. SEABC has exam papers and reports dating from 1990 and also contains archived possible solutions prepared by experienced designers demonstrating suitable exam techniques.

We recently uploaded the exam papers up to September 2020, and the Examiners Reports up to January 2020.

Check out: seabc.ca/resources

Candidates seeking exam guidance can find details here:

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Date: Wednesday December 7, 2022
Location: Zoom Webinar
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Date: Monday March 6, 2023
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Date: June 25 – July 1, 2023
Location: Sheraton Wall Centre, 1088 Burrard St, Vancouver, BC, V6Z 2R9
For more info: Please check your emails in the coming weeks for more information regarding the conference.

Final Words

Editorial Information

The SEABC Newsletter is published by the Structural Engineers Association of British Columbia. The current and past issues are available on the SEABC website at www.seabc.ca.

The Newsletter is edited and managed by the SEABC Communications Committee.

- Committee Chair: David Harvey
- Newsletter Editor: Catherine Porter
- Editorial Assistant: Mark Budd
- Webmaster: Ricardo Ruiz

Submissions are welcomed and all SEABC members are encouraged to actively contribute to the Newsletter. Submissions, letters to the Editor, questions and comments can be sent to: newsletter@seabc.ca.

The Committee reserves the right to include or exclude submitted material and in some cases, edit submitted material to suit overall space requirements. If content is not to be edited, please advise so at submission time.

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Structural Awards 2022

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Structural Awards 2022

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Supreme Award winners

The Structural Awards 2022 – a new approach for a new era

This has been a particularly exciting year for The Structural Awards, with the introduction of a completely new format leading to a brilliant spread of winners. Tim Ibell (Chair of the Judging Panel) and Will Arnold (IStructE Head of Climate Action, and Judging Panel Member) reflect on the changes, most notably in response to the Institution's ongoing commitment to climate action.

The structural engineering industry is continually evolving, and so in 2021 the Institution set up a task group to undertake a review of the format of The Structural Awards, with the aim of better reflecting the Institution's vision and values. The backdrop was the equal footing on which the Institution has placed structural safety and sustainability.

Following this review, the task group made two significant changes to strengthen and enrichen the awards.

First, there are no longer entry categories – the awards have been decategorised. This was done because, under categories, the judges were required to choose just one winner from each (no matter how many award-worthy projects are entered into it), and had to overlook entries that fell between categories.

Decategorisation makes the awards more inclusive and fairer, as it enables a wider pool of entrants and a more diverse range of great engineering to be celebrated, as demonstrated by the shortlisting of projects such as the People's Pavilion and the Folkestone 51 skatepark (Figure 1).

Second, the task group then set out a definition for great engineering. We developed four key attributes: People, Planet, Process and Profession (Figure 2); four areas that all engineers should aspire to excel in, across all of their projects. More information on these can be found at www.istructe.org/structural-awards/shortlist/new-criteria/.

Entrants had to outline their project's excellence in reference to at least one of these four attributes; although demonstrating greatness across multiple attributes did not automatically increase the chances of shortlisting.

We believe that decategorisation and a focus on our four attributes of great engineering enabled entrants and judges to focus on what is most important.

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↓FIGURE 1: Shortlisted projects such as the People's Pavilion or Folkestone 51 might not have found a place in the categories of past years

'Planet' attribute

Only one of the four attributes was compulsory for entrants to respond to: Planet. Since 2019, the Institution has treated sustainability on a par with life safety, and in the same way that we would not expect an unsafe structure to be entered into the awards, we would also not expect to receive an entry in which the engineers were not able to demonstrate an understanding of the sustainability implications of their scheme.

We asked 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 were required to submit quantification of the embodied carbon footprint of the structure using a version of The Structural Carbon Tool that we provided.

What was interesting to discover was that in demonstrating excellence in this category, entrants were typically also able to demonstrate excellence in another – highlighting the increased ability to reduce the environmental impact of a structure when designing for societal benefit, utilising exemplar engineering processes, and sharing as part of the wider engineering community.

Shortlisting

Each judge was allocated a 'random' set of submissions to consider, with any conflicts of interest being eradicated at this early stage. Every submission was initially read by five judges. Each judge was asked the simple question for each submission: Can excellence be found in any of the four attributes? If the answer was yes, then that project would be earmarked by that judge for shortlisting.

On average, it turned out that each judge recommended about half a dozen projects for shortlisting from their personal list of around 20 projects. This allowed the first judging meeting to concentrate discussion on projects which received recommendations for shortlisting, and to create a final shortlist. In the end, we had a list of 41 projects which the judges felt exhibited excellence.

As part of the shortlisting process, the judges considered the self-reported carbon footprint of the projects in addition to reviewing the entrant's insights across the attributes that they chose to describe. As the carbon footprint numbers were self-reported, the numbers were only treated as indicative of climate impact, but they enabled the judges to gain a general insight to the impact of the submitted projects.

The indicative nature of the self-reported numbers also means that the numbers and the SCORS ratings will not be shared for any of the entrants.

However, this information meant that, for the first time ever, the judges understood each project's environmental impact alongside its technical prowess. Several projects with notably high carbon footprints, even allowing for inaccuracies in specific carbon quantities, were removed from the shortlist as the judging panel felt that the 'value for carbon' of these projects could not be justified. This step felt transformative to the judges, unanimously.

Out of the 41 shortlisted projects, about half achieved a SCORS C-rating or better, meaning that they had carbon footprints less than 250kgCO_2e/m^2 – a number 30% lower than the 'business as usual average' reported by Arnold *et al.*[1], and work undertaken by IStructE, LETI and RIBA to review a set of industry targets in 2021[2].

Winners

All unconflicted judges proceeded to consider the shortlisted projects at the finalists' meeting, looking for excellence in structural design through reference to the four attributes. There were no quotas for any of the attributes in any sense. The judges were asked to identify what was truly outstanding about potential winners and to vote for these projects through explicit reference to at least one key attribute. Usefulness to users, ingenuity of design, advocacy of our profession, collaboration and co-creation, and stretching as thinly as possible the precious use of carbon – these and more were discussed at length until the judging panel had settled on their winning projects, of which there were 10 this year.

The judges never chose winners purely based on their carbon footprint, but it was clear where engineers were touching the ground lightly. This was inevitably reflected in the projects chosen as the eventual award winners for 2022, with five out of the 10 award winners declaring a SCORS A-rating or better.

An A-rating on SCORS equates to A1–A5 upfront embodied carbon emissions (across the superstructure plus substructure) of less than 150kgCO_2e/m^2, less than half of the business-as-usual average referenced above. This is also in the range of what the average structural design is required to exhibit in 2030 if the structural engineering community is to play its part in helping the world stay below 1.5°C global warming[1].

