Foresight ▸ Innovation ▸ Research ▸ Sharing ▸ Training

Issue 7 2019

FORGE

A new life with a new function:

University of Chicago Hong Kong campus

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Foreword

Across the world there is a growing realisation that concerted and substantial steps are required if we are to create a future where people and the planet can both thrive. The United Nations' Sustainable Development Goals (SDGs) represent a pathway to achieving the changes required. Arup has made a commitment to and put plans in place to align our work with these SDGs.

In this issue, you can peek into how we are meaningfully contributing to sustainable development through our projects and in our research. These include how we embedded sustainable design features across the University of Chicago Hong Kong campus, marrying the old with the new to ensure the environmental expectations of students and faculty are addressed. We also look in-depth at the sustainable urban design for Tung Chung New Town Extension and a major upgrade of the existing San Wai Sewage Treatment Works to serve new communities in Hong Kong.

Climate change, bringing with it increasing extreme weather events, is no longer a threat for the future. In this issue, we explore ways to help clients evaluate seismic resilience of their structures and assess the risks of climate change to satisfy the recommendations issued by the Task Force on Climate-related Financial Disclosures.

Also, in this issue, you will hear from Arata Oguri and VC Cheong about their career journeys and what inspired them to persevere and come up with better solutions for their clients. You will also read our foresight, innovation, digital and knowledge management initiatives, which continuously enable us to find a better way to shape a sustainable future.

We hope you enjoy this issue and find it valuable.

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'd love to hear from you at ***ea.arupuniversity@arup.com****.*

A new life with a new function: University of Chicago Hong Kong campus

The University of Chicago's new campus has opened its doors on historic Mount Davis in Hong Kong, becoming a regional hub for research, education and collaboration.

The academic facility, officially named as The Hong Kong Jockey Club University of Chicago Academic Complex | The University of Chicago Francis and Rose Yuen Campus in Hong Kong, is now home to the University's faculty, graduate students and undergraduates working and studying in Hong Kong. Tours and exhibitions highlighting the history of the site are also available to the public.

Arup's Hong Kong and Seattle offices provided a range of engineering services for this challenging project, transforming a military bridgehead into a modern academic complex.

Client:
Revery Architecture (formerly known as Bing Thom Architects)

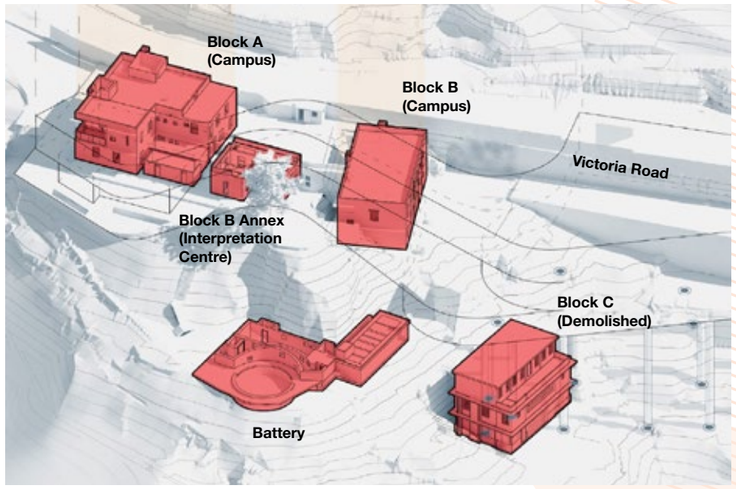
Owner:
University of Chicago

Donor & Sponsor for Heritage Revitalisation:
Hong Kong Jockey Club

Arup's scope of services:
Civil, geotechnical, structural, acoustic, audiovisual, fire safety strategy, building services and sustainability

