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FIRST

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Cutting through complexity:

Managing the design and build contract for CUHK Medical Centre

Foreword

Planning, designing and building healthcare facilities in the post-COVID 19 era involves complex infrastructure and operational design considerations. Whether it is managing the design and build of a hospital or structurally designing a seismically resilient hospital in an earthquake zone, two recently completed healthcare projects that Arup took part in, both highlighted in this issue, reaffirm that the top priority is to keep medical personnel – and their patients – safe.

Hospital projects demand a high degree of accuracy in execution. For the CUHK Medical Centre (CUHKMC) in Hong Kong, we adopted a systematic approach to managing the complexity of planning, design, construction, fit-out, procurement and installation works. In Istanbul, we designed the world's largest base-isolated complex, which comprises more than 2,000 seismic isolators, within an area that has suffered highly destructive earthquakes in the past.

The global health crisis has prompted not only the healthcare industry but also policymakers, planners and building professionals to rethink the design of future healthcare. In a recent publication, our Foresight team envisions that future healthcare infrastructure, delivery models and services will be made resilient enough to mitigate the effects of climate change while providing more inclusive, accessible services to keep citizens healthy at a lower cost.

An important part of what Arup University has been doing is implementing a learning culture across Arup, which helps drive our business forward and continue to innovate. In this issue, you will read about how our training and entrepreneurship programmes encourage Arupians to take ownership of their learning journey and come up with innovative solutions that work.

Last but never the least, you will read interviews with Raul Manlapig, Director and Head of Arup Manila, and Theresa Yeung, Director and Head of Arup's East Asia Planning Team, in which they explain the keys to success of leadership. We hope you will find this issue to be informative and insightful.

FIRST is a publication produced by East Asia Arup University (AU) for our clients and partners, exploring design, innovation and technical solutions for the built environment. It takes its name from the unique model of AU: Foresight, Innovation, Research, Sharing, and Training.

If you have any thoughts, questions or comments, we would love to hear back from you at ea.arupuniversity@arup.com.

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Cutting through complexity

Managing the design and build contract for the CUHK Medical Centre (CUHKMC) requires a systematic and humane approach that accounts for every detail.

About CUHKMC

The state-of-the-art private teaching hospital, wholly owned by the Chinese University of Hong Kong (CUHK), provides 516 in-patient beds, 90 day places, 28 operating rooms, 49 consultation rooms and 16 special medical centres. It comprises 14 storeys with a total CFA of about 100,000 square metres. The hospital aims to bridge the gap between Hong Kong's private and public healthcare services by offering quality healthcare at affordable, transparent packaged prices. This hospital is the first smart hospital in Hong Kong and commenced operations in Q1 2021.

Client:
CUHK Medical Centre (CUHKMC)

Arup's scope of service:
Project management

Designing and building hospitals is among the most complex types of projects today. The project manager ought to take into consideration complicated building components and systems, diverse stakeholders' needs, healthcare technology and equipment, specialised functions, different financing methods, as well as building codes and regulations. All of these complexities require meticulous planning in the early stage while maintaining meaningful, effective communications with all stakeholders during the project's lifecycle.

With the successful delivery of CUHK Medical Centre (CUHKMC) as the Project Management Consultant (PMC), Arup demonstrated its competences in healthcare facility design and build project management in terms of time management, cost control, design quality control and stakeholder communication.

Project objectives

Apart from building a modern hospital designed with optimal operational flow, patient comfort and safety in mind, the project is also meant to provide an innovative, conducive clinical training environment for medical students of the CUHK. Smart technologies were also deployed to provide affordable healthcare services to the wider community while meeting stringent regulatory, hygiene and safety requirements.

Challenges

The timely completion of the project is the primary measure of the project's success. Many factors contributed to the complexity of the CUHKMC project. Therefore, we formulated a systematic project management approach to account for the intricacies and risks, both known and unknown.

Design and build procurement route

Due to the tight schedule, the client had decided to procure a design and build (D&B) contractor. Since D&B contracts are not commonly used in Hong Kong for private projects, it was a challenge to finalise the procurement approach which best fits this new private teaching hospital.

Meeting project deadlines amid crises

The restrictions of the Land Lease issued by the Lands Department and limited funding meant that timely completion within the budget became one of

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the key objectives of the client. The social unrest that broke out in 2019 and the pandemic throughout 2020 inevitably caused disruptions to construction activity.

Diverse stakeholders' needs

As the hospital was designed to suit the operational needs of different clinical and non-clinical departments, the number of end-users with influence on the design was much more than for other typical facilities. At the CUHKMC, 20 departments with over 80 end-users had to be involved in the design development. A detailed workflow and schedule were required and agreed on with the end-users in order to manage the interfaces at the onset of design stage.

Outcomes

Meaningful stakeholder engagement

For a hospital project that requires the input of numerous end-users in the design development, the workflow, timeline and schedule were set out and agreed on with all stakeholders from the very beginning throughout the entire design development process.

To ensure meaningful engagement of all stakeholders, we implemented a comprehensive, multi-level approach. In the schematic (1:200) layout design stage, only five key executives were involved in the discussion process, so that the process was relatively less complicated and the time taken from the start to sign-off by the client was just two months.

In the detailed (1:50) layout design stage, as many as 80 senior staff members from across 20 departments were involved. To ensure effective communication within a limited time frame, we presented the drawings produced by the contractor in departmental meetings with the help of visual aids, 2D plans, 3D modelling, etc to communicate abstract design ideas and visualise complex dimensions more effectively. In total, we arranged about 160 User Related Design Meetings during the second phase of stakeholder engagement.

Selection of pre-qualified contractors in two stages

A transparent and fair tendering process was the topmost concern. Since the costs incurred in bidding for a D&B tender may be prohibitive to candidates, selection of prequalified contractors was carried out in two stages. The first stage involved sending an Expression of Interest (EoI) to all qualified building contractors. The second stage comprised a detailed technical evaluation, including interviews, of all tenders who have passed Stage 1 screening.

A homely and healing environment is provided in the hospital by employing finishes and lighting in warm colours, together with some feature decoration and landscaping.

In the tendering exercise, invited tenderers were assessed by their technical competence and commercial capability at a specific ratio, so that the D&B contractor would be selected based on their technical experience and track records, rather than the lowest price, which often results in low quality of work, claims and time overruns.

Effective time and cost management

Effective time management ensures the timely completion of the project and is one of the most important factors in hospital projects. After learning from the client that the hospital was scheduled to open by the end of 2020 (which was pushed back to Q1 2021 due to the social unrest in 2019 and the pandemic in 2020), we set out a realistic master programme of activities in a short period of time, including the key milestones for progress tracking. We informed the client of whether the project was ahead of or behind schedule on a monthly basis and recommended measures to mitigate time-cost overruns.

Cost includes the processes involved in planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project can be completed within the approved budget. Adding to the above-mentioned factors, change management was also a parameter in the project's success. Throughout the project, we collaborated with the QS consultant to provide a monthly snapshot of the cost situation to the client. This not only included the current costs but also the cashflow and projected final costs based on the estimate tracked by Arup's change management system and the variation co-ordination meeting chaired by Arup.

The change management system was approved by the client's Building Committee. The system ensured material changes, which were generally initiated by the client, are managed effectively. For variations with quotations submitted by the contractor, Arup would review the details with the contractor to understand the intention, followed by a fair assessment based on the project progress in order to identify ways to minimise the impact on the contractor and the extra cost incurred.

Partnering reduces conflicts and costs

We worked closely with the D&B contractor on a "partnering" relationship to resolve site issues. With common goals, this approach helped ensure that agreements would be executed successfully by establishing guidelines for co-operations accepted by all.

Arup worked closely with the D&B contractor on a "partnering" relationship to resolve site issues.

Arup's added value

Medical equipment planning, procurement and installation

Since the CUHKMC is a new smart, private and teaching hospital, it involves lots of medical equipment to move-in, testing and commissioning as well as licensing prior to putting the hospital into operation. To ensure this part of works proceeded smoothly, we worked directly with the clinical staff and medical equipment vendors to understand their functions and specifications and ensure the equipment was integrated in a way that optimises the best patient care possible, efficient healthcare delivery and facility performance.

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In one instance, our responsive action to resolve an issue arising from the potential duplication of fit-out work between medical equipment vendors and the D&B contractor not only saved duplicative costs for the client but also enhanced the quality of the final deliverable and reduced potential construction waste.

To ensure that the medical equipment would function properly when hospital operations commence, the equipment delivery, installation and testing and commissioning (T&C) schedule was planned well in advance and closely co-ordinated with the D&B contractor.

Building of a network-based smart hospital

To enhance the safety, quality and efficiency of healthcare services, certain smart technologies and third-party logistics for pharmaceutical and medical consumables were adopted for the operation of the CUHKMC. As some of the technologies and methods were first to be deployed in the hospital industry in Hong Kong, Arup worked closely with the CUHKMC and its vendors to define the design requirements in the building provisions and to align the new systems with the operational needs.

For example, we facilitated the design of a data centre with sufficient IT rack space and infrastructure to enable the deployment of smart technologies. The entire complex is covered with perfect Wi-Fi and 5G coverage in operating theatres for real-time monitoring and delivering continual treatment information with the deployment of Internet of Things (IoT) and wearable devices.

Protection of water sensitive areas

In order to prevent damages to the expensive and delicate equipment typical of a smart hospital, as well as to reduce the risk of contamination to the clean/sterilised areas due to water dripping or leakage from the overhead pipework, Arup led the client and the D&B contractor in undertaking a thorough review of the routing of water supply pipes and drainage pipes during the design stage. By doing so, we identified the water sensitive areas and then reviewed the current layout and checked if there were any water supply pipes or drainage pipes running overhead within these areas.

Expertise in hospital project management

For the CUHKMC project, we employed a systematic approach to design management, procurement, contractual arrangement, cost control and construction management. This drove the project to a successful outcome, which was completed according to the approved plan, within the client's approved budget, quality and safety requirements.

For us, being a responsible project manager is not just about delivering a capital project on time, up to the quality and within budget. Equally important is that we communicated with the client and stakeholders on a structural level so that we understood how operations would be implemented into the facility and the purpose it would serve.

> "Arup's responsive, proactive and adaptable approach in this highly complex project is key factor in ensuring the hospital meets our goal in providing quality healthcare services and training facility to the healthcare professional."

Dr Hong FUNG
Chief Executive Officer
CUHK Medical Centre Limited

The client, Arup and contractor teams (photo taken in the main entrance lobby).

Relevant United Nations Sustainable Development Goals (SDGs)

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Chapel of Sound

Located in a remote valley next to a segment of the Great Wall, this boulder-shaped concrete structure contains a semi-outdoor amphitheatre. The geometry and texture of the ambitious structure is engineered with advanced computational technology to create excellent acoustics and thermal comfort. Aggregate from local rock was used to minimise consumption in material transportation.

© Zaiye Studio

Client:
Aranya, China

Architect:
OPEN Architecture

Arup's scope of services:
Structural and MEP engineering

Chapel of Sound sits in a rocky valley at the foot of Jinshanling Great Wall near the northern boundary of Beijing municipality. It was a pilot project that aims to revitalise this remote mountainous region. Arup was engaged as the structural and mechanical, electrical, and plumbing (MEP) engineers, working closely with the architect OPEN Architecture and the lighting and theatre consultants during the design stage, as well as the construction manager and other contractors during the construction stage.