It's also worth reflecting on the prevalence of reuse and retrofit projects among this year's award winners – five of the 10 projects. This came from a recognition of the fact that creative reuse of existing structures will play a key role in reducing emissions – particularly in the richer, more damaging countries of the world which already have an abundance of existing buildings and infrastructure.

Supreme Award

One of the most difficult decisions each year is choosing the winner of the Supreme Award. It is a cliché, but it really always is a nearly impossible decision. And it was no different this year. So, what are the additional things we look for which elevate a project from a winner to a Supreme winner?

The Supreme winner must have a message for all structural engineers. It must say, 'So, this really is indeed possible to achieve, after all.' This year, we have chosen two Supreme Award winners. It isn't becoming a habit, despite this being the second year in a row that we have awarded two. The judges genuinely had a perfect split-vote tie in their deliberations.

One project oozed creative biomimetic innovation using local material (bamboo in this case), while the other demonstrated how far retrofit can go when we extract every ounce from the existing structure. Both pushed the boundaries in different ways, and both provide inspiration for our community, particularly in showing how the value of the structural engineer can be enhanced still further when engaged at the very earliest stage.

Looking to the future

While the judges may have been looking at this year's awards entries in a new light compared with previous years, we recognise that most entries to the awards were designed during the late 2010s, when the term 'climate emergency' wasn't even in the common lexicon. We expect to see the trend towards thinking about our work in terms of positive outcomes on society and the environment flourish in coming years, as we start to see more and more entries that were conceived and designed in the 2020s.

We look forward to celebrating structural engineers playing a core role in collaborative design for societal benefit, unlocking the abundance of what is already present through a focus on place and reuse, and utilising our unique set of skills to leave a positive impact on the environment and all living things.

FIGURE 2: Four attributes for the new-look Structural Awards

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Judging panel

Chairman

Prof. Tim Ibell

Tim was President of the Institution of Structural Engineers in 2015, and is a Fellow of the Royal Academy of Engineering. He has a passion for celebrating creativity within our profession, and for using this creativity to inspire students.

Tim has been Professor of Structural Engineering at the University of Bath since 2003, including a year's interlude as the Sir Kirby Laing Professor of Civil Engineering at the University of Cambridge in 2017/18.

Will Arnold

As Head of Climate Action, 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 emergency guidance. Prior to his current role, he was a practising structural engineer at Arup for over 10 years, where he was responsible for key aspects of ambitious architectural projects across the world from the UK to Taiwan and Rwanda.

Will is Chair of the CIC's 2050 Group, and helps lead the Institution's Climate Emergency Task Group. In 2017, he was presented with the Institution's Young Structural Engineering Professional Award for his design work while at Arup.

Louisa Brown

Louisa is a Senior Structural Engineer at Arup in Amsterdam with over 10 years' experience in the UK and Europe. Working predominantly within the healthcare, science and industry sectors, she has built up expertise in delivering functional specialist buildings in an efficient and sustainable way.

Louisa is a chartered structural engineer and an active member of the Institution of Structural Engineers as a member of the Technical Products Panel and former Council member and Young Members Panel Chair.

Dr Michael 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 well known in the industry for his significant contribution to designing innovative buildings. Mike is a former Vice-President of the Institution and is now Chair of its Climate Emergency Task Group. He was awarded the Institution's Gold Medal in 2020.

In 2009, Mike received the IABSE Milne Medal for his contribution to structural design, and in 2017 he received an honorary Doctorate of Engineering from the University of Bath. He is a Fellow of the Royal Academy of Engineering and Adjunct Professor of Creative Design in the Department of Civil Engineering at Imperial College, London.

Kayin Dawoodi

Kayin is co-lead of Tyréns Sweden's Concept Design Department, championing creative design collaboration and education. Prior to moving to Sweden, he worked at Arup for close to 10 years. He has a background in architectural and structural design of unusual design-led projects worldwide as well as connections at leading universities.

He is the current IStructE Representative in Sweden, co-founded the Bridges to Prosperity UK Charitable Trust and was the 2014 winner of the Young Structural Engineering Professional Award.

Prof. Jiemin Ding

Professor Ding is the Chief Engineer of Tongji Architectural Design (Group) Co., Ltd. Throughout his career, he has demonstrated dedication to excellence in structural engineering design. Professor Ding specialises in steel structures, super-high-rise buildings and long-span complex structural systems.

He has completed the structural design for more than 10 high-rise buildings above 250m and more than 80 sports buildings. Professor Ding is a council member of the Institution of Structural Engineers and he was awarded the IStructE Gold Medal in 2018.

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.

He founded international bridge designers Knight Architects in 2006 and his practice has completed more than 50 bridges in the UK and internationally, including the award-winning Merchant Square Bridge in London, the iconic Lower Hatea River Crossing in New Zealand, and the 270m-long Ulm Kienlesbergbrücke in Germany.

Eric Kwok

Eric is a Technical Director at Goldwave Steel Structure Engineering and is passionate about structural engineering. He received his professional training in the UK and has over 23 years of experience in major international practice. He is a chartered structural engineer and a Fellow of the IStructE, and has extensive design and construction experience across projects in Europe, the Middle East, the Americas, South East Asia and the PR of China.

His work includes the HZMB-Passenger Clearance Building roof structure. Other master works include: Wembley Stadium, Sutong Bridge, HAECO Hanger No. 3A, Marri Processing Plant, Olmsted Dam Development, KWH Hospital Steel Structure and Yuen Long Footbridges erection.

Michelle McDowell

Michelle is a Principal and Chair of Civil & Structural Engineering at BDP, with over 35 years' experience of design and delivery of many challenging, innovative and award-winning projects.

In 2010, Michelle was awarded an MBE for services to the construction industry. She is a fellow of the Royal Academy of Engineering and in 2011 was named Veuve Clicquot Business Woman of the Year. In 2012, she was named the ACE's Engineering Ambassador of the Year and in 2020 was given a Lifetime Achievement Award by Women in Construction and Engineering. She is currently leading the Palace of Westminster Restoration and Renewal project for BDP.

Toby Maclean

Toby is a structural engineer and 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.

Toby's career so far has been one based on providing practical yet technically sophisticated and holistic solutions to diverse projects in the built environment and concentrating on design from first principles. Having served a stint with Arup after graduation, Toby spent five years based in the studio of an architect/artist, before establishing TALL Engineers in 2005. After merging TALL with Entuitive in 2016, Toby remained as UK Director until leaving to concentrate on Allt.

Dr Andrew Minson

Andrew is Director of Concrete and Sustainable Construction at the Global Cement and Concrete Association. He is currently chair of the Design Practice, Risk and Structural Safety Committee of the Institution of Structural Engineers and a member of the Engineering Leadership Group.

He had 10 years with Arup in building engineering where he worked in multidisciplinary teams on international projects, before 14 years leading The Concrete Centre in the UK.