The original site

The three revitalised building blocks blend well with the new campus building



Location of the heritage buildings in the site

Converging the past and the future

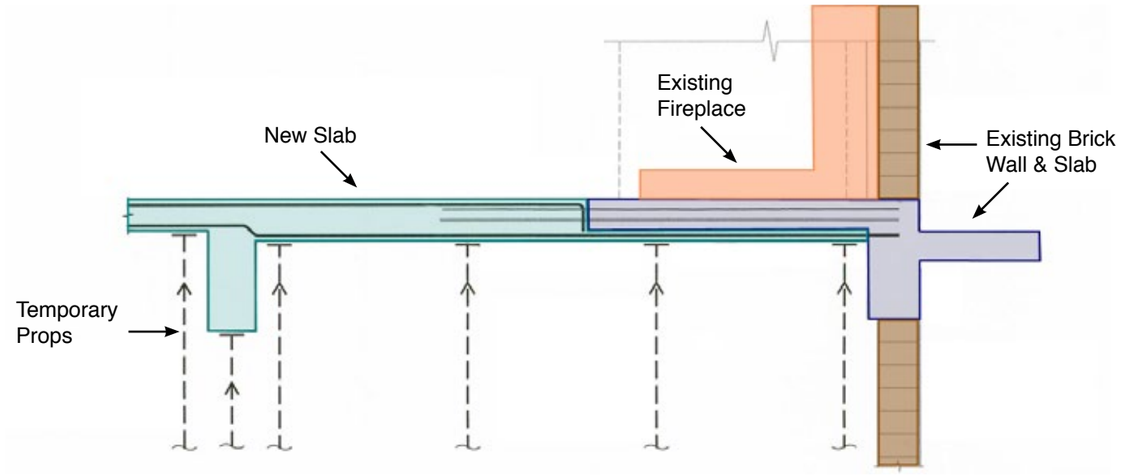
The site includes part of a military complex built by the British Army in the 1930s to defend the western side of Victoria Harbour. After World War II, the Special Branch of the Hong Kong Police Force took it over and converted it into a detention centre. After the handover in 1997, the site served as accommodation for police officers. In 2013, the University of Chicago Booth Business School was granted this site to set up their EMBA programme in Hong Kong.

The original site consisted of four building blocks – A, B, C and Block B Annex – sprawling across the coastal slope near the Mount Davis Path. Blocks A, B and C were 2-storey reinforced concrete buildings, while Block B Annex is a 1-storey building of reinforced concrete and masonry. A battery and a few supporting amenity blocks (e.g. magazine, kitchen, vaults) were constructed close to the coastline.

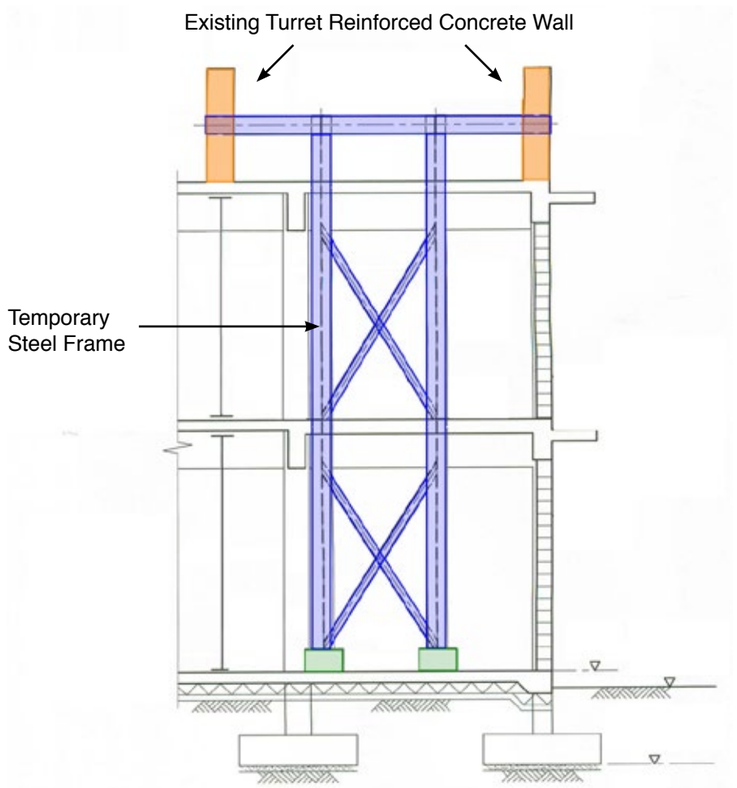
Extensive alteration and addition works were carried out to convert Blocks A and B into functional buildings for the business school while Block B Annex was converted into a Heritage Interpretation Centre for exhibition to the public. Block C and the kitchen buildings were demolished but the outline ruins were retained for exhibition purposes while the magazine block was left intact for display.