Designed to emulate the irregularities of a natural rock formation, the spectacular Chapel of Sound is a boulder-shaped concert hall that features a 790-square metre semi-outdoor amphitheatre, an outdoor stage, viewing platforms and supporting spaces. The structure is made of concrete mixed with an aggregate of crushed local, mineral-rich rocks, shaped acoustically for music performances. Openings in the roof and walls pull in the sky and surrounding landscape, building on a sense of place for the concert hall, as well as the sounds of nature; light and rain, bird song and the chirp of insects gently fill the chapel.

The interior shape was inspired by the contours of shells, wooden instruments and the human ear. Through digital optimisation, the acoustic properties are tweaked to produce the best possible sound quality. The openings of the building are placed strategically to avoid unwanted reverberations while simultaneously allowing in natural sounds and views. The building adopts an inverted umbrella structure, which touches the ground with the smallest "footprint", minimising the impact on the surrounding natural environment.

© Zaiye Studio

The spectacular Chapel of Sound is a boulder-shaped concert hall designed to emulate the irregularities of a natural rock formation.

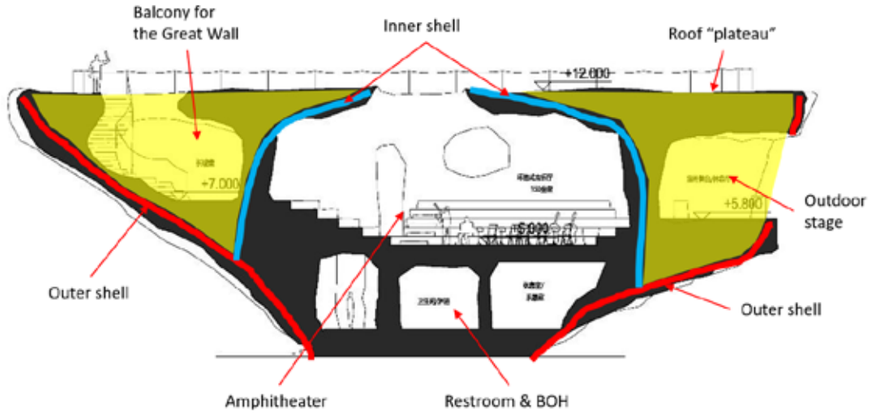
Modelling the complex structure

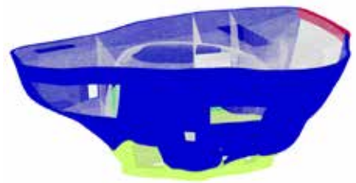
Due to the geometric complexity of the structure, advanced digital design technology was adopted at the early design stage. Arup's structural engineers created a parametric model for the structure, carried out topology optmisation to find the efficient structural layout and also rationalised the surface undulating pattern to minimise the panel numbers of formwork.

In the beginning, the architect provided a 3D scanned file of the handcraft model. Through parametric modelling we created the smooth structure surface, developed a double-shell structure and continued fine-tuning the design until all details in a full 3D design environment, including all rebars and MEP pipes/routes, were worked out. We made several adjustments to the geometry to achieve the optimal structural behaviour as well as acoustic performance. The undulating surface with the sedimentary layers were also fine-tuned to reduce the use of formwork.

The shape of the inner shell was designed based on acoustic principles. The stepped hard surface reflects sound as acoustic scattering panels, while the openings absorbs sound to control the space reverberation. The carefully planned openings on the top of the inner shell and the wall provide views of the sky and the surrounding valley while introducing the subtle sounds of nature to the amphitheatre and reducing echo.

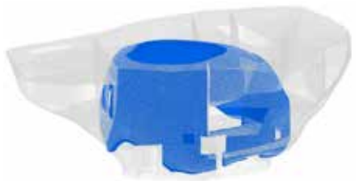
Sectional structure





Outer shell structure

Fin walls between inner and outer shells



Inner shell structure

Floorplates

Balancing passive design and thermal comfort

Respect for nature is displayed not only in the project's unique relationship with its environment, but also its efforts in sustainability. Another aim of the project was to employ passive design strategies to adapt to the continental climate of Beijing, where the natural and environmental conditions can be extreme. The project's hilly environment further requires an architecture oriented towards thermal comfort and passive sustainability.

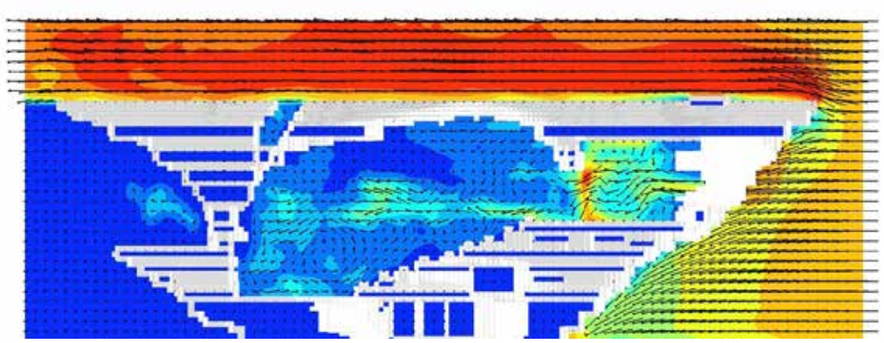
Therefore, we performed a computational fluid dynamics (CFD) analysis to optimise natural ventilation performance and advised on the creation of openings for cross-ventilation. A structural temperature field analysis confirms that the temperature of the concert hall will not be too high in summer without air conditioning. Since the large opening atop the structure brings not only sunlight but also water when it rains, we also designed a sophisticated drainage system to drain rainwater away.

Facilitating collaboration

Essential to the success of the project was Arup's facilitative role as virtual design and construction (VDC) modeller to streamline workflows among different project team members. After importing the architect's 3D scanned handcraft model into the software platform (Grasshopper and Rhino 3D), we merged structural engineering and digital input from the building physics, acoustics, lighting engineers and parametric modelling and then produced 2D construction drawings.

The VDC model was also used to co-ordinate these processes with the MEP systems to ensure all system pathways and structural penetrations were designed prior to on-site construction. For example, not only did we provide laid-flat drawings for all rebars to facilitate the rebar fabrication and fixing, all rebars and MEP pipes/routes were also modelled in 3D while the final model was delivered to the contractors, too. This collaborative workflow significantly reduced the resources and costs required in the design stage.

Arup performed a computational fluid dynamics (CFD) analysis to optimise natural ventilation performance and advised on the creation of openings for cross-ventilation.



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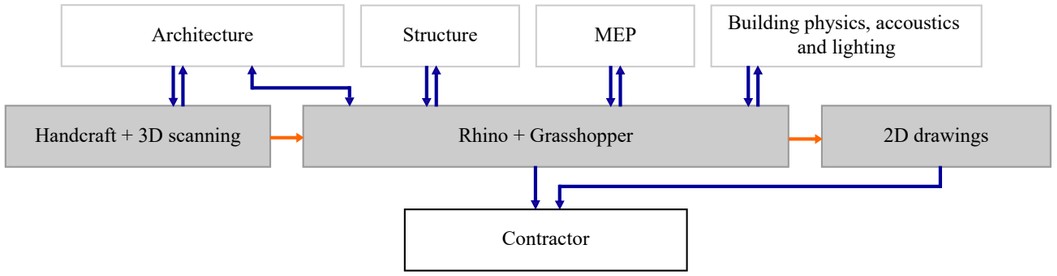

Essential to the success of the project was Arup's facilitative role in streamlining communications and co-ordination of works among different project team members.

During design and construction preparation, the model was used to assess the constructability and costs of different options, predict the building quality and safety hazards that might occur during the construction phase. As part of our pre-construction testing, we selected aggregates from locally mined mineral-rich rock materials for concrete block tests and studied the colour and strength of the concrete to be used.

During construction, we provided the construction manager with the co-ordinates of all formwork panels, and the co-ordinates of the nodes of all steel bars, totalling 11,350, that form the rebar skeleton of the inner and outer shells, complemented by their laid-flat 2D drawings, to guide the on-site processing, binding and installation of steel bars as well as to improve the accuracy of formwork measurements. Last but not the least, 3D printed models of different sizes were created to help the construction manager understand the different feasible construction methods and their implications.

© OPEN

Arup provided the construction manager with the co-ordinates of the nodes of all steel bars and their 2D drawings.

© Zaiye Studio

The finished fair-faced concrete of the outdoor stage resembles a "frozen" flowing curtain.

Contributing to UN SDGs

Chapel of Sound is a pilot project that aims to revitalise this mountainous region and boost the local economy by bringing in tourists and even residents, ultimately narrowing the income gap between those living in cities and this rural region. Performing music also provides the potential to attain social and emotional wellbeing.

With sustainability in mind, the project makes use of locally sourced materials and crushed local rocks and adopts a passive design, with a structure designed to minimise the impact on the surrounding environment. The timber formwork was also collected and recycled by a local furniture workshop. These benefits and achievements are in alignment with these UN SDGs.

Relevant United Nations Sustainable Development Goals (SDGs)

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Arup delivers CCGT power plant for CLP

Black Point Power Station's additional gas-fired generation unit (D1 project)

Located in the New Territories of Hong Kong, Black Point Power Station (BPPS), 70% owned and operated by CLP, is one of the world's largest gas-fired combined-cycle power stations with ultra-low-sulphur diesel as backup fuel source.

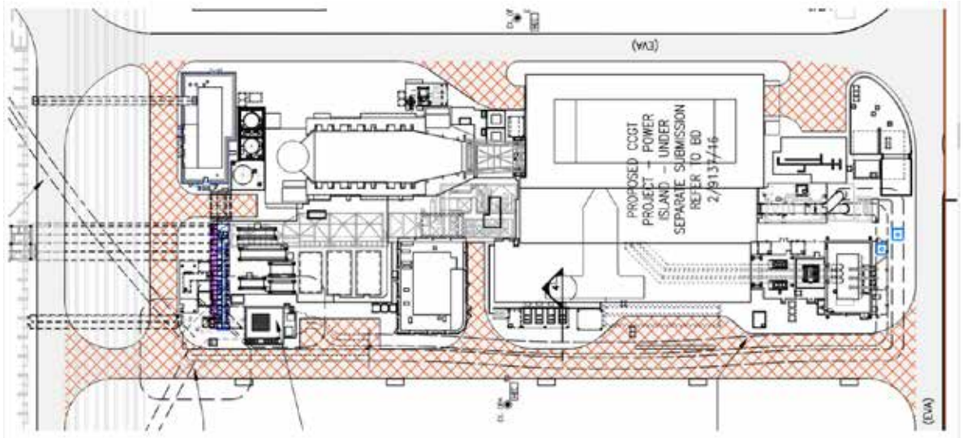
Client:
CLP Power Hong Kong Limited (CLP)

Arup's scope of services:
Architectural, landscape, civil, structural, geotechnical, building services and BEAM Pro certification consultancy; also served as statutory agents for Buildings Department submissions and site supervision.

Arup was appointed by CLP as the Owner's Engineer for the design of a new combined cycle gas turbine (CCGT) generating unit at BPPS. The additional gas-fired generation unit is an advanced design from Siemens, which was responsible for delivering the basic design of the site and building layouts to accommodate the generating plant. Arup took this generic input and refined it based on Hong Kong's statutory requirements, CLP's architectural and technical aspirations and a desire to shape a better world through enhancing efficiency and utility.

CLP requested a building that would not only deliver functional requirements but also would present its brand and identity. This resulted in an industrial building that incorporates a variety of facade materials to create an interesting mix of corporate colours and textures.