Angeliki Palla

Angeliki Palla is a Structural Engineer at O'Connor Sutton Cronin (OCSC). Originally from Greece, she studied Civil Engineering at the National Technical University of Athens, before completing postgraduate studies in General Structural Engineering at Imperial College, London.

She began at OCSC in 2017 and has played an integral part in residential and commercial projects. Angeliki is an active member of the Institution, former Chair of our Young Members Panel and a STEM Ambassador.

Paul Fast

Since establishing his own structural engineering consultancy in 1985, Paul Fast has worked on iconic buildings in North America, Europe, Asia and the Middle East.

With offices in Frankfurt, New York, Seattle and Vancouver, his firm has become a leader in the design of hybrid structures, which include the Grandview Heights Aquatic Centre, winner of the 2016 Supreme Award, the 18-storey TallWood House at the University of British Columbia, and the 2010 Richmond Olympic Oval.

Paul was the recipient of the 2021 Gold Medal, the IStructE's highest accolade.

Ian Firth

Ian is a leading expert in bridge design and construction. During his career he has been involved with world-famous bridge projects like the strengthening of the Severn Bridge, Erskine Bridge and West Gate Bridge, and the concept design of Stonecutters' Bridge in Hong Kong, as well as many smaller pedestrian bridges such as the Inner Harbour Bridge in Copenhagen, Taplow Bridge near Maidenhead and the Sail Bridge in Swansea.

Ian is also a leading advocate of bridge-building charity Bridges to Prosperity and a Past President of the Institution of Structural Engineers.

Tanya de Hoog

Tanya is a founding director of Thornton Tomasetti's London office. Her professional experience spans Europe, the Middle East, Southeast Asia and Australia, where she has worked on a diverse range of projects that focus on engineering creativity and innovation with an intent to foster good design.

Celebrating the contribution structural engineering can make to society, promoting continued education and the application of sound engineering principles to emerging technologies are of significant importance to Tanya.

Susan Giahi-Broadbent

Susan is a Senior Divisional Director working with Jacobs since 2016. She is a chartered engineer, Fellow of the Institution of Structural Engineers and the Chartered Institution of Highways & Transportation. She is an active member of both institutions, contributing to councils, committees and panels.

Susan has accumulated three decades of technical expertise and leadership roles on a variety of challenging high-profile infrastructure and building projects in the UK, Asia and Africa. The majority of her work over recent years has involved multidisciplinary transportation schemes with more focus on bridges.

Tristram Hope

Tristram is a chartered structural engineer and Fellow of the Institution of Structural Engineers, with 35 years of experience in multidisciplinary building engineering design and management, having worked with several of the UK's leading practices, including BDP, Buro Happold and Arup. He is Founder and Director of independent construction consultancy Thisolutions Ltd, where he works with a wide variety of clients, principally in investigative and advisory roles.

Tristram chairs the Industrial Advisory Board for the Department of Civil and Structural Engineering at the University of Sheffield.

Dr Katherine Ibbotson

Kat is Director for WSP in the UK's Strategic Advisory Net Zero team. With over 10 years' experience in leading carbon reduction strategies and net-zero services within infrastructure, Kat's net-zero leadership and experience is rooted in taking a holistic approach to complex systems, bridging the gap between policy and embedding practical action, facilitating and enabling the connections across sectors and technical disciplines.

Kat has supported clients across several sectors, delivering a variety of services from infrastructure resilience and net-zero transformation, through to target setting and quantification, whole-life carbon management, assurance, and review.

Sam Price

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

He has advised on a number of cathedrals, and is a member of the Cathedral Architects Association. He has lectured at Cambridge, Glasgow, Trieste, Bergen, Hong Kong, and Vancouver. He was for 12 years a member of the Architectural Panel of the National Trust.

Roger Ridsdill Smith

Roger is the Head of the Structural Engineering team at Foster + Partners. He is a Fellow of the Institution of Structural Engineers and a licensed Professional Engineer and Structural Engineer in the USA.

He was awarded the Royal Academy of Engineering Silver Medal in 2010, and the IABSE Milne Medal in 2017.

Nick Russell

Nick is a Consultant at Perega, an 80-strong consulting organisation specialising in civil and structural engineering, glass engineering and building surveying. His extensive experience spans many sectors, including expert witness, commercial, retail, industrial, education, residential and major losses. Nick's primary role at Perega is in advising on training of staff.

Nick has a passion for conceptual design and in making structures as effective as possible. He is a Past President of the IStructE and a Fellow of the Institution of Civil Engineers and the American Society of Civil Engineers. He also holds visiting professorships at the universities of East London and Surrey and is immediate past chair of the Joint Board of Moderators.

Kristina Scheibler-Frood

Kristina is a Chartered Civil and Structural Engineer at AECOM working in the London structures team. Over the last eight years she has been involved in the design and construction stages of major projects, specialising in retained facades, listed buildings and deep basements. Projects have included No 1 Palace Street, a luxury residential development and North West Cambridge, a highly sustainable new suburb of Cambridge.

Kristina is also committed to engaging with students of all ages and the wider community to promote the engineering industry. In recognition of her work, Kristina was awarded the IStructE's Young Structural Engineering Professional Award 2019.

SawTeen See

President of See Robertson Structural Engineers SawTeen See is President of See Robertson Structural Engineers and provides consulting design services; she is partly retired.

SawTeen was the Managing Partner of Leslie E. Robertson Associates (LERA) from 1991 to 2017. She has extensive experience in the structural design of the full spectrum of building types, with particular expertise in tall building design and long-span structures. SawTeen was the partner-in-charge of the structural engineering of iconic structures including the Shanghai World Financial Center, the Lotte World Tower in Seoul and the Merdeka PNB 118 Tower, Kuala Lumpur.

Peter Terrell

Peter is Chairman of the Board of the Institution of Structural Engineers. He is founder and President of Terrell Group Consulting Engineers. After early years with Ove Arup, Peter set up as sole practitioner in 1982 in Paris, building a practice that is today recognised as one of the leading structural engineering consultancies in France, with over 100 employees.

He has been at the forefront of many successful projects, including the Doha Tower (CTBUH Best Tall Building Worldwide 2012) and the DR Byen Concert Hall in Copenhagen.

Location London, UK

1 Triton Square

Awarded for: Showcasing the power of circular economy principles across all aspects of a project.