A new 3-storey academic building was built as the main building for Booth Business School. It features a curvy ribbon profile spanning about 100m from the north to the south of the site, seamlessly interlocking with the heritage buildings. The south part of the building floats above the mountain slope with slender columns up to 17m tall, connected by a 22m link bridge to the north part which rests at street level facing Victoria Road.

Roof turrets at the top of Block A (building with white roof)



Strengthening works for the floor slab under the fireplace



Underpinning works at the roof turrets during the floor demolition works

Structurally preserving a building's history

Blocks A, B and the Annex were modified and strengthened to suit the needs of the new Interpretation Centre and classrooms of the school. Block An underwent extensive demolition and recasting to reinstate the original building design while meeting modern structural integrity standards. Key elements with significant historic importance were retained and protected during the structural modifications including two roof turrets, a masonry fireplace and an internal staircase. Underpinning works were carried out to support the turrets during floor demolition works. The floor slab under the fireplace was strengthened by carefully recasting the lower half of the slab from 150mm thick to 180mm thick through new rebar fixings and well controlled concreting works.

Fireplace in Block A, constructed by the Royal Engineers during 1951-1961, was retained

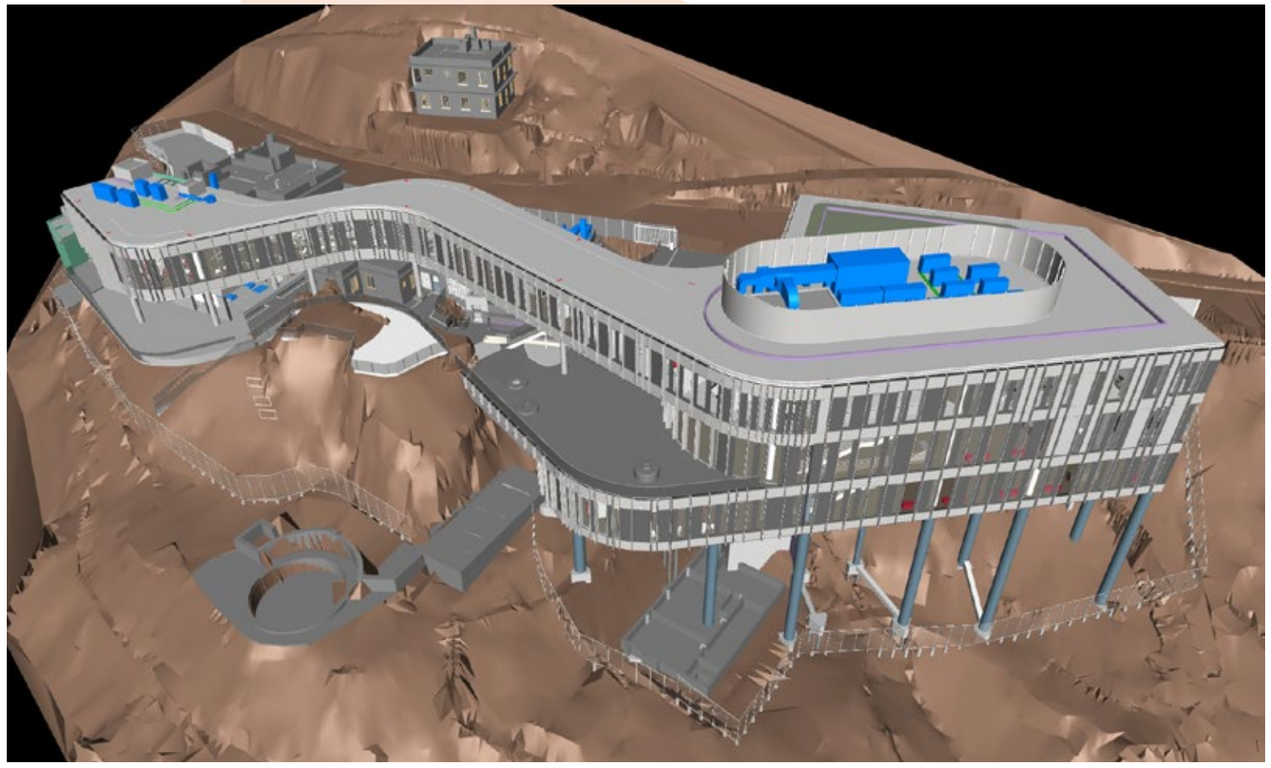
Traces of detention cells found on the ceiling and ground floor slab of Block B

In the Block B detention centre, cells were removed before site possession but the cell marks were left on the floors and ceiling, as they were considered historically significant. Transparent anti-carbonation coatings were developed to protect the slabs with cell marks against further carbonation. In addition, part of the original concrete beams were demolished and recast as encased composite beams to preserve the character and structure of the historic building.