The major above-ground structures include the turbine hall and electrical annexe, heat recovery steam generator (HRSG), stack, transformers, pipe/cable bridges and associated ancillary buildings and tanks. Below ground is the cooling water (CW) system comprising inlet, diversion chamber, pump station, outfall, access shafts and pipes/culverts linking the whole system together.



The key feature of a CCGT is its combined cycle dual turbine design, consisting of a gas turbine and a steam turbine. Natural gas is burned in the gas turbine to generate electricity.

Since Arup was responsible for all aspects of engineering and architecture, a holistic design was formulated to balance competing demands from different disciplines to deliver a project that has a value larger than the sum of individual contributions.

The new 550MW unit expands BPPS' overall generation capacity and features a state-of-the-art CCGT configuration that provides an efficiency of around 60%, higher than that of the existing gas-fired units.

The key feature of a CCGT is its combined cycle dual turbine design, consisting of a gas turbine and a steam turbine. First, natural gas is burned in the gas turbine to generate electricity. During the process, the heat exhausted from the gas turbine is captured and transported to heat up water in the HRSG. As a result, steam is produced to drive the steam turbine for power generation. The combined cycle design allows for greater output and higher fuel efficiency without using additional fuel.

The major above-ground structures include the turbine hall and electrical annexe, heat recovery steam generator (HRSG), stack, transformers, pipe/cable bridges and associated ancillary buildings and tanks.

The two main civil works components are the power island (PI) and a cooling water (CW) system just less than 1km in length. The approx 100m by 200m PI contains a turbine hall, which houses most of the equipment including gas and steam turbines, generator and main control unit, while the rest of the area is taken up by the HRSG and other supporting systems.

BIM was used to pre-identify clashes between the various elements within the turbine hall, as well as clashes between the multiple embeds and heavy reinforcement of the turbine table foundation.

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Power island's steel structures

The most iconic structures are the turbine hall, HRSG and stack as these are the most visible structures on site. The turbine hall is a braced steel framed building measuring approximately 60m by 60m on plan and 35m high. The turbine hall houses the gas and steam turbines, generator, switch gear and electrical annexe.

The key functions of the turbine hall building are sheltering the machinery, allowing access via internal platforms and providing support to MEP and maintenance cranes of various ratings from 2.5 tonnes all the way up to 500 tonnes. The requirements of the overhead cranes drive most of the design criteria for the steel framed building.

The deflections must meet much stricter criteria than typical buildings to ensure that the crane is able to operate without undue wear or even failure caused by uneven movements of the crane rails. To achieve the deflection limits, large depth fabricated I section columns were specified along with moment connections of the columns to the roof truss rafters to provide additional stiffness under wind loads. Differential movements caused by unbalanced wind and settlements/rotations resulting from pile shortening were both important contributors of the deflection cases.

CW system

The intake of the new CW system was created by demolishing and re-building part of the existing supplementary intake culverts to form a branch connection to the proposed pumping station.

As the works were located within a seawall made up of rock fill, grouting to achieve a traditional dry excavation scheme was highly risky. An innovative underwater excavation lateral support scheme with precast concrete units was therefore designed and constructed to form the diversion chamber.

The CW system is constructed of 2.6m internal diameter pressurised steel reinforced cylinder pressure pipes (RCCP) running from the condenser at the PI and out to existing sea outfall via an inverted siphon discharge section of the CW system. Roughly half of the Bonna pipes were installed by pipe jacking method and the rest by cut and cover.

Originally, a total of four launch/retrieval shafts were proposed with shorter straight drives but to compress the tunnelling programme this was optimised to three shafts together with a ~400m length curved pipe jacking alignment. This has set a record for the largest diameter jacked pipes in Hong Kong while also fulfilling a curved alignment.

The shafts were formed by pipe piles to around 30m depth to avoid tunnelling through the deep rock fill layers formed during reclamation works back in the early 1990s. Advanced precautionary grouting was carried out ahead of the pipe piling works to control the ground settlement induced by coring in the porous rock fill layers.

The turbine hall is a braced steel framed building measuring approximately 60m by 60m on plan and 35m high.

CW system's civil structures

The CW system is a key component of any power station as an enormous supply of cooling water is required for waste heat rejection. The D1 project shares an inlet with the existing CW system, with a diversion chamber installed just before the existing pump station to allow water to be extracted for use in the new system.

From the diversion chamber onwards an entirely new below-ground system was installed which required deep excavation in difficult ground conditions to provide a pump station, three access shafts (which also provided launching/retrieval locations for tunnel boring machines) of approximately 1kM of 2.6m diameter pipes installed with a mix of pipe jacking and open cut and an outfall culvert.

From the diversion chamber onwards, an entirely new below-ground system was installed, which required deep excavation in difficult ground.

While all elements posed technical challenges, the most difficult element was the diversion chamber. The diversion chamber was constructed in the rock fill of an existing sea wall. The open structure of the rocks and free flowing ground water both meant that forming a watertight excavation would be very difficult as grout would be washed away before setting.

To overcome this construction issue, a precast scheme for the diversion chamber was developed to be installed underwater. The precast option was further refined using the contractor's input to select suitable weight limits and materials. An 800-tonne capacity barge mounted crane was selected to reduce the number of elements required to only four, with a maximum element weight of 420 tonnes.

Arup's value and results

Arup was employed for a full structural, geotechnical, MEP, sustainability, project management and architectural service by CLP and collaborated closely with the contractor to provide a highly co-ordinated and construction optimised design. By responding quickly to site issues and maintaining good communications with all parties, Arup was able to deliver an effective design despite the significant site and programme constraints associated with working on a functioning power station.

Moreover, due to the project's nature, a lot of the design packages involve elements of works that are atypical to the Hong Kong Buildings Department (BD). The project team worked hard to secure the BD approvals for the many interfacing packages. This was further complicated by the BD's request to submit some of the larger equipment such as the HRSG while the overseas designers are not familiar with the local BD system.

Upon completing this project, Arup has successfully delivered, from initial design through to its commissioning, a new state-of-the-art CCGT unit that is capable of achieving above 60% efficiency, which is significantly higher than existing gas-fired units at BPPS, and contributing to further emissions reduction and de-carbonisation in Hong Kong.

Relevant United Nations Sustainable Development Goals (SDGs)

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Designing a seismically resilient hospital in Turkey

As one of the world's most populous cities, Istanbul saw the need to expand their healthcare offerings with a new large-scale hospital to serve its growing population. In addition to providing world-class healthcare services, the hospital needed to be seismically secure, as Istanbul is located near the North Anatolian fault and has suffered highly destructive earthquakes in the past.

Client:
Rönesans Holding

Arup's scope of services:
Structural engineering and seismic design

Working with Rönesans Holding, currently operating in the roles of main contractor and investor in 28 countries around the globe and ranked 33rd in ENR's list of the world's largest construction companies, Arup designed Başakşehir Pine and Sakura City Hospital. Opened in May 2020, the hospital was jointly built by Rönesans Holding and Sojitz Corporation, a Japanese investment and trade corporation, using a Public-Private Partnership (P3) model. The hospital is the largest base-isolated building in the world, and features more than 2,000 seismic isolators, as well as one million square metres of construction area.

Başakşehir Pine and Sakura City Hospital features three hospital towers, six clinic buildings, and five auxiliary facility buildings that provide 2,682 beds divided between the main hospital, psychiatric hospital, and the physical treatment and rehabilitation facility.

© Rönesans Holding

The use of seismic isolation reduced the earthquake forces used in the design of the superstructure by a factor of 3.

As the structural engineer for the project, Arup ensured the seismic resilience of the large-scale hospital, which is located near the North Anatolian fault in an area that has suffered highly destructive earthquakes in the past.

Meeting ASCE 41 performance objective

The engineering behind the seismically resilient hospital was no small feat – it involved evaluation of hundreds of structural configurations, including multiple seismic isolation schemes and concrete wall layouts. By utilising digital tools and cloud computing, Arup was able to make the analysis of the large-scale structure possible while significantly improving the efficiency of the design process. By conducting the rapid seismic isolation and structural optioneering studies at the outset of the project, Arup was able to complete the design of the hospital in less than a year.

The hospital is designed to meet the ASCE 41 'Immediate Occupancy' seismic performance objective under a very rare earthquake event. To achieve the enhanced seismic performance criteria of the design, Başakşehir Pine and Sakura City Hospital's structure is supported by 2,068 triple-friction-pendulum (TFP) isolators, which can displace up to 700mm in a seismic event, allowing energy to be dissipated and reducing damage to the superstructure.

© Rönesans Holding

The hospital is the largest base-isolated building in the world, featuring more than 2,000 seismic isolators.

Harnessing the power of cloud computing

The seismic design for a building of this scale required far more complicated analytical modelling than would normally be the case. These models typically require stronger computing power and data processing capacity and, possibly, convergence issues. Therefore, Arup utilised cloud computing to run several analyses simultaneously to swiftly move this project forward while achieving substantial cost savings with optimisation methodologies.

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The hospital needed to be seismically secure, as Istanbul is located near the North Anatolian fault and has suffered highly destructive earthquakes in the past.

To design the building, the engineering team developed and utilised cloud-based structural analysis and data processing procedures. These procedures enabled the team to autoe structural optimisation processes and perform non-linear time history analysis of multiple structural schemes. The nonlinear time history analyses were performed using LS-DYNA software.

Over the past decade, Arup has developed a workflow for LS-DYNA analyses that features autoed model generation, multiple concurrent analyses, and postprocessing via cloud computing. With a cloud-based workflow, it is possible to run large suites of analyses in parallel, saving a significant amount of time. LS-DYNA has a large library of erial models that accurately capture the nonlinear behaviour of reinforced-concrete elements.

The hospital's concrete walls were modelled using composite layered shell elements available in LS-DYNA, using Concrete EC2, which is a concrete erial model developed by Arup. The concrete walls, coupling beams, and isolators were modelled inelastically. The hospital's gravity system as well as the isolation plane elements — concrete beams tying the isolators together and the concrete pedestals — were modelled as elastic elements.

Achieving substantial time and cost savings

The design team employed optimisation methodologies to minimise construction costs and to improve floor plan efficiency. Arup conducted a wall optimisation study in which a total of 180 different wall thickness configurations were evaluated. Performance results of each configuration and the associated concrete quantities were shared with the client via the Arup Optioneering platform. The intuitive interface allowed the client to be engaged in the engineering design and to leverage this inforion as part of their procurement strategy and process.

To further help the client decide on the most feasible isolator type for the project, Arup ran a full building performance evaluation using non-linear time history analyses on six different isolation schemes. Through traditional means of analysis and post-processing, this process would have taken approxiely six to seven months. However, by leveraging digital technology and cloud computing, Arup was able to go beyond standard computational limits and finish this evaluation within two months. This enabled the client to choose the most optimum isolation scheme based on performance, cost, and schedule.

The use of cloud computing and proprietary digital tools not only made the analysis of this large-scale structure possible, but also significantly improved the efficiency of the design process. By conducting the rapid seismic isolation and structural optioneering studies at the outset of the project, Arup was able to complete the design of the hospital in less than a year.

From the client's perspective, these benefits translated into actual cost savings of more than US$30 million, including the savings from the optimised volume of concrete used in the shear walls after a comprehensive analysis of wall configuration options during the design process. We also reduced documentation time by up to 30% by creating tools and processes to take inforion directly from engineering to the documentation model, bypassing the mark-up phase.