PROJECT TEAM

- **Structural designer:** Arup
- **Client:** British Land
- **Principal contractor:** Lendlease
- **Architect:** Arup

IN BRIEF…

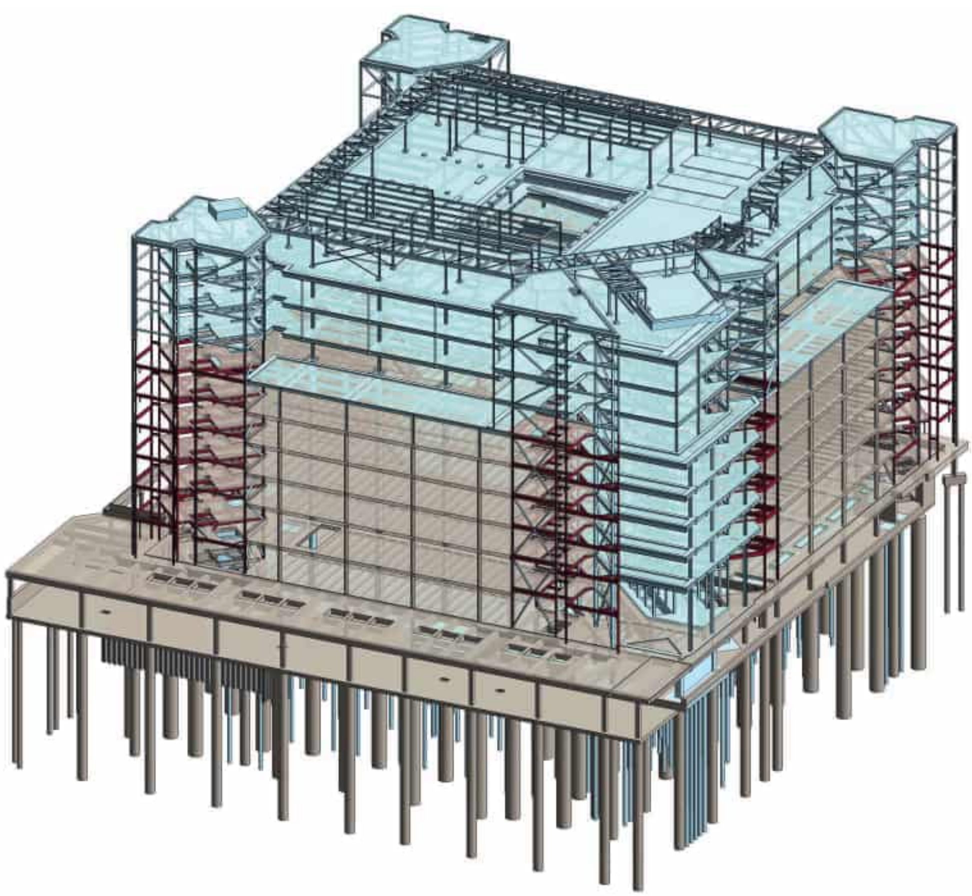
- The client and design team saw the potential to increase this 1990s building's size and transform it for today's workstyles – opting for refurbishment to save time, money and carbon.
- The original 1990s scheme was a 72m × 72m square building with six storeys above ground and a single-storey basement, following a 9m × 9m grid.
- The new scheme involved extensive modifications to the existing structure, including part in-filling the central and entrance atria and adding three new floors on top, resulting in a near doubling of the office area.
- As well as minimising the actions on the structure through lightweight new construction and optimised loading allowances, the new scheme introduced a range of innovative strengthening solutions to steel and concrete columns, stability elements and the existing piled foundations.

JUDGES' COMMENTS

An excellent project-wide approach to minimising carbon and negative impacts. The structural team adopted a comprehensive raft of measures and demonstrated a noteworthy willingness to minimise strengthening of the existing building through precise investigation and analysis.

As a result, the project is a valuable reference to the industry at large for reuse of buildings and the profession will benefit greatly from the lessons learned.

The completed building sets a benchmark for the environmental targets that can be reached now and improved upon in the future.



3D view showing proposed new structure in blue, existing structure in grey

Completed building sets benchmark for environmental targets

Find out more

Read more about this project in the March 2021 issue of *The Structural Engineer*: bit.ly/3fLBXpf

FRP-wrapped concrete column

Location Dubai, United Arab Emirates

Expo 2020 Dubai Sunshades

Awarded for: Innovative form-finding and detailing in response to complex environmental conditions.

PROJECT TEAM

- ➜ **Structural designer:** Webb Yates Engineers
- ➜ **Client:** Bureau Expo Dubai 2020
- ➜ **Principal contractor:** Pfeifer
- ➜ **Architect:** Hopkins Architects
- ➜ **Cost consultant and project manager:** Turner & Townsend
- ➜ **Main works contractor:** AFC
- ➜ **Wind tunnel testing:** RWDI
- ➜ **Mechanical engineering consultant:** Eadon
- ➜ **Programme management:** CH2MMace

IN BRIEF…

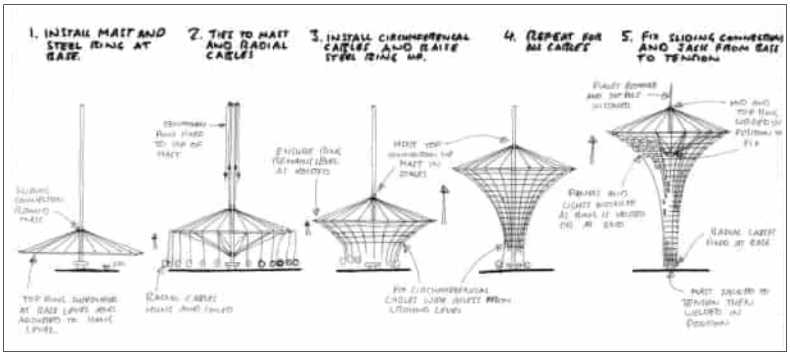
- →| Expo 2020 Dubai Sunshades comprises 50 shading structures on a small but visible site for the expo, which ran from October 2021 to March 2022.
- →| The structure was formed by suspending a thin steel cable-net from a steel mast and pulling it tight to the base. From this net, thin perforated aluminium panels were hung, carefully balanced to follow the shape of the net, and form the shading element of the structure.
- →| The cable-net was form-found and tensioned to create an efficient and stiff structure, meaning the panels pivot out of the way of strong winds, reducing the design wind pressure on the structure.
- →| The design called for an easy-to-install pivot that would be tolerant of repeated panel swinging when subjected to loads in various directions, panel flex, cable movement and wear over the structure's life.

JUDGES' COMMENTS

These simple and elegant structures served many aesthetic and practical functions and are beautifully detailed.

The rigorous testing, analysis and design of the aerodynamics of the swinging panels required high levels of analysis and wind-tunnel testing to investigate and understand wind effects. These complex dynamic issues were successfully dealt with, offering the benefit of dynamic analysis for future projects.