Forming the 'Treehouse of knowledge'

The new academic building was inspired by the concept of 'Treehouse of knowledge' in which tall slender columns emulate tree trunks growing up from the sloped side under the building to echo the history of squatter buildings occupied by the Chinese Nationalist Party soldiers in the Mount Davis area during the civil war.

The building was constructed using structural steelwork primarily and a localised reinforced concrete structure with the longest beam spanning up to 22m at the link bridge connecting two sides of the building. The south side is supported by tall slender 600mm diameter columns towering as tall as 17m. Fair face concrete was adopted where the building envelope was not covered by the fritted glass curtain wall, while internal steel columns were covered with architectural fair face concrete. Raking mini-piles support the building by providing gravity resistance and lateral stability.



Virtual model in BIM assists the engineers to design the new building

© Revery Architecture

A sustainable and inspiring learning environment

Sustainable learning campus

Targeting BEAM Plus Silver certification, Arup successfully fulfilled the University's desire to create a sustainable environment for learning. The designers incorporated a wide range of sustainable features into the design including a high-performance façade, high efficiency air conditioning system with heat recovery, reduced lighting power density, daylight responsive controls, increased fresh air flow rate and a demand-driven fresh air supply system.

These sustainable features have not only enhanced the indoor environment quality but also made the building more environmentally friendly and more energy efficient – helping to cut energy consumption and CO_2 emissions by approximately 10%. Water saving fixtures were also adopted, targeting a 30% potable water usage reduction.

In this project, the University of Chicago together with the team of architects and engineers have conducted extensive studies in order to retain the Grade 3 heritage buildings. This creates a new local example of how new developments can integrate with heritage buildings.

Strengthening the slopes

The slope beneath the south building was strengthened by cement stabilised soil using the pit-by-pit replacement method. It is a more cost effective and quicker solution compared to the traditional soil nail solution. The 30-degree cement soil slope has become a more stable geotechnical feature and this method also avoided any possible clashing of the soil nails into the raking piles.

However, soil nails were installed in selective slopes along with masonry retaining walls to strengthen the slope. An uncharted retaining wall along Victoria Road was upgraded with a new skin wall with a tie-back system. Arup reviewed and advised on constructability issues with the pre-construction advisor to ensure that the proposed piling and site formation works could be carried out safely within the tight construction programme.

Fitting function in form

Whether in the sweeping, clean, ribbon architecture of the new construction, or the careful integration into the historical parts of the facility, the building services team worked closely with the architect and contractor to create an exemplary project of historic preservation with modern technology. Our designed systems meet a variety of modern technological and environmental requirements and seamlessly integrate into the required functions without compromising the historic character of the building but still retaining the architectural intent of the new facility.

Seamless integration of historical and modern architecture

© Revival Heritage Consultants Ltd

A town of vision:
Tung Chung New Town extension

Project:
Planning and Engineering Study on the Remaining Development in Tung Chung

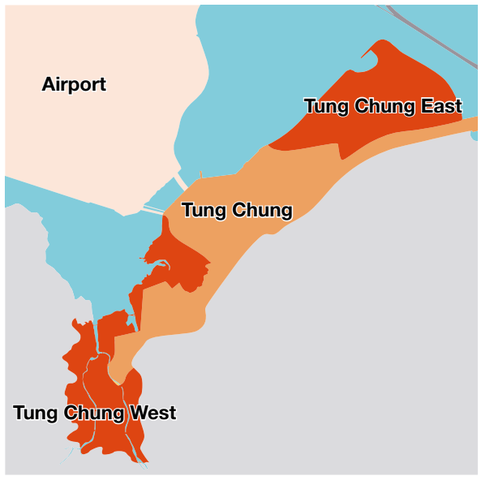
Client:
Planning Department and Civil Engineering and Development Department (CEDD) of HKSAR Government