Arup Optioneering

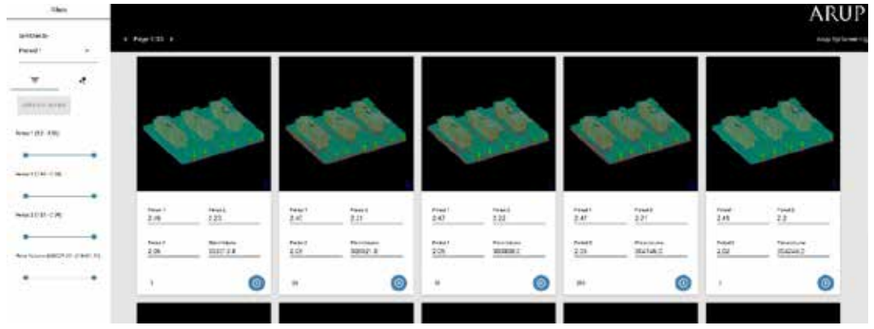
The Arup Optioneering application was used to provide structural engineers with the ability to seamlessly iterate and visualise analysis for concrete wall optimisation, as well as to provide the client with a straightforward way to gain insight into the ongoing optimisation studies.

With the Arup Optioneering interface, analysis results for the 180 models were compared. Based on the optimisation constraints set at the beginning of the study, wall concrete volume varied from 62,000m^3 to 72,000m^{3}s. The corresponding fixed based period of the structure was observed to be varying depending on the solution selected. The design team selected solution number 151, with a wall concrete volume of 66,005m^3 and a fixed based period of 1.73 seconds.

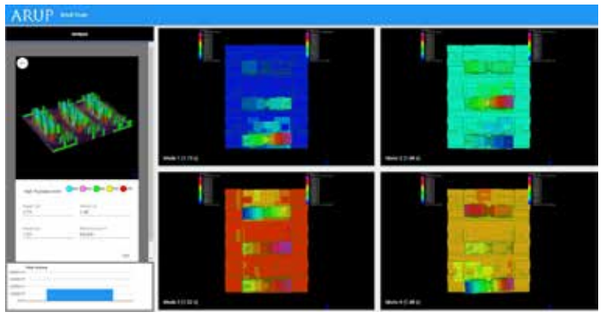
The final design ensures that the hospital can remain operational, even for functions as delicate as surgeries, after a Maximum Considered earthquake, an event so rare that it is expected to occur only once in approxiely 2,500 years.

Reference:

ASCE Source Magazine - https://source.asce.org/performance-based-seismic-design-succeeds-in-turkey



The Arup Optioneering web application was used for concrete wall optimisation.



Detailed modal analysis results for one of the 180 models on the cloud platform.

Relevant United Nations Sustainable Development Goals (SDGs)

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Traffic in Hanoi, Vietnam

Contributing towards Hanoi's seamless mobility

Client:
The World Bank

Arup's scope of service:
Transport consulting

Key facts

Only 10% of Hanoi's 7.7 million residents use public transport, whereas 70% of people use motorbikes, resulting in massive congestion issues and delays to buses.

The World Bank and others are tackling this by funding new Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) lines. Integration with the bus network is fundamental to achieving 35% public transport mode share by 2030.

Background

For rapidly developing countries like Vietnam, never has the need for improved transportation been more apparent. As urban population continues to grow, railway is considered to be the most efficient solution to meet the demand from commuters, adding a plethora of social and economic benefits, such as alleviating road congestion, promoting job opportunities, and lesser impact on the environment.

As part of the country's 2030 Transport Master Plan, Hanoi's transport authorities plan to build eight urban rail corridors, which will amount to 318km in length, and a suburban rail line, as well as 12 BRT corridors (totalling 44km in length) and 3 monorail corridors (totalling 205km in length).

The objective of the master plan is to reduce traffic congestion and pollution through an increase in public transport mode share to 35-45% of all trips and a reduction in the private transport mode share by 30%. A policy to ban motorbikes by 2030 is also being considered.

Scope of study

Against this backdrop, the World Bank commissioned Arup in 2019 to carry out an accessibility analysis on solutions to restructure the existing bus network to complement the BRT and rapid transit corridors, therefore providing an efficient, seamless feeder system and transfer experience for commuters.

To find out how rail and bus operators can work better together to improve the people-moving performance of multi-modal transport systems in high-demand corridors, Arup identified and carried out three major tasks in this study, including a network-level accessibility analysis, determination of highest-priority corridors, and development of bus route optimisation/reorganisation scenarios.

Network-level accessibility analysis

Arup's transport experts from Hong Kong, Ho Chi Minh City, Sydney and Melbourne offices developed comprehensive guidelines to formulate a set of bus network options to complement the new metro lines and improve network efficiency and accessibility.

We also developed a cutting-edge analytical tool for the network-level accessibility analysis – each of the options was tested to determine the optimal feeder bus network, as well as to prioritise future metro rail corridors. GPS data from buses, actual schedules, and arrival times of buses, together with the latest population and job information, provide insight into accessibility levels in the city.

The basis for the accessibility analysis is multi-modal travel time (including walk, wait, ride, transfer, etc) from one's home to a specific location (including job centres, hospitals, and schools) or vice versa. The yardstick used is often "the number of jobs accessible within XX minutes" or "the population within XX minutes of a hospital".

The map shows the population accessible in 2020 assuming implementation of BRT-1, MRT-2A and MRT-3. Green areas are more accessible to residents and may indicate better locations for job centres and higher density business parks.

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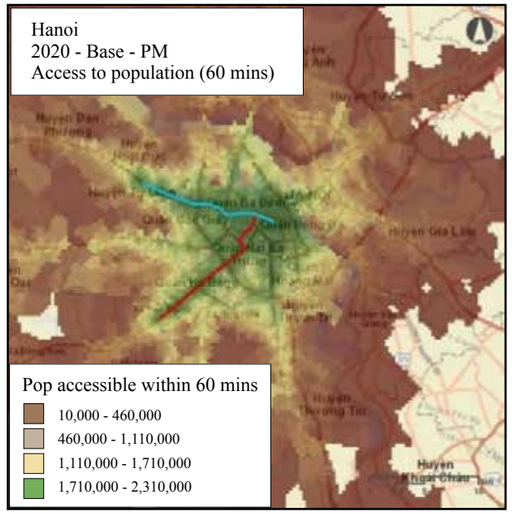


Accessibility analysis

Determination of highest priority corridors

The second task aims to determine the highest priority corridor(s) for new mass transit service investment. The 2030 Transport Master Plan identified nearly 20 corridors that could be eligible to be selected as the highest priority corridor for mass transit service by this World Bank Study. After analyses of on-site surveys and accessibility conditions, we recommended at preferred transit mode (i.e. BRT vs Light Metro) for each of the high-priority corridors (including different phases).

Development of bus routes optimisation/ reorganisation scenarios

The third task includes case studies on the past bus route restructuring and optimisation works carried out by Seoul, Dublin, and Ho Chi Minh City. Based on these findings, the current performance of the bus system in Hanoi and the impending opening of various rail lines to meet the 2030 Master Plan, Arup defined the vision for Hanoi's transport restructuring and optimisation plan as "creating an optimised public transport system with integrated and seamless rail and bus networks aligning with new mass transit corridors in 2020 and 2030", including the following desired outcomes:

– Seamless transfers between rail and bus

– Greater use of public transport and improved system performance

– Increased productivity and economic benefits from reduced congestion

– Safer and healthier residents/workers from less driving and accidents

We compared scenarios A and B developed for 2020 and 2030 respectively, including a Business as Usual (BAU) scenario and optimised schemes for the existing public bus network considering access to jobs/population in the city, provision of an effective feeder system to the new BRT corridor, the impending initiation of several urban rail lines by these time periods, as well as implications on operating costs and vehicle requirements.

Overall findings

After a comprehensive analysis, the "B" scenarios are concluded as the best means of integrating the bus network with the rail network to create a seamless and integrated public transport system for Hanoi.

In Scenarios B, feeder and spine choice of 15 minutes is deemed to be reasonable in order to provide "frequent service". And since minimising duplication on spines and targeted truncation can allow more frequent service on feeders, improve accessibility and system efficiency, long-distance, direct routing is considered to be desirable for riders. However, such routes may perform poorly while contributing to congestion. Targeted truncations should occur on key spines and future MRT corridors in 2020 (i.e. MRT-1/MRT-5), accompanied by service increases.

Service increases must be carefully considered. For 2020B, service increases for all rail feeders spines may be too extensive, resulting in net increase in Revenue Vehicle Hour (RVH). As a result, flexibility should be allowed when increasing service (possibly targeting high-performing routes instead of low-performing ones) to reduce RVH.

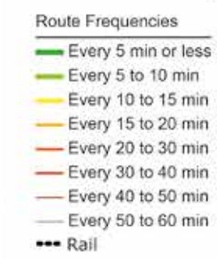
Recommendations

Policy

An integrated transport authority is suggested to be established to oversee Hanoi's public transport system, including rail and bus services, which should be held responsible for service co-ordinations, schedules, fares and facilities. The coverage versus productivity trade-off is something that the transport authority should pay attention to. Integrating fare payments across various transport systems, which are recommended, will benefit the patron and system. For the passenger, it makes it easier to use the entire transport system by simplifying the way the customer pays to use those services or allows easy switching or transfer between modes. Discounted fares or free transfers should also be offered for bus-to-bus and bus-to-rail interchanges.

2020B Scenario

2030B Scenario



Planning

To understand loading and establish headways, comprehensive on/off surveys of routes should be performed, in which mobile data can be collected, aggregated and analysed to understand travel patterns of bus passengers and the public. Metrics or standards should be established to gauge the performance of different services (i.e. strong/weak performers) and create route/service improvement framework. GPS data can be used to assess the bus service performance, such as speed, reliability, etc.

Physical

The development of improved integrated intermodal systems can result in a higher quality of service and passenger satisfaction. Better phyical integration of bus stops and rail stations with effective wayfinding will allow for convenient intermodal transfers. Bus priority measures on spine corridors (i.e. bus lanes, signal priority, etc.) are also recommended to set the stage for future rail development.

Arup's expertise and the study's impact

In this study, Arup developed comprehensive guidelines to formulate a set of bus network options to complement the new Metro lines and improve network efficiency and accessibility, ultimately improving the commuter experience with expanded use of sustainable transport modes. We employed an innovative quantitative methodology to measure the efficacy of the bus network, analysing variables including real-time GPS data, land-use information, and public transport locations. If proven successful in Vietnam, our approach could be reapplied to other Southeast Asian cities that face similar transport and congestion issues.

Having said that, several challenges were faced during the data collection process, such as limited availability of bus operating/performance data, lack of electronic ticketing system that tracks people's movements, outdated master planning assumptions and land-use forecasts, etc. Therefore, recommendations were made using the best available information provided, complemented by surveys, workshops, and our professional judgement.

Although there are several crucial challenges ahead for Hanoi, this study that aims to identify high-priority mass transit corridors and to develop a bus restructuring plan for 2020 and 2030 represents a positive step for Hanoi in achieving its mobility vision and public transport mode share goals.

Relevant United Nations Sustainable Development Goals (SDGs)

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Strategic leader

Raul Manlapig

Raul Manlapig is the Director who heads our Manila Office. He started working for Arup in 1995 as a Structural Engineer and assumed leadership of the office in the early 2000s. The office has grown from a purely buildings practice into a multi-disciplinary practice delivering projects mostly in the Philippines, while also providing support to other Arup offices in several regions. Raul ensures that he has the right talent mix and resources to deliver these projects.