↑ Expo 2020 Sunshades viewed from below



↗ Construction sequence

↙ Panels were rigorously tested to understand wind effects

Location London, UK

HYLO

Awarded for: **Full exploitation of an existing structure to maximise retrofit potential.**

PROJECT TEAM

- ➔ **Structural designer:** AKT II
- ➔ **Client:** CIT Group
- ➔ **Principal contractor:** J Coffey Group and MACE
- ➔ **Architect:** Horden Cherry Lee
- ➔ **M&E consultant:** RHB Partners
- ➔ **Quantity surveyor:** Arcadis
- ➔ **Planning consultant:** DP9

IN BRIEF…

- →| HYLO absorbs and transforms the former mid-rise Finsbury Tower to become a modern, high-rise development; the existing building extends upwards by 70%, with 13 new storeys added to its existing 16 floors, and all while reusing its existing frame and foundations.
- →| A significant volume of concrete was saved through the substantial reuse of the existing structure. The site's leasable area doubled (from approx. 12 000 to 25 800m^2) while saving just over a third of the 'upfront' carbon (around 35%) in comparison with the equivalent new construction.
- →| In-depth finite-element modelling was performed on the existing structure, using a time-dependency analysis, to assess the structure at every stage of its lifecycle, from its original construction through to the proposed demolition, the new loading, and the long-term settlements and creep.
- →| The existing superstructure was enhanced with targeted column strengthening made of high-strength concrete, together with steel jacketing, to help minimise their required area within the tower's floorplates. The steel jackets are also exposed to form a striking interior feature.

JUDGES' COMMENTS

A highly intelligent, well-integrated retrofit-first extension of city office space. This project is a fantastic example of how we can meet the requirement for creating sustainable cities and communities.

Enormous amounts of works were required to carry out inspection, investigation and analysis of the condition of the existing building and, as a result, the existing structure and foundations could be utilised.

Through a granular analysis of the existing structure, most of the new loads were strategically directed into areas with spare capacity, allowing a minimal intervention of column strengthening and additional foundations. This saved around 35% in 'upfront' carbon when compared with an equivalent new build.

© FRITZIE MANOY/AKT II

↑ HYLO after project completion

© FRITZIE MANOY/AKT II

← Former mid-rise Finsbury Tower before project start

© AKT II

→ Targeted column strengthening using steel jackets

Location Wellington, New Zealand

Rankine Brown Library

Awarded for: A technically impressive and well-communicated response to save a public building after earthquake damage.

PROJECT TEAM

- **Structural designer:** Beca
- **Client:** Te Herenga Waka – Victoria University of Wellington
- **Principal contractor:** LT McGuinness
- **Architect:** Athfield Architects
- **Steelwork subcontractor:** MJH Engineering Ltd
- **Building services:** Beca
- **Quantity surveyor:** RLB
- **Fire engineering:** Holmes Fire

IN BRIEF...

- After New Zealand's Kaikōura earthquake (magnitude 7.8) an assessment of Te Herenga Waka – Victoria University of Wellington's 10-storey Rankine Brown library building was undertaken. The building's north and south lift shafts were noted as seriously damaged, with cracks easily big enough to fit a cricket ball.
- Prompt installation of temporary supports secured the damaged lift shafts as soon as possible after the main shake – further damage could have seen the building written off.
- Undertaking construction in an occupied building while supporting eight storeys of reinforced concrete lift shafts demanded a particularly innovative approach. The lift pits were widened to accommodate new steel-framed lift shafts supported on six super-low-friction slider bearings, which move laterally with the building while continuing to support gravity loads.
- Construction waste was minimised by reusing the temporary steelwork needle beams and temporary propping frames for the perimeter columns.

JUDGES' COMMENTS

Great pains have been taken to restore this library following earthquake damage and the efforts to justify the building through repairs and upgrade are admirable, providing enormous savings on the alternative of new construction.

The design implemented improvements beyond code requirements under severe working constraints as the library remained in use throughout.

There was impressive communication of the engineer's role in the process at a digestible level for everyone involved to understand. This communication of the complex works to building users throughout the project stands out as a good example of the importance of our profession: teamwork, communication, collaboration and responsiveness.

↑ Rankine Brown library remained open during post-earthquake repair works

↗ Damaged lift shafts during engineering inspection in hours after Kaikōura earthquake

↗ Left: shows construction of steel-framed lift shaft on six super-low-friction slider plates. Right: shows temporary supports removed and load transferred to permanent structure. Highlighted blue are temporary supports, red indicates permanent structure

Location Stuttgart, Germany

Stadtbahnbrücke

Awarded for: Research-informed innovation of novel high-performance materials.

PROJECT TEAM

- ➜ **Structural designer and architect:** schlaich bergermann partner
- ➜ **Client:** SSB Stuttgarter Straßenbahnen AG
- ➜ **Principal contractor:** Adam Hörnig Baugesellschaft mbH & Co. KG and MCE AG
- ➜ **Carbon hangers:** Carbo-Link AG and Fehraltdorf
- ➜ **Component testing and carbon expertise:** Empa (Federal Laboratories for Materials Testing and Research Institute)
- ➜ **Structural checking:** Consortium Nellingen
- ➜ **Geotechnical engineering:** VEES | PARTNER
- ➜ **Geotechnical reviewer:** Moormann Geotechnic Consult
- ➜ **Further cooperation:** Material Testing Institute

SBP – ANDREAS SCHNUBEL

↗ Stadtbahnbrücke in use

➜ Roll-in of network arch bridge

IN BRIEF…

→| A new double-track crossing of the A8 highway was built in an exposed elevated position. The light rail arch bridge, *Stadtbahnbrücke*, consists of a central main span and two approach spans. The main span is connected by an 80m network arch and two protruding truss frames, which continue the swing of the slender arches – the span between the footings is 107m.

→| The three most important design objectives were minimal disruption of traffic, an appealing design as well as a robust and long-lasting structure. The network arch bridge was chosen to ensure a subsequent 'roll-in' could be realised from the construction site beside the highway.

→| The light rail line features hangers made entirely of carbon-fibre polymer composite. The use of elaborate cushioning measures becomes unnecessary due to the higher tensile and fatigue strengths of carbon tension members, and couplings are no longer required.

→| The hangers are connected by means of built-in components, which are integrated into the edge girder of the arch segment as upright sheet metal disks. The hanger forces are transferred to the edge beam of the superstructure via concrete dowels. In addition, head bolts were arranged near the edge and dimensioned for the load transfer of the hanger forces.

SBP – ANDREAS SCHNUBEL

↗ Carbon-fibre polymer composite hangers were used

JUDGES' COMMENTS

A worthy demonstration of new materials and new applications. The resulting design embodies a combination of well-known techniques and new cutting-edge technology to provide a graceful, highly efficient take on the classic cable-hanger arched bridge.

The development of the bonded carbon-fibre composite members was the result of material science research and a very rigorous testing regime, involving over a million stress-test cycles, to demonstrate the suitability of this hybrid material for use in these circumstances.

Location London, UK

London South Bank University – London Road Building

Awarded for: **Transformative sustainable design through minimal intervention.**

PROJECT TEAM

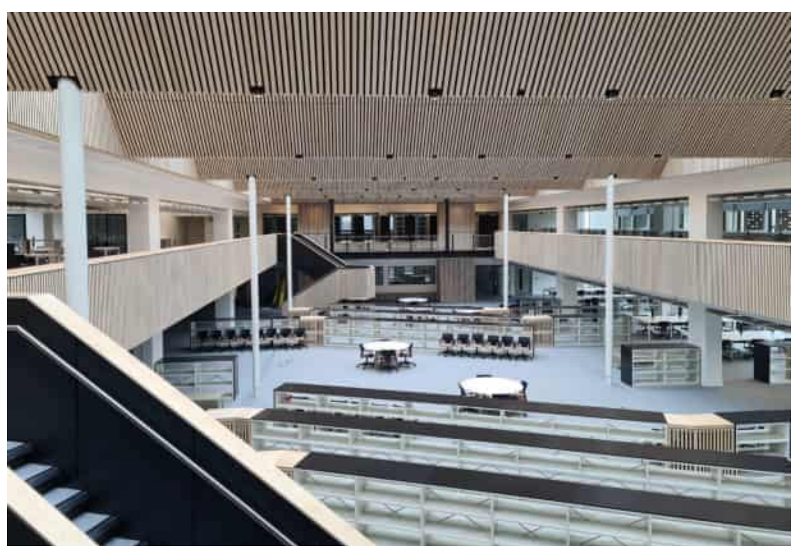
- **Structural designer:** Eckersley O'Callaghan
- **Client:** London South Bank University
- **Principal contractor:** Wilmott Dixon Interiors
- **Architect:** Wilkinson Eyre Architects
- **MEP engineer, combined services, acoustic, town and country planner:** BDP
- **Fire safety consultant:** Tenos
- **Landscape architect:** Churchman Landscape Architects
- **Building control consultant/ approved inspector:** JHAI Ltd
- **Carbon fibre subcontractor/ designer:** CCUK Composites Construction
- **Drainage and facade:** Eckersley O'Callaghan

© SIMON YEUNG

Retrofit of London Road Building sought to minimise carbon footprint of construction

IN BRIEF…

- London Road Building is a refurbishment and extension project of an existing four-storey reinforced concrete-framed building from the 1970s with an overall internal area of 20 000m^2.
- The new design includes lecture theatres, library, sports facilities and catering areas and is part of a wider campus redevelopment. The building originally had an extremely cellular layout unfit for modern use.
- Existing structure verification, carbon-fibre strengthening, further modifications and new structural additions were performed to justify and reuse the building's original concrete frame.
- The structural embodied carbon value of the project per gross internal floor area is five to six times lower than that of an equivalent new-build concrete-framed structure of this scale.



© ECKERSLEY O'CALLAGHAN

Large hanging floor infill over sports hall: new library area with feature stairs

JUDGES' COMMENTS

A retrofit-first approach to sustainable building design has transformed an outdated concrete building into a vibrant new student centre. The project team enabled minimal intervention based on detailed analysis of the existing structure, extending its design life by another 50 years and also achieving a great visual improvement.

Great care was taken to minimise the carbon footprint of construction by refurbishing and saving as much of the existing materials as possible. The SCORS A+ rating is fantastic for such a major project.

Carbon-fibre shear strengthening to existing waffle slab

Location Bali, Indonesia

The Arc, Green School

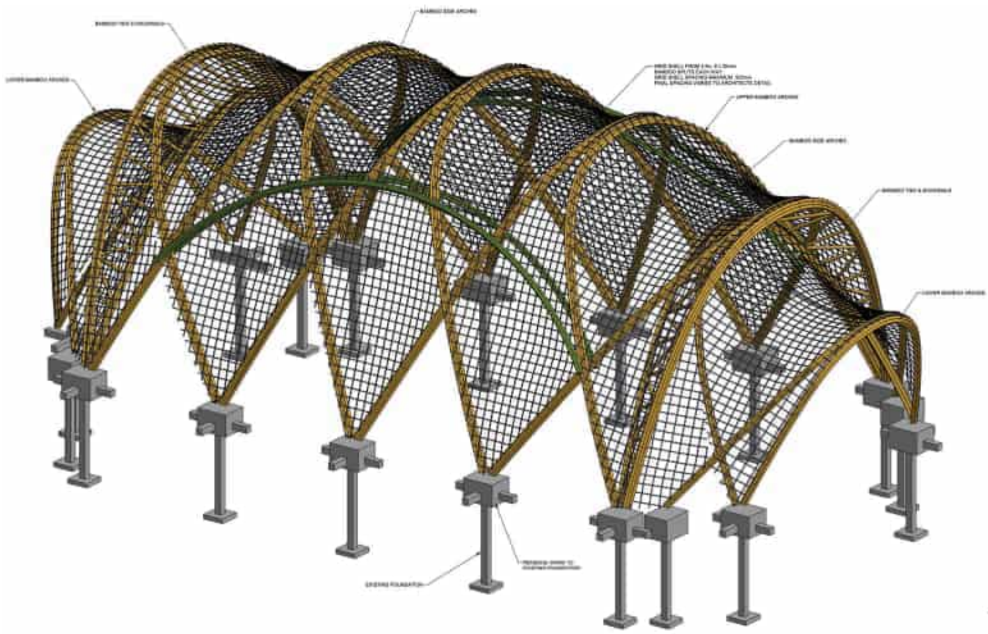
Awarded for: Advancing the structural application of low-carbon materials.

PROJECT TEAM

- ➜ **Structural designer:** Atelier One
- ➜ **Client:** The Green School, Bali
- ➜ **Principal contractor:** PT Bamboo Pure
- ➜ **Architect:** Ibuku
- ➜ **Bamboo master craftsman:** Jorg Stamm
- ➜ **Lighting:** Studio Nimmersatt
- ➜ **Photographer:** Tommaso Riva
- ➜ **Testing coordinator:** James Wolf

IN BRIEF...

- →| The Green School was looking for a replacement for its existing gymnasium that had reached the end of its life, and the new structure was required to utilise the existing foundations.
- →| In response, the Arc was designed: a 14m high × 19m span roof consisting of a series of bamboo bundle arches connected by bamboo lattice anticlastic saddles, topped with a bamboo mat surface. The structure's strength would come from its form, with the arches and saddle surfaces acting compositely.
- →| For the Arc, whole culms harvested from near the site were used. This meant that the emissions due to processing and transportation were minimal. The quantity of bamboo required was drastically reduced due to the structurally driven form, with the arches and saddle surfaces all contributing to the strength. Combined with the use of existing foundations, the resulting carbon footprint of the building is negligible.
- →| Developing relationships with local craftspeople in Bali – and learning from the bamboo expertise that has been handed down through generations – the team was able to introduce new typologies and structural principles to them. This two-way information exchange was a hugely satisfying experience for all involved.