He marked a new milestone in his career when he was appointed as a member of the Arup East Asia Board in 2019. "I feel that it's more like a celebration of my career in Arup for more than 25 years by being part of the Board. This actually gives me an opportunity to represent the Southeast Asia region and bring to the board a better perspective of what is happening in this rapidly growing regional market."

"It's my aspiration to play a part in the country's sustainable urban development process, especially the implementation of efficient urban transport systems and initiatives to build smart and resilient cities that will improve the quality of life of our citizens."

Raul Manlapig,
Director, Arup Manila

Arup's reputation attracts top talent

During his childhood, Raul found himself fascinated with how things were built. Armed with drafting technology knowledge earned during high school, he pursued a civil engineering degree. Working as a draughtsman while earning his degree, he started developing an interest in structural engineering and the idea of collaborating with architects and engineers in designing buildings with a sense of purpose.

"I had always wanted to be in an integrated design environment. In 1995, I applied for a job through a blind recruitment advert. When I realised that it was Arup, I didn't care about the salary. I just wanted to work for Arup because of its reputation. I had been a big fan of Arup's work for many years before joining."

Then, Raul began experiencing the One Arup approach to project delivery seeing first-hand how it resulted in better outcomes for the projects. He describes Arup's positive environment as open with mutual trust, so that ideas are welcomed and exchanged freely at any point in a project.

Essential entrepreneurial skills for engineers

As he climbed up the career ladder, he found his way into managing the office and growing its business. Engineer-turned leaders not only have to draw on their technical foundations to excel in project planning, implementation and delivery, but also in areas that are essential for managing a business, such as business acumen, financial literacy, people and client relationship management, in order to sustain the organisation.

Arup Manila office celebrated its 25th anniversary in 2017.

"Nowadays in Arup, I spend nearly 80% of my time managing the business instead of doing technical work. Since clients know Arup as an integrated, multi-disciplinary consultant, you need to be technically adept with a wide range of disciplines. In many instances, I have to be able to confidently talk about strategies to deliver complex projects, talk about geotechnical issues, building services, water, energy and so on, even though my experience is that of a structural engineer."

Managing a business is a challenge but the ultimate reward is seeing the fruition of your work. One has to be patient and persevering because growth does not happen overnight. He takes pride in being able to grow the Manila office from a mostly building structures practice to an office that can now serve the infrastructure, building and consulting sectors.

"It took a great deal of time and effort because the Philippines had gone through a turbulent economy brought about by a lot of natural disasters and political turmoil over the years, but I'm glad that we were resilient enough to wade through it and grow."

Career highlights

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Grand Hyatt Metrocenter
Located in the Business District of Taguig city in the Philippines, the Grand Hyatt Metrocenter is the tallest and biggest mixed-use building in the Philippines. Arup provided structural, wind and seismic engineering services for the building. The building employs Arup's Damped Outrigger System which reduces wind or earthquake induced sway vibrations in tall buildings.

© Mike Alquinto/ AP Images

St Francis Shangri-la Place
Located in Mandaluyong City in Metro Manila, St Francis Shangri-la Place it is the tallest residential building in the Philippines. This landmark development comprises two towers, each rising 60 floors to 217m high and providing a total of 1,200 units. Arup's patented damped-outrigger system was deployed in the project to help reduce the motion of the towers in windy weather and to dissipate energy during earthquake events. A total of 32 dampers were installed, 16 for each of the twin towers.

© Federal Land Inc

The Seasons Residences
This four-tower lifestyle complex is rising in Grand Central Park BGC Taguig. Arup's offices from Manila, San Francisco, London and Hong Kong have collaborated to provide the structural, wind, and seismic engineering services for the project.

Arup's main task was to provide a design that ensures safety, resilience, and cost-effectiveness. Through a performance-based design approach, a damped outrigger system with VCD was employed to provide additional damping for wind and earthquake, reduced the force imposed to the tower and allowed the structure to achieve a ductile performance.

© Marcel Lam Photography

Mactan-Cebu International Airport (MCIA)
The second largest airport in the Philippines has undergone a substantial transformation to cope with the growth in passenger traffic (before the pandemic). Structural timber is used as its main element for creating the large span roof, exuding earthy material warmth that is rarely seen in other international airports. Arup provided multidisciplinary services including aviation planning, airfield engineering design, transport planning, and bridges, civil, electrical, façade, fire, highways, mechanical and structural engineering.

Leadership journey

As expected, Raul's initial leadership roles were associated with his functional expertise. He was good at developing action plans and schedules to complete engineering projects while dealing and managing groups of technicians and engineers.

"As the head of a small office back then, I would say I had an authoritative style of management. But I have learned to be more strategic. I now try to focus on the long-term goals and align those with our vision. I put a lot more trust in our leaders to manage their teams and I give them as much room as possible to make their own decisions as this gives them the opportunity to learn, grow and develop."

Urbanisation requires infrastructure upgrades

Like other developing countries, rapid urbanisation is happening in the Philippines as the country's economy grows. The Philippines' GDP has increased by more than 6% per year since 2012. While investments in the real estate have grown rapidly in the past 15 years as well, the country's infrastructure development lagged.

Therefore, the government is trying to increase the public spending to about 5-7% of its GDP. With the Build Build Build programme, policymakers have demonstrated a strong will to build new infrastructures and improve the existing ones, from highways and bridges to railways, ports and airports, in efforts to upgrade the country's connectivity.

> "Apart from ensuring that we have the right talent mix and capacity to serve certain sectors, we also have to look for other markets and clients which we can grow with in the long run while having a positive impact on the environment and its communities."

"With our recent involvement in major infrastructure development plans like those for the Asian Development Bank (ADB)'s Infrastructure Preparation and Innovation Facility (IPIF) 1 and 3 as well as PPP projects, I think we have positioned ourselves very well to take a large chunk of this market in the years to come," he says.

"It's my aspiration to play a part in the country's sustainable urban development process, especially the implementation of efficient urban transport systems and initiatives to build smart and resilient cities that will improve the quality of life of our citizens."

For IPIF 1, all feasibility studies have been completed. Out of the eight potential projects the team was asked to investigate, at least three of the projects have been found to be feasible. These projects have gone through the review and approval process of the National Economic and Development Authority (NEDA) successfully. For IPIF 3, the team has continued to provide technical assistance to the Department of Transportation, mostly on rail projects in and around Metro Manila, as well as the Bus Rapid Transits, ports and commuter rail in other parts of the country.

Strong project pipeline fuels growth

Despite the disruptions caused by the pandemic, Raul believes the country's strong project pipeline bodes well when the economy starts to recover from the pandemic. The growth happening in the ASEAN region, including the Philippines, is seen to be a contributor to Arup's own growth in the years to come.

"Looking ahead, we will continue to help our clients tap on the numerous infrastructure development opportunities in ASEAN together with our strategic partners," he says.

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Listening builds trust

Theresa Yeung

Theresa Yeung, Director, East Asia Masterplanning & Urban Design Skill Leader and East Asia Board member, is head of Arup's East Asia planning team, leading a group of town planners, urban designers, sustainability and community engagement experts. She is recognised for her achievements in masterplanning, urban design and sustainability. More than that, she is a well-respected urban planner with a focus on community engagement.

While professional knowledge and technical skills certainly matter in the planning profession, achieving sustainable city planning requires the support, commitment and involvement of a variety of public and private stakeholders. To engage the community in the planning process, it requires an effective communication strategy that keeps stakeholders well informed, motivated and keen to participate, according to Theresa.

> "The skills to communicate effectively with community members from all walks of life are essential to an urban planner."
>
> Theresa Yeung,
> Director and Head of Arup's East Asia Planning Team

Childhood curiosity with how communities are built

As a child, we learned to wonder — and ask questions about the things around us. Theresa's natural curiosity during childhood about how communities are put together compelled her to explore her neighbourhood.

"When I was a few years old, I looked around at the public housing estate I lived. Why are there public spaces, community centres and amenities? There was a playground nearby, and my school was just within walking distance. And there was also a community centre, where underprivileged kids like us could play together." At that time, Theresa did not realise that behind every neighbourhood there is a planner who plans things out carefully.

Until when Theresa was in Form 5 of secondary school, she learned from student career talks about urban planning as a profession. That time she was already interested in human geography, a branch of geography that deals with humans and their communities, and interactions with the environment. "It's very much close to urban planning. That's why I decided to pursue my bachelor's degree in Geography at The University of Hong Kong, followed by a master's degree in Urban Planning at the same university."

The "Land Use Planning for the Closed Area" feasibility study was granted two awards by the Hong Kong Institute of Planners (HKIP) in 2007, during which Theresa was still working as a sub-consultant to Arup before joining the firm in 2008.

She believes that thoughtful community planning can create inclusive, liveable communities, where even underprivileged families can live a high quality of life in terms of green space, community places, public transport and local amenities. "That's the real satisfaction of being an urban planner."

Joining Arup to build the planning team

During the first ten years after graduation, she mainly worked as town planner in a local consultant firm. In around the mid-2000's, she joined another reputable planning consultancy, where she was involved in various planning studies, local and abroad, as sub-contractor over the ensuing few years.

In fact, Theresa had already worked closely with Arup on a lot of projects as sub-consultant before joining the firm. Shortly after the Hong Kong government had announced plans to build ten major infrastructure projects, she joined Arup in 2008. The reason for joining Arup is that she appreciates the corporate culture that encourages co-operation, rewards creativity and fosters a positive working style that creates opportunities for all individuals.

The very first project she worked on was a consultancy study on enhancement of the Lau Fau Shan rural township and surrounding areas. Theresa's team won a few more contracts afterwards, including the "Land Use Planning for the Closed Area" feasibility study awarded by the Planning Department (PlanD). Thanks to the trust established with the Hong Kong government, especially the PlanD, since the Lau Fau Shan study, Theresa's team was awarded even more contracts as the city's government intended to identify suitable housing development sites to boost short-to-long term land supply. "At that time, we only had a small team, but we were already overwhelmed with a large amount of work from internal and external clients. I still remember we worked on the Lau Fau Shan study through the Christmas holiday of 2009, and spent the

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Theresa spoke at a public consultation event for the planning and development of the Lau Fau Shan Rural Township, Hong Kong in 2010.

whole Chinese New Year holiday of 2010 on the Sha Tau Kok study. The Easter was spent on yet another study on Lok Ma Chau Loop," she recalls.

Listening to the community

For Theresa, the most challenging — and yet rewarding — part of the work is participation in public consultation activities. Her first major involvement in community engagement was to pave way for the construction of the MTRC West Island and South Island Lines, which were completed and commenced operations in 2014 and 2016, respectively.

The public consultations she was involved in for the development of Yuen Long South, a rural area in the New Territories, into a master-planned community was even more challenging. In 2011-2012, the PlanD commissioned Arup to carry out a series of studies to identify potential sites suitable for housing development, including Yuen Long South. Developing the area into a new community would have a large impact on the nearby rural villages.

Two rounds of public consultations were carried out in 2014 and 2016, respectively, to gauge the public's views on the preliminary and recommended outline development plans drawn for Yuen Long South as part of the planning study.

"I listened to what the villagers had to say… then I also had to explain to them the development objectives in layman's terms. I realise that there's always a way to talk to people with lower educational levels or the elderly. The skills to communicate effectively with community members from all walks of life are essential to an urban planner." Though the Yuen Long South study was complex, the process was smooth, thanks to a fantastic teamwork and companywide support, she says, adding that expertise from other teams was brought in.

Planning turned into a key business

Theresa did not expect planning could be turned into a major business function for Arup in ten years' time. The Lau Fau Shan study gained recognition not only from the government and professional bodies but also the media and the public in Hong Kong.

The team then drew on the experiences accumulated in Hong Kong's planning works, including transit-oriented development (TOD) projects, to undertake comprehensive planning projects in the Pearl River Delta (PRD) Region such as Qianhai and Nansha. In the past five years, Arup's planning team has expanded its presence across the whole country with a solid track record of over 200 projects in 16 Chinese cities.

Integration of SGR, UN SDGs into policymaking

Theresa also takes pride in having convinced policymakers to incorporate Arup's Smart Green Resilient (SGR) approach, which links human factors, smart city principles, sustainable development and resilience together to make the most of our resources and find the optimum solution. The SGR approach has now been adopted by the PlanD as Hong Kong's 'new planning vision'.

Arup also advocates policymakers to link the UN Sustainable Development Goals (UN SDGs) to their planning goals. In 2018, Theresa's team was awarded a contract to design the Urban Master Plan of the Macao SAR. It is the first masterplanning project in the East Asia region to encompass several of the UN SDGs.

Collaborative leader

As a leader, Theresa needs to make sure that team members share the same vision. She sees herself as a collaborative leader while providing strategic direction, boundaries and coaching for the team.

Finding work life balance

Apart from heading up the East Asia planning team and being a member of the East Asia Board, Theresa also sits on multiple statutory bodies such as the Planners Registration Board, the HKIP, Antiquities Advisory Board, Hong Kong Housing Society, the Corruption Prevention Advisory Committee of the Independent Commission Against Corruption (ICAC), and Professional Green Building Council.

When asked how she juggles with all these often-competing priorities, Theresa says she believes that finding work life balance is important. She exercises regularly, jogging, hiking, you name it; enjoys social activities; travels regularly; and practises yoga exercises for meditation and concentration. "It isn't only that exercise supports better physical health, exercise leads to better integration of professional and personal lives."

"Listening to my team members and understanding their concerns and difficulties are equally important. Very often I play the role of the mediator as well and serve as the catalyst to bring people together… a collaborative leader wears different hats at different times."

Arup's SGR approach was adopted by Hong Kong government's Planning Department (PlanD) as the city's planning vision in 2016. Pictured (left to right) are Theresa, Albert Cheng Ting-ning (now Executive Director at Construction Industry Council) and Wilfred Lau (now a Consultant to Arup and previously East Asia Board member, an Arup Fellow and Director).

Walking in the dark, bringing light to others: Orbis Moonwalkers 2018.

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Everything you know about healthcare is about to change

In its publication *Future of Healthcare Ecosystems*, Arup Foresight envisions that the future of healthcare service will be remarkably different from how it is provided today.

As one would expect, the pandemic years of 2020 and 2021 are going to change profoundly the way our healthcare system works. Rising temperatures, more frequent weather events and natural disasters as a result of climate change will also impact our future healthcare systems. And by 2050, the global population aged over 60 is expected to more than double.

Future healthcare infrastructure, delivery models and services will need to be resilient enough to mitigate the effects of climate change and their consequences whilst accommodating the needs of senior residents, according to a recent publication, called *Future of Healthcare Ecosystems*, by Arup Foresight.

Fortunately, advances in digital and mobile technology are leading to new ways of accessing and delivering healthcare services. Artificial Intelligence, wearable technology and telemedicine will help reduce costs and drive efficiency, whilst improving accessibility and convenience.

While the world is reeling from the effects of a global health crisis, societies are looking to provide more inclusive, accessible healthcare, and incorporate new techniques that keep citizens healthy at a lower cost. The publication addresses these topics through the lens of the built environment.

The Arup Foresight team used a variety of research methods to explore how healthcare ecosystems will evolve. Through this research, the team identified the key trends and drivers shaping the industry; these were then mapped and contextualised to build a holistic picture of future healthcare ecosystems in the urban environment.

A comprehensive view of future healthcare

Through their research the Arup Foresight team identified seven overlapping trends that will impact the future of healthcare ecosystems:

1. A shift to preventive models

Many of today's chronic illnesses are exacerbated by modern lifestyles, and treatment of these conditions is expensive. The publication suggests that in the coming years we will see a more preventive approach to healthcare which should cut those costs. We might, for instance, see more cycle paths in cities to encourage active travel or more frequent interaction with medical professionals who can help monitor people's health.

2. Greater accessibility

Today, medical treatment is largely made available by physically visiting healthcare facilities. However, the publication identified several examples where healthcare is becoming more diffuse — from mobile clinics to wearables with personalised advice for the individual.

3. Technology-enabled, human-centred experiences

The trend towards wearables and high-tech gadgetry is already well established in the healthcare sector. The authors expect this to expand further in the future, with ever more sophisticated tools entering the market. Nonetheless, this is not expected to replace humans — rather, it will enhance human care and assist with secondary, repetitive tasks.

4. Personal medicine

The "one size fits all" approach to healthcare that dominates in many countries will come to seem anachronistic. The publication expects personalised healthcare to become the norm — both in terms of the way medical services are applied in different cultural contexts, but also in the way medical facilities are designed. Gynaecology wards, for instance, might be designed with flexible floor spaces so they can be adjusted to provide differing levels of privacy and access in line with the cultural preferences of individual patients.

5. Urban regeneration

As more of the global population lives in cities than ever before, the publication highlights opportunities to respond by embedding healthcare into urban systems. By designing buildings, urban spaces and healthcare facilities to meet the health needs of the population, the city will be revitalised. We may, for instance, see healthcare pop-ups in neighbourhoods where people can drop in for a blood test on the way to work.

6. Localised healthcare

The publication also identifies a trend towards a more diffused healthcare system. Unlike today's model, where health services are only accessible in strictly defined locations (such as GP surgeries and hospitals), future healthcare will be accessible far more widely — at gyms, healthcare clubs, in the workplace. It will be more pervasive and therefore more likely to catch illnesses early.

7. Digitisation of healthcare operations

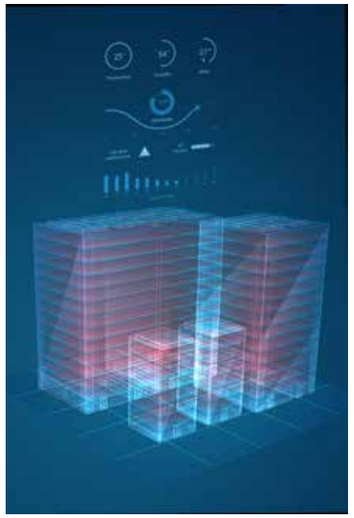
A final trend that the publication highlights is that many of the less visible sides of healthcare — from logistics to facilities management– will need to adapt too. We will begin using new technologies to meet changes in demand, from Big Data and AI to drones which can deliver materials to health facilities. This will increase efficiencies and offer cost savings to healthcare providers.

Although this holistic, pervasive approach to healthcare is not yet with us, the authors found numerous examples of healthcare services being offered in ways that are a step in this direction. This is a key aspect of Foresight research — identifying emerging business models which give signals of what the future will look like.

Health outcomes

The Arup Foresight publication develops an appealing vision for the future of healthcare, suggesting that a thoughtful urban design means many illnesses are avoided or their impact reduced. It is one where people receive the most appropriate care for their needs. And it is one where the link between individuals, society and the planet's health are recognised and aligned.

But this vision is far from certain — it will require a shift in our philosophy around healthcare. City leaders, urban planners, architects and engineers must therefore start asking where healthcare fits with their plans. Are buildings modular and flexible? Is healthcare easily accessible to all? Does a neighbourhood meet the healthcare needs of citizens, and the planet's health needs too?



Digital twins are poised to play an important role in the digital transformation of healthcare.

Download the Future of Healthcare Ecosystems publication

Watch the Future of Healthcare Ecosystems webinar

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Competitions drive corporate entrepreneurship

Through "start-up pitch" contests, an organisation is able to create an intrapreneurship ecosystem that supports and sustains innovation over time.

As we continue our journey towards a smarter built environment, it is increasingly important for organisations in the building and construction sector to know how to drive innovation. Promoting entrepreneurship from within is one way to boost corporate innovation. Encouraging aspiring employees to come up with innovative business models and participate in 'start-up' events can help promote 'intrapreneurship'. This way employees are encouraged to think like an entrepreneur.

Organising in-house competitions, forming teams to take part in open competitions, and organising open competitions can have many benefits. Employees can benefit because their ideas can come to fruition without them having to quit their job and risk their livelihood for their dream. The company can benefit because it allows them to keep their best and brightest employees while also taking advantage of their creativity. By organising open pitch competitions, organisations can crowdsource innovative ideas and solutions from the start-up ecosystem.

Organising in-house pitch competitions

More and more organisations, industry bodies and companies are organising pitch competitions for their employees or members. Take Arup as an example. Arup University has been arranging venture trainings and pitch competitions for employees. Apart from internal mentoring and funding support, winning teams are often encouraged to further take part in external competitions.

In collaboration with AI developer AI Gaspar, Arup won the 2021 Hong Kong Smart Transportation Challenge organised by the Hong Kong Science and Technology Parks Corporation (HKSTP).

One of the pitch competitions Arup University organises every year is Arup East Asia Ventures Pitch Competition. Just in March, three teams were named winners after impressing a judging panel made up of Arup's senior executives including Michael Kwok, East Asia Region Chair, and Isabel Dedring, Global Ventures Committee Chair and Arup Group Board Member.

While one or two in-house contests may not lead to substantial results right away, we acknowledge the long-term benefits that well-structured internal competitions and innovation programmes teach employees new skills, connect them across disciplines, and amplify the organisation's intrapreneurship, which provides an environment to support and sustain innovation over time.

Like the role of Arup University, organisations may further consider running internal incubation and intrapreneurship programmes. Through contests, intrapreneurs with great ideas and enthusiasm can be identified and then encouraged to enter open competitions. Outcomes may include a variety of possibilities, such as a new product line within the company, spin-offs and strategic partnerships.

Competing in open competitions

Effective solutions that can solve real-world problems require both innovation and practical experience. For entrepreneurs, succeeding in a competitive industry requires industry knowledge from industry experts who know the industry's pain points. That is why Arup has been partnering with tech start-ups to build teams with diverse areas of expertise to enter open competitions. Recently, there are two recognitions we are particularly excited for.

At the 2021 Hong Kong Smart Transportation Challenge hosted by the Hong Kong Science and Technology Parks Corporation (HKSTP), the AI-enabled traffic planning solution designed by a team formed by Arup and AI Gaspar, a Hong Kong-based AI developer, was selected from among 30 worldwide contestants as the best solution in analysing traffic situations, forecasting future situations and applying smart technologies to relieve traffic congestions.

At another international contest hosted by the Asian Development Bank (ADB), ASafeRide, developed by Arup, was selected as one of the two best solutions from the "Modelling a Safe Return to Work Challenge" and "Driving Safe Transportation Using Digital Solutions Challenge" under the #DigitalAgainstCOVID-19 hackathon held in December 2020. The app uses real-time crowdsourced data to connect commuters to various public transportation modes.

Receiving recognitions from high-profile pitch competitions will also open up funding, partnership, and business opportunities for not only Arup but also our partners.