➚ The Arc's roof structure rests on existing foundations

➔ Structurally driven form reduced quantity of bamboo required

➘ Locally harvested bamboo was used for structure

JUDGES' COMMENTS

This dramatic roof structure is a breathtaking use of sustainable, locally harvested bamboo. The project was beautifully detailed following years of research into the material's unique properties. The result is a very low-carbon structure superbly executed, showcasing the fantastic artistry and workmanship of the engineers in the varied structural forms.

The project demonstrates the exciting potential of bamboo as a mainstream building material. Architects and engineers alike should be inspired.

Location London, UK

The Gramophone Works

Awarded for: Exemplar use of timber at scale in a retrofit project.

PROJECT TEAM

- ➜ **Structural designer:** Heyne Tillett Steel
- ➜ **Client:** Resolution Property
- ➜ **Principal contractor:** Graham
- ➜ **Architect:** Studio RHE
- ➜ **Quantity surveyor:** Quartz Project Services
- ➜ **Surveyor:** Anstey Horne
- ➜ **Sustainable timber contractor:** B&K Structures

IN BRIEF…

- →| The Gramophone Works is a new landmark canal side commercial scheme comprising a mix of refurbished, extended, and new-build contemporary office spaces in West London.
- →| The low-carbon development has successfully refurbished an existing building and extended it from two to six storeys, adding a further 60 000sq.ft (5500m^2) of commercial office space. It is believed to be the biggest mass timber office structure constructed in the UK.
- →| The building has also been designed to promote reuse within a circular economy through the design of connections facilitating future disassembly, allowing for members and floorplates to be recycled for future developments.
- →| High levels of insulation are incorporated into the design to mitigate heat loss, along with solar reflective glazing, shading fins and louvres. On the roof, photovoltaic solar panels contribute to the building's energy supply.

JUDGES' COMMENTS

This major reuse project champions the use of mass timber in the commercial sector to create an adaptive space which is responsive to the end user's needs.

A lightweight CLT and glulam structure has been used to extend the existing concrete frame, increasing the building from two to six storeys and adding 60 000sq.ft.

© HTS

↙ 3D model of timber structure

© TIM CROCKER

← Exterior of building showing extension from two to six storeys

↓ Exposed timber connections inside building

© HTS

Specifying timber as opposed to a heavier building material such as steel or concrete has allowed for minimal strengthening to the existing foundations which have been reused to support the additional four storeys.

Exemplar low-carbon thinking.

Location Chengdu, China

Tianfu Agricultural Expo Main Hall

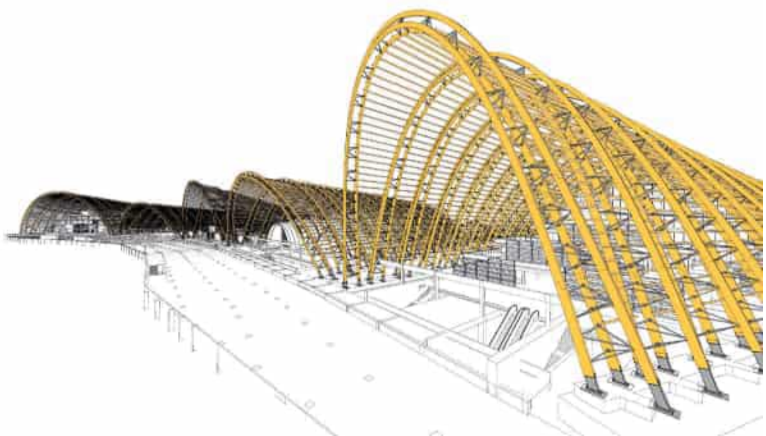
Awarded for: Structural elegance through integrated design and construction.

PROJECT TEAM

- **Structural designer (roof vault structures):** StructureCraft
- **Structural designer (base building):** China Architecture Design & Research Group
- **Client:** Sichuan Tianfu Agriculture Expo Investment Ltd
- **Principal contractor:** Beijing Urban Construction Group Co Ltd
- **Architect:** China Architecture Design & Research Group
- **Parametric design consultant:** Mule Studio
- **Manufacturer:** Hasslacher Norica Timber

© GUANGYUAN ZHANG

↗ Exposition is surrounded by agrarian land



↗ Design of glulam roof structure with steel trusses

IN BRIEF…

- At over 75 000m^2, the Tianfu Agriculture Exposition is the largest timber project in Asia, and one of the largest timber projects in the world. This series of five vaults uses unique Vierendeel-inspired trusses – a hybrid of timber chords and steel webbing – achieving clear spans up to 110m and heights up to 44m.
- The wave of the building provided challenges for the engineering team on a very tight schedule. Housing museums and displaying agricultural products from the region, the roofs of these halls are clad with ethylene tetrafluoroethylene (ETFE) but are open-ended, encouraging a direct connection with the surrounding farmland.
- The result is a unique series of long-span timber structures, created through cooperation of team members on three different continents in a year and a half throughout the Covid-19 pandemic, showcasing a sustainable solution and a world-class attraction through innovative engineering and design.
- An additional challenge was that engineers were unable to visit China throughout the duration of the project, due to the pandemic. Remote working, quality control/assurance, and structural inspection techniques, including use of SaaS platforms, enabled a 'living' shop drawing process. This ensured engineers could track the status, quality and accuracy of each pre-assembled piece throughout its construction lifecycle.

JUDGES' COMMENTS

The design of the Vierendeel-inspired timber chord and steel webbing structure with ETFE membranes is aesthetically pleasing and seemingly melts into the surrounding environment. Thoughtful detailing of the unique shear-key connection is innovative and able to withstand seismic force.

Computational design aided the geometry design process. An integrated workflow enabled the design data to be directly used by the manufacturer, streamlining the processes of fabrication ensuring clear communication. The CNC manufacturing process further increased the accuracy of assembly of all components and ensured an efficient erection process with minimised wastage.

Efficient, thoughtful and collaborative engineering at its best.

Location Geneva, Switzerland

United Nations New Office Building

Awarded for: Creative sustainable design at scale that responds to the unique environment.