Hosting your own start-up events

From the perspective of a large enterprise, organising or co-organising your start-up events, such as pitch competitions and hackathons, can quickly crowdsource ideas and solutions that will catalyse innovation and accelerate your digital transformation. These activities stimulate the creative energies of participants and foster problem-solving activities in a lab or staging environment.

The diversity of participants and their disciplines in a competition creates an atmosphere that forces them to convert their visionary concepts into to actionable solutions, and at times, marketable products. Furthermore, outsiders can bring a fresh perspective to the challenges your organisation faces.

As long as your organisation is strategic about engaging with start-ups, partnering with them can help accelerate the digital transformation of your business processes, services or products. In turn, the start-up can leverage the organisation's expertise, resources and networks to expand their business. From our observation, organisations that understand the benefits and risks of partnering with early-stage start-ups outweigh the costs, such as time, money and manpower spent on start-up events and mentorship, can make the most of these partnerships.

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Integrating fire engineering data into interactive platform

Introduction

Fire safety is one of the primary considerations in building design and operation. Fire safety provisions are designed and provided in buildings to ensure adequate fire safety level are maintained.

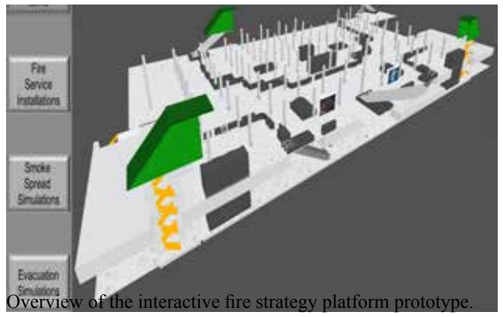
Fire safety design and operation records are now documented in a "book report" format. It means that complex analysis results from fire engineers, including architectural requirements, fire service installation requirements, CFD (computational fluid dynamics) simulations of smoke spread patterns and evacuation simulations are documented and presented in static format.

Building stakeholders may therefore have to seek assistance from fire engineers to explain these complex fire safety documents. It is important for them to understand the concepts of fire safety design and requirements thoroughly to ensure fire safety provisions are provided and maintained in good conditions. A more effective management of fire safety provisions can help ensure prescribed fire safety levels are rendered during the building operation stage.

The development of a digital fire platform provides opportunities for building stakeholders to understand the concepts and requirements as well as record inspections and maintenance records on a 3D building model platform.

Functionality

The prototype of the digital fire platform consists of four core functional modules. They are: (1) "fire safety items", which provides the building's fire safety requirements, information and records of fire safety provisions; (2) "fire service installations", which provides design parameters, drawings and condition of fire service installations; (3) "CFD simulation results", which illustrates smoke spread patterns of different fire scenarios in 3D view; and (4) "evacuation analysis results", which illustrates combined evacuation simulation results of different evacuation scenarios.



Overview of the interactive fire strategy platform prototype.

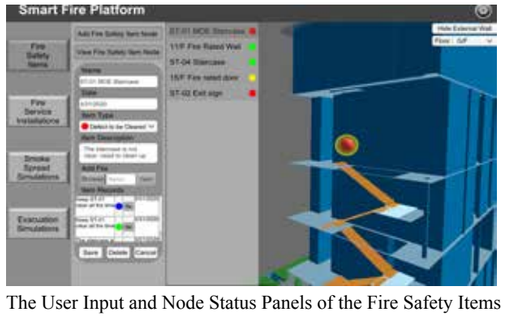
Fire safety items

Instead of illustrations and markings in reports, fire engineers can highlight and present the fire safety strategy and design concept on the platform. Fire engineers can provide design considerations, rationales and requirements in the 3D building model. Users can visit nodes in the model to understand fire safety design.

Users can also add and update the status of fire safety provisions in the building during the operation stage. Related documents (including drawings, product catalogues, calculations, etc.) can be added to the information node so that building operators can retrieve all design information related to building elements.

Fire service installations

BIM data of fire service installations can also be imported, illustrated and updated on the platform. Design drawings and calculations as well as the installation models can be imported into the platform. Data will be selected and extracted from the BIM model in order to provide a concise and compact information set for users. The design team can also highlight important design considerations on the platform for users to notice.



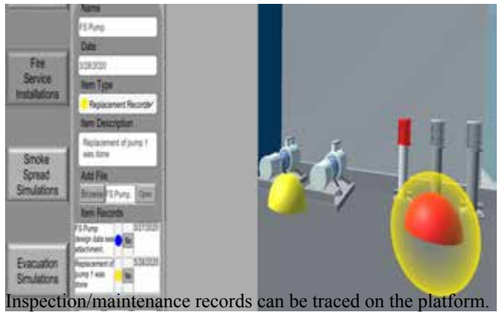
The User Input and Node Status Panels of the Fire Safety Items module.

Users, especially building operators, can update the inspection and maintenance records of system on the platform. Instead of log-sheets and discrete drawings records, users can examine all relevant system information and history on the platform.

CFD smoke spread analysis results

CFD smoke spread analysis results can be imported into and illustrated on the platform. Based on CFD simulations for different fire scenarios prepared by fire engineers, simulation result database files (ISOSURFACE data sets) are decoded by Submerge and migrated into the platform by UNITY. Simulations of smoke development patterns are visualised through the core platform.

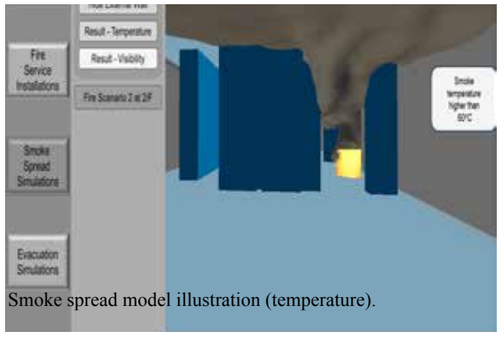
Instead of providing CFD simulation snapshots, the platform provides a 3D environment for users to merge data sets in different fire scenarios, and it helps users work out how smoke will develop and how the smoke-management system will react.



Inspection/maintenance records can be traced on the platform.

Evacuation analysis results

Evacuation simulation results can be imported into and illustrated on the platform as well. Based on MassMotion simulations for different evacuation scenarios by fire engineers, simulation result database files (MMDB files) are decoded



Smoke spread model illustration (temperature).

MassMotion results can be visualised on the platform.

by Submerge and migrated into the platform by UNITY.

Different from the snapshot results shown in the report, users can retrieve the simulation results by "going into the model". Users can observe and investigate evacuation patterns in different evacuation scenarios in a 3D environment. It not only helps fire engineers obtain the Required Safe Egress Time (RSET) but also enables engineers and building operators to understand local evacuation patterns and develop evacuation strategies.

Concluding remarks

The development of a digital fire platform is the first step to transform "static" fire safety strategy into "alive and expandable" data for visualisation, analysis and sharing with other stakeholders of buildings. Not only does this platform give building operators a clearer understanding of the fire safety design, it also allows fire engineers to explore the value of existing data and utilise the data to their maximum potential.

This prototype paves the way for a major overhaul of how fire engineers communicate their fire safety design and strategies with other engineers and building operators. The script is compatible with Neuron, Arup's proprietary smart building console that combines BIM with IoT and AI analytics, as we continue to build a digital twin building platform.

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Structural health monitoring of Stonecutters Bridge

After the super typhoon Mangkhut hit Hong Kong, Arup analysed the measurement data collected from some of the sensors deployed on the bridge with statistical tools that permit the detection and classification of the wind climate and structural responses.

Stonecutters Bridge structural safety monitoring

Designed by Arup and opened to traffic in 2009, Stonecutters Bridge is a cable-stayed bridge with a steel main span of 1,018m and a total length of 1,596m. It is the fourth longest span cable-stayed bridge in the world[1]. The towers are 298m tall with 1,055 tonnes of structural stainless-steel skin in the cable-stay anchorage zone. A vertical clearance of +73.5m below the deck will allow future generations of container vessels to access the Kwai Chung Container terminals.

A SHM for Stonecutters Bridge, called the SCB-WASHMS (Wind and Structural Health Monitoring System for Stonecutters Bridge), was developed by Arup, including the SHES (Structural Health Evaluation System) and SHMS (Structural Health Monitoring System) modules, and was deployed for the monitoring and evaluation of Stonecutters Bridge under its in-service condition.

The SCB-WASHMS is used to monitor and evaluate four main categories of physical/chemical quantities: (1) environmental loads and status, including wind loads, temperature loads, seismic loads and corrosion status; (2) operation loads, including highway flows and loads, ship impact loads and permanent loads; (3) bridge structural characteristics, including static influence coefficients/lines, global dynamic characteristics and stay cables dynamic characteristics; and (4) bridge responses, including geometry profiles, static stress distributions, dynamic stress distributions, fatigue life estimation, articulation performance, and composite-section interfacing performance.

Measuring Stonecutters Bridge's performance during Mangkhut

Methodology

The super typhoon was formed on 6 September 2018 and dissipated on 17 September 2018. It was a Category 5 storm with 180 mph winds at its peak and 130 mph wind gust when it hit Hong Kong. After the typhoon, Arup analysed the data[2] collected from the SCB-WASHMS sensory system to verify the design wind engineering process by studying the actual performance of the bridge under strong typhoons.

After acquiring and cleaning up the raw data, we developed event-specific wind climate models. Then, we developed methods to calculate the dynamic displacement of the bridge using acceleration data. We established a wind climate model based on the dynamic typhoon speed fluctuations and generated the representative power spectra. Based on these results, a wind buffeting analysis was carried out in frequency domain with the dynamic wind properties as the loading input. We then compared the structural effects such as the displacement and natural frequencies between the analysis and the actual performance measured by the WASHMS.

Process

The wind buffeting analysis model previously built during the design stage was calibrated and set up to simulate the same level of Serviceable Limit State during a particular period of the day of the extreme weather event. The analysis of the model using the recorded wind data input and assessment of the aerodynamic responses were done. The structural effects due to wind (including the dynamic displacement of the deck under wind loads), and comparison of these effects from design and measurement were also studied. Potential causes of overstress or any other unexpected behaviour was investigated.

Results

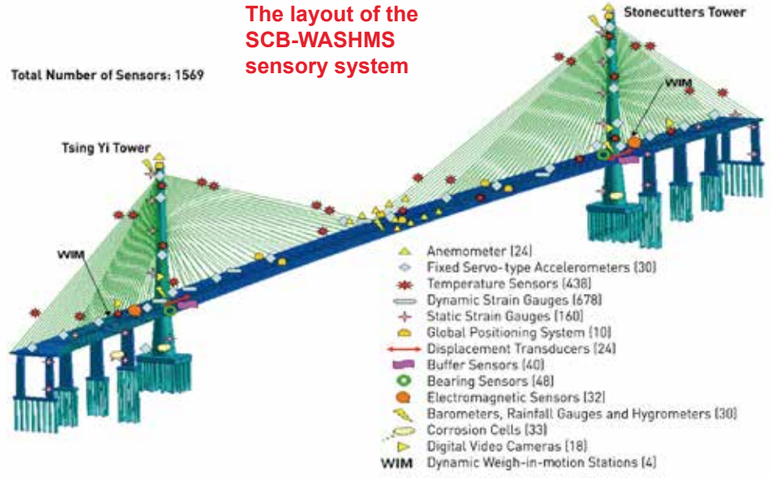
The research has shown some valuable insight into the SCB-WASHMS data. Some anomalies in results have been observed, which will help us further understand the wind climate and the behaviour of long-span bridges under such events. This is the first detailed validation of the WASHMS data after the WASHMS had been designed by Arup and deployed on the Stonecutters Bridge, giving us insight into the performance of the monitoring system as well as the bridge's real-time response. It also keeps Arup at the forefront of asset management and deploying the health monitoring system for long-span bridges in the drive towards digital twins.

WASHMS data for a bridge like this, which is fully instrumented, gives us more confidence in the analysis technique and computational models we use during detailed designs. The research has also provided our bridge and wind engineering teams with further insight about the dynamic behaviour and aerodynamic stabilities of bridges, which can help us earlier in the tender design to narrow down options and potentially save time and costs.

Conclusion and next steps

Arup is considered to be at the forefront of engineering innovation. We have already applied some of these health monitoring techniques to large structures, including Stonecutters Bridge in Hong Kong, Canton Tower in Guangzhou, mainland China, Queensferry Crossing in the UK and Marina Bay Sands in Singapore. This monitoring project and the results have strengthened our understanding of the loads acting on the bearings, the traffic events and the type of traffic passing over the bridge as well as the dynamic displacements of the bridge girder.

The layout of the SCB-WASHMS sensory system



[1] The longest span is the 1,104m span Russky Bridge in Russia. The second longest span is the 1,092m span Hutong Bridge in China. The third longest one is the 1,088m span Sutong Bridge in China.

[2] The data were provided by HKSAR Government's Highways Department, operator of Stonecutters Bridge, with permission for use in this research being granted.

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KM experts discuss post-COVID innovation at annual AKIF

Expert speakers shed light on lessons learned from the pandemic and discussed best practices in knowledge management (KM) at the annual Asian Knowledge and Innovation Forum (AKIF) co-organised by Arup University and the Polytechnic University of Hong Kong (PolyU).

COVID-19 has profoundly changed the way we work, live, and socialise. What role can knowledge management (KM) play to help organisations apply their expertise in new ways and thrive in this new normal? This topic was explored at the Asian Knowledge and Innovation Forum (AKIF), which took place online in March this year. The annual event was jointly organised by Arup University and the Knowledge Management and Innovation Research Centre of Hong Kong Polytechnic University (PolyU) with the support of Construction Innovation and Technology Application Centre (CITAC) and the Hong Kong Knowledge Management Society.

"As a knowledge-driven organisation, Arup's well-established KM strategy and early investment in digital transformation have paid off, allowing us to work closely while staying apart using new tools and systems housed in the cloud. Beyond internal operations, a structured KM system has also enabled us to quickly re-deploy our skills and develop new products and services – such as Neuron Health – for our clients during the pandemic," said Michael Kwok, EA Region Chairman of Arup, in his opening address. "We believe that knowledge and best practice sharing across industries will inspire more ideas and generate meaningful insights in terms of KM and business innovation as well."

Michael Kwok, EA Region Chairman of Arup, delivered the opening address at the AKIF 2021.

Asian Knowledge and Innovation Forum (AKIF) speakers

Dennis Wong
Senior Vice President of Emerging Technologies, HKT

Eric Chan
Chief Public Mission Officer, Cyberport

Dr Toa Charm
Associate Professor of Practice in Management, The Chinese University of Hong Kong Business School

Jade Lee
General Manager, Analytics and Technology Application, Sustainability and Innovation Centre, Chow Tai Fook Jewellery Co Ltd

Edward Chan
Assistant General Manager, Henderson Land Development Co Ltd

Yannick Lenormand
East Asia Foresight Leader, Arup

From creating a start-up ecosystem to democratising data literacy for knowledge intelligence and from digitalisation in the retail industry to health and well-being in buildings, five speakers from different industries shared the latest trends and developments in their areas of expertise to inspire more ideas and drive further innovation in the post-pandemic era. Arup's East Asia Foresight Leader, Yannick Lenormand, joined the speakers to share insights around the theme "knowledge and innovation in the post pandemic era".

The 2020 Hong Kong Most Innovative Knowledge Enterprise (MIKE) Award was also presented on this occasion. These organisations (sorted by alphabetical order) are recognised for their best practices in KM: CLP Power Hong Kong Ltd; EY Hong Kong; Hong Kong Correctional Services Department; Hong Kong Police Force; and Sino Innovation Laboratory Limited.

A number of the Hong Kong MIKE winners also received awards at the Global MIKE Award, showcasing that they have achieved global standards in transforming organisational knowledge into value-creating ideas and solutions.

> "We believe that knowledge and best practice sharing across industries will inspire more ideas and generate meaningful insights in terms of KM and business innovation."
>
> Michael Kwok, EA Region Chairman of Arup

Virtual walk-through

Take a virtual walk-through of the Digital Den at Arup's Hong Kong office (the event venue), view the speakers' profiles and MIKE Award winners in 3D and watch the playback of the event by scanning the QR code below.

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Learn smart, work smart!

Arup's Skills Networks provide a guided, sequenced curriculum taking employees through a strategic learning journey, so that employees of each technical discipline know what they are expected to learn in their current and future roles.

Arup's success is in part built on its capability in providing multidisciplinary services. Through Learning Paths, Arup University supports Global and Regional Skills Network Leaders to design and provide an adaptive, progressive learning experience tailored to the mix of skill sets and knowledge expected of the employee in his or her current or future role.

A Learning Path is a selection of training resources structurally tied together for an employee to progress through to succeed in the role. While there is no single path that fits all, it is being used as a framework to help Skills Networks, each of which contains experts who share best practices with each other based on specific industries and technologies, plan the development of future training.

Arup University works closely with Arup Skills Networks in the curation of face-to-face, online, formal and informal learning resources, from lunch talks and webinars to LinkedIn learning and formal classroom-style courses. Employees are encouraged to embark on a Learning Path. By doing so, not only will they learn new or enhance existing skills but can also deliver real-time work performance improvements.

How does a Learning Path work?

The training starts with the Learning Path matrix, which shows how Skill Categories are mapped to different proficiency Levels. The Skill Category represents a broad level skill/knowledge area, under which there are more specific requirements. They are laid out on a matrix which lists the Level on the vertical axis and the main categories of capability on the horizontal axis.

When there is a capability requirement present at a certain level within that category, the box in the matrix is highlighted to indicate a requirement.

The next layer of detail would detail the expected level of knowledge, skill or capability at the indicated level, and also list out all the learning activities that the employee can self-enrol on. Completion status is all recorded in our corporate database.

Learning methods

	Face to face		Online		
Informal	**Lunchtime Talk/ Presentation** Short presentation delivered live	**Masterclass** Group of presentations delivered live	**Online presentation** Short presentation delivered live online	**Online video** Stand-alone video	**Learning burst** Online, Moodle-based module consisting of multiple learning resources
Formal	**Classroom** Classroom-style learning		**Click and learn e-learning** Click-through e-learning for very large audiences	**Virtual classroom** Live online classroom session combined with online resources	**Self-directed distance learning** Moodle-based module consisting of learning resources with graded assessments

Types of Learning Path

- Technical Learning Path: Discipline-specific Learning Paths designed by Skills Networks
- Digital Learning Path: A learning framework for increasing the digital capability of all Arupians across roles, disciplines and businesses
- Sustainability Learning Path: A pathway to develop capabilities needed to fulfil our purpose of creating a sustainable future

Benefits of a Learning Path

Apart from the numerous advantages of continuous training and development for employees, a Learning Path has multiple benefits. Based on the required skill set, Skills Networks can analyse the skill gap and create a learning activity to close that gap while providing everyone in the discipline with clearer guidance about expectations and development options. It also helps the Skills Network prioritise and plan their yearly learning activities.

Based on the skills gained after completing a Learning Path, employees can be redeployed on the assignment they are good at and ease evaluation process for employees. For the courses and topics, our learning portal, Moodle, can provide real-time latest content for knowledge augmentation.

What a Learning Path looks like?

The two main elements that create the path are Level within the organisation and Category. These are laid out on a matrix which lists the Level on the vertical axis and the main categories of capability on the horizontal axis.

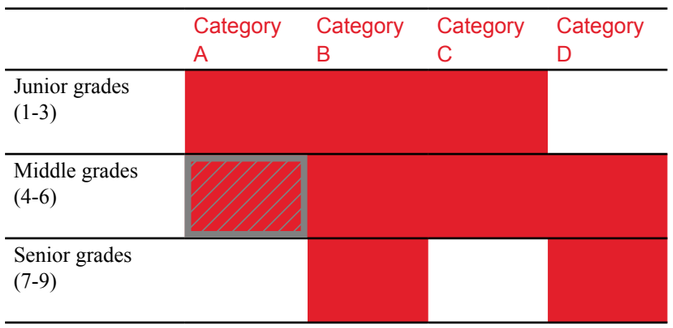
Category represents a broad level skill/knowledge area, under which there are more specific requirements (e.g. in Bridges & Civil Structures: structural form, materials, construction, analysis, loading, etc).

Level within the organisation can be linked to grade, cluster of grades, core role or length of time in the organisation (i.e. junior grade 2);

When there is a capability requirement present at a certain level within that category (e.g. the grey-framed cell), the box in the matrix is highlighted to indicate a requirement. The next layer of detail would provide several bullet points that outline the expected level of knowledge, skill or capability at the indicated level.

Learning path structure

- Design of X built in stages
- Awareness of XX principles
- Ability to evaluate and diagnose faults in XXX
- Others



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Offshore wind: what can Asia learn from Europe?

With the offshore wind market in Asia expected to reach 100GW of installed capacity by 2030, the region could emerge as a powerhouse in renewable energy. This is according to Peter Thompson, Arup's East Asia Energy Business Leader, who has spoken about how marrying the best of European experience with opportunities and local expertise in Asia is the right approach to take in unlocking the market. Writing on arup.com, Thompson said European wind engineers may encounter new challenges when working in Asia, including typhoons, high seismicity, soft marine deposits and hard volcanic and sedimentary rock sea-beds.

Scan to read Thompson's commentary:

Engineering design for tall buildings recognised

Arup enjoys a tremendous success at this year's CTBUH Awards. A total of 12 Arup projects in Asia have been named as Awards of Excellence winners. Organised by the Council on Tall Buildings and Urban Habitat (CTBUH), the awards programme honours projects that have made extraordinary contributions to the advancement of tall buildings and the urban environment, and that achieve sustainability at the highest and broadest level. Our engineering designs for CITIC Tower Beijing and Raffles City Chongqing – the tallest buildings in Beijing and Chongqing – were awarded in multiple categories. Our ten other projects in mainland China, Hong Kong, Singapore and Seoul were also recognised with a multitude of awards in other categories.

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Scan to view all winning projects:

Arup joins global Race to Zero as it sets sights on net zero emissions by 2030

Arup has reaffirmed its commitment to become net zero by 2030 by signing up to the Race to Zero, a global campaign to rally businesses, cities, regions and investors to take action for a healthy, resilient, zero carbon recovery that prevents future threats, creates decent jobs and unlocks inclusive sustainable growth. The initiative commits members to achieving net zero emissions by 2050 at the very latest to limit global temperature rise to 1.5°C above preindustrial levels. Earlier this year Arup committed to achieving net zero emissions across its entire operations by 2030, reducing its scope 1, 2 and 3 greenhouse gas emissions by 30% within the next five years and set out a plan of how this would be achieved. This target has been classified as ambitious by the Science Based Target initiative as it exceeds the minimum requirements for keeping global temperature rise under 1.5°C.

Scan to read the full article:

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