PROJECT TEAM

- **Structural designer:** Skidmore, Owings & Merrill
- **Client:** United Nations
- **Principal contractor:** Implenia
- **Architect:** Skidmore, Owings & Merrill
- **Local architect:** Burckhardt+Partner
- **Local structural engineer:** INGENI
- **Lighting consultant:** Nulty Lighting
- **MEP consultant:** RAPP Technique du Bâtiment SA
- **AV/IT/Security:** Shen Milsom & Wilke LLC
- **Landscape architect:** Oxalis Architectes Paysagises
- **Accessibility:** Handicap Architecture Urbanisme
- **Wood supplier:** JPF Ducret
- **Facade supplier:** Sottas SA

IN BRIEF…

- Strategically responding to a sloping site, the new UN administrative building is perceived as a series of cascading terraces discreetly placed into the Parc de L'Ariana. A careful balance was struck to not compete with the historic Palais des Nations. Two inner courtyards add to the overall effect of a building working in harmony with the natural context of the lake and mountains.
- The new building creates an additional area of approx. 24 000m² to accommodate 1400 staff. Open-plan, activity-based neighbourhoods offer staff a new way of collaborating, working and sharing knowledge. Courtyards and roof terraces, accessible from every floor, ensure that green, outdoor areas are available to all staff.
- The project brings elegant structural engineering front and centre, showcasing structural timber detailing as an integral part of the architectural expression. By utilising visually exposed structural members and elegant details throughout, the building becomes a celebration of structural engineering and demonstrates that the benefits of sophisticated engineering go well beyond providing a safe commodity structure.

ALL IMAGES: UNOG/SOM/DAVE BURK

↖ New UN office building built into slope

← Exterior was designed to not compete with nearby Palais des Nations, the first UN building in Geneva

↓ Stairs use unadorned structures to express architectural aesthetics

JUDGES' COMMENTS

This project has a clear focus on both the environment and the end user. An innovative hybrid timber and concrete structural slab and beam system solution was adopted and significantly reduced the embodied carbon emissions. The timber landscape stairs and the perimeter columns directly use unadorned structures to express the architectural aesthetics.

A fantastic example of timber-concrete composite being used at scale.

Location London, UK

HYLO

Awarded for: **Full exploitation of an existing structure to maximise retrofit potential.**

PROJECT TEAM

- **Structural designer:** AKT II
- **Client:** CIT Group
- **Principal contractor:** J Coffey Group and MACE
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IN BRIEF…

- HYLO absorbs and transforms the former mid-rise Finsbury Tower to become a modern, high-rise development; the existing building extends upwards by 70%, with 13 new storeys added to its existing 16 floors, and all while reusing its existing frame and foundations.
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- In-depth finite-element modelling was performed on the existing structure, using a time-dependency analysis, to assess the structure at every stage of its lifecycle, from its original construction through to the proposed demolition, the new loading, and the long-term settlements and creep.
- The existing superstructure was enhanced with targeted column strengthening made of high-strength concrete, together with steel jacketing, to help minimise their required area within the tower's floorplates. The steel jackets are also exposed to form a striking interior feature.

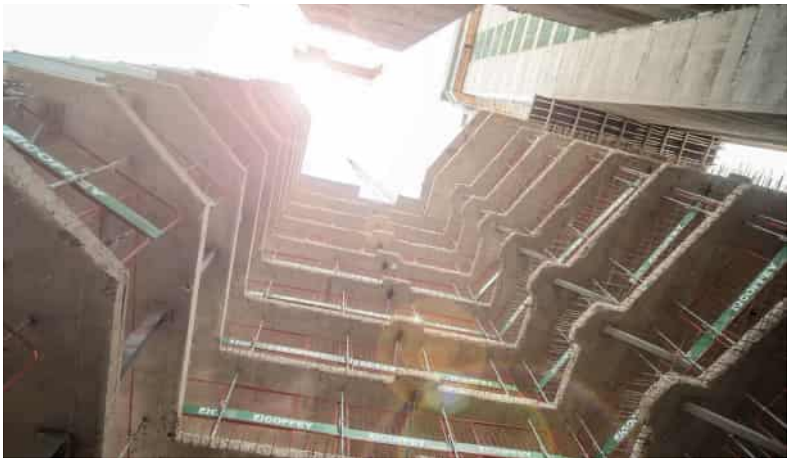
JUDGES' COMMENTS

HYLO could only have been achieved through masterful structural engineering. A 13-storey building was added on top of an existing 16-storey building, with only the most essential strengthening works necessary to the existing frame and foundations. This was achieved through redirecting load paths, and allowed the designers to exploit the inherent spare capacity in the original structure – in essence, they cashed in on the previous carbon footprint to save carbon on the extension. A quite brilliant example of structural retrofit.

JAN FRIEDLEIN/AKT II

External view of HYLO

"A QUITE BRILLIANT EXAMPLE OF STRUCTURAL RETROFIT



AKT II

Retained floorplates from former Finsbury Tower

Location Bali, Indonesia

The Arc, Green School

Awarded for: **Advancing the structural application of low-carbon materials.**

PROJECT TEAM

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IN BRIEF…

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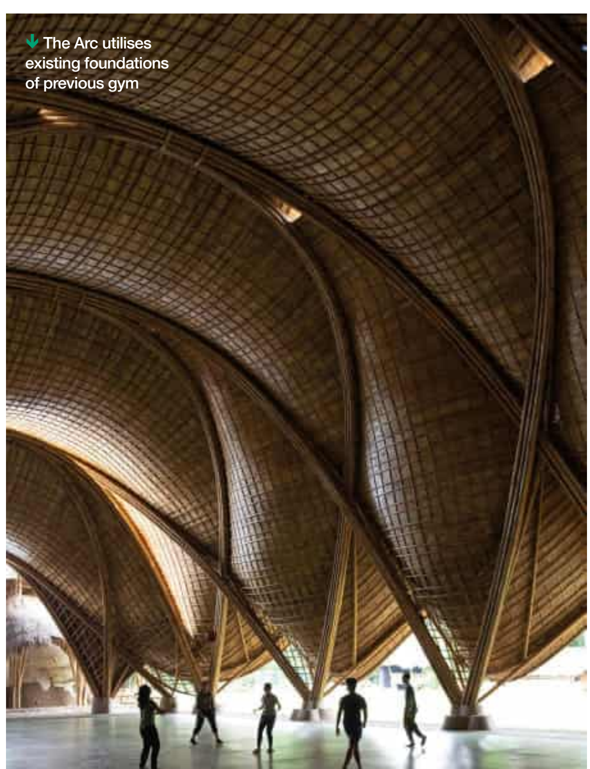
- Developing relationships with local craftspeople in Bali – and learning from the bamboo expertise that has been handed down through generations – the team was able to introduce new typologies and structural principles to them. This two-way information exchange was a hugely satisfying experience for all involved.

Structure's strength comes from arch and saddle surfaces working together



The Arc utilises existing foundations of previous gym

> **MARVELLOUS DEMONSTRATION OF ARTISTRY, TECHNICAL KNOW-HOW AND A DRIVE TOWARDS NET ZERO**

JUDGES' COMMENTS

The Arc Gymnasium is an extraordinary project. It brings together local materials, fundamental research and creativity-charged structural engineering expertise to produce something of pure delight. Not only does it demonstrate how we might consider the spectacular use of natural building materials for major projects, but it also lays out the path, via research, which can lead to the confident use of such materials. This is a marvellous demonstration of artistry, technical know-how and a drive towards net zero.