Arup's scope of services:
Assessment of land requirement, environmental impact, traffic and transport impact, urban design, landscape and sustainability

Project:
Tung Chung New Town Extension (West) - Design and Construction

Client:
CEDD

Arup's scope of services:
Civil engineering design, site supervision



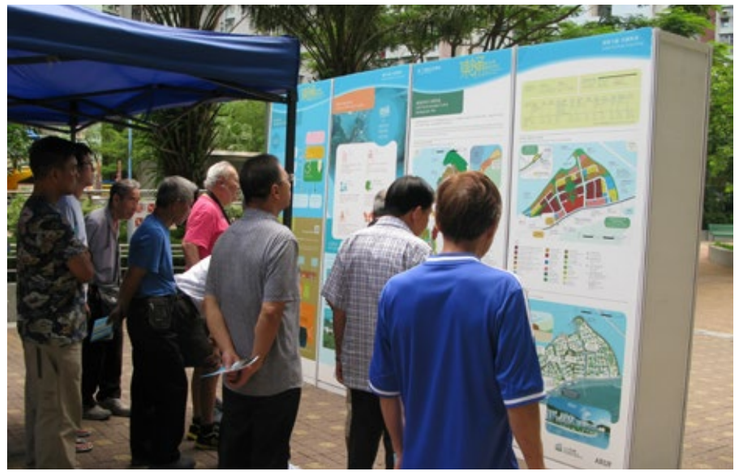
■ Location of TCNTE

Tung Chung New Town Extension (TCNTE) is an initiative of the Hong Kong Government to increase land supply and further develop the existing Tung Chung New Town to meet long-term housing needs.

Arup was commissioned by the Planning Department (PlanD) and Civil Engineering and Development Department (CEDD) in 2012 to carry out a planning and engineering (P&E) study. The objective was to explore the development potential and opportunities of Tung Chung and its adjacent areas and recommend a preferred development scheme. Our work included environmental impact assessment, public engagement and detailed technical assessments on the feasibility of the development plans with respect to various disciplines. These included marine ecology, traffic and transport, geotechnical, urban design and landscape, drainage, sewerage and utilities.

With its proximity to the Hong Kong International Airport (HKIA) and the Hong Kong-Zhuhai-Macao Bridge (HZMB), Tung Chung is in a strategic location to become a regional commercial hub. On the other hand, Tung Chung is surrounded by two large country parks with areas of high ecological value and cultural heritage. Therefore, it is important to strike a balance between urban development and natural conservation.

The proposed TCNTE will cover areas on the eastern and western flanks of the Tung Chung New Town (TCNT), namely Tung Chung East (TCE) and Tung Chung West (TCW). A 3-stage public engagement exercise, including roving exhibitions, public fora and more than 30 focus group and statutory advisory meetings, was carried out from 2012 to 2014 to gather comments and proposals from stakeholders, green groups and local communities for consideration in formulating the initial land use options. Based on the technical assessments and the public views collected, zoning and the recommended outline development plans (RODP) for TCNTE were formulated.



■ The public engagement process included a community workshop (top) and roving exhibitions (bottom)

The main objectives of the RODP are to:

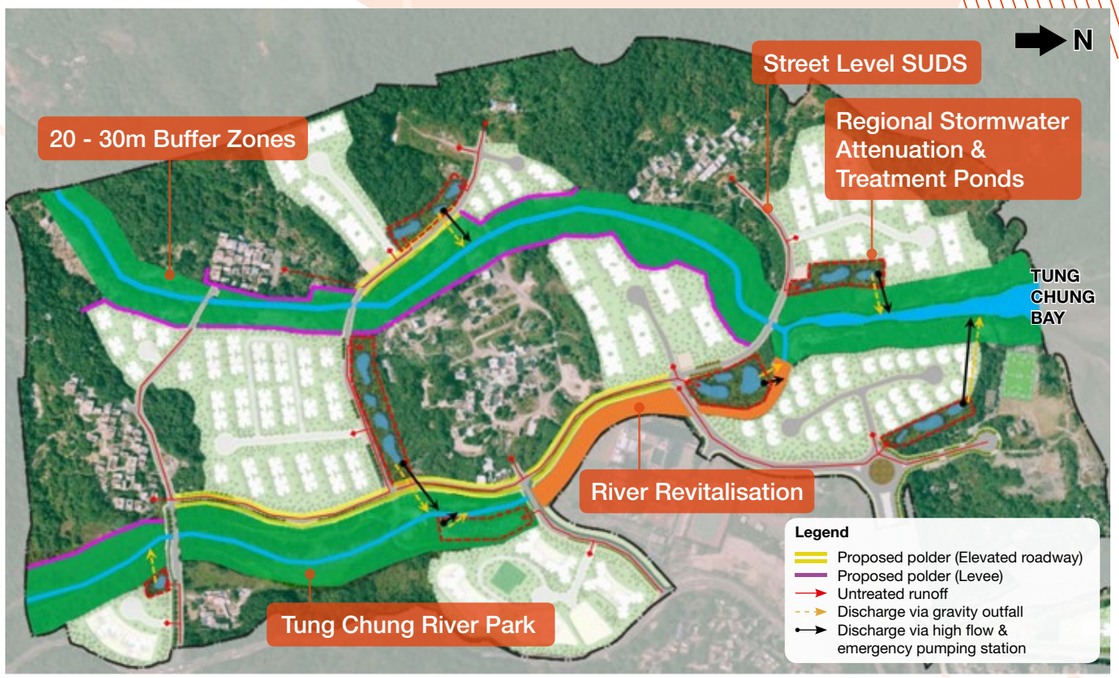
- Meet housing needs:
  TCNTE will provide about 49,600 flats to accommodate a population of 145,500, with a balanced mix of public and private housing.
- Promote economic development:
  TCNTE will promote regional commercial activities. Around 877,000m² GFA for commercial use will be provided and 40,000 new jobs will be created. A new technical institute has also been planned to match the skills required in supporting HKIA.
- Improve connectivity:
  The provision of a comprehensive road network and two new railway stations at TCE and TCW will improve connectivity to other districts in Hong Kong as well as in-town access.
- Provide balanced allocation of facilities and open space:
  Locations of government, institution and community facilities have been planned with careful consideration to ensure easy accessibility. A long-awaited standard sports ground and other forms of open space will also be provided.
- Adopt sustainable urban design:
  Development of TCNTE will integrate with the natural topography to create a sustainable living environment.
- Preserve heritage and ecology:
  Ecologically-sensitive areas will be designated with appropriate conservation zonings and historical sites, such as the Tung Chung Fort and Battery, will be protected. Local villages will be preserved and the distinctive Ma Wan Chung fishing village will be revitalised to promote tourism.

Proposed overall SUDS

The RODP has adopted different development strategies for TCE and TCW. For TCE, which is to be built on around 120ha of reclaimed land, design constraints will be minimal and will follow a high-density, transit-oriented development (TOD) model. On the other hand, TCW is characterised by its rich natural resources and cultural heritage. Hence its RODP focuses on conservation and only low-rise, low-density residential uses compatible with the natural and rural environment have been proposed.

Despite the different development approaches, environmental considerations have been key drivers. Environmental issues were not simply taken as constraints but also treated as opportunities to seamlessly integrate with existing land uses. Some examples:

Conceptual layout of the proposed Tung Chung River Park



Conceptual design of the Tung Chung River Park

Tung Chung River Park

To promote a water-friendly culture, the east tributary of Tung Chung Stream will be developed into a river park for educational and recreational use, the first of its kind in Hong Kong. The river park will comprise a 415m long revitalised engineered channel section together with a 360m long intact natural section immediately upstream.

Revitalisation of the engineered section will involve removing the concrete surfaces of the channel and replacing them with natural materials such as river pebbles to stabilise the embankments and promote growth of aquatic plants. Elements such as fish ladders and flow deflectors will also be introduced to enhance biodiversity. For the intact natural section, a buffer about 30m wide on both banks will be zoned as Conservation Area to protect the core habitat of a rare butterfly species and also to serve as flood storage during heavy rainstorm events.

A real-time flood warning system will be devised and implemented in the park.

Due to the proposed development in TCW, an increased risk of polluting Tung Chung Stream and Tung Chung Bay is anticipated. For more effective protection of the ecology and environment, a comprehensive Sustainable Urban Drainage System (SUDS) will be applied at both street and regional levels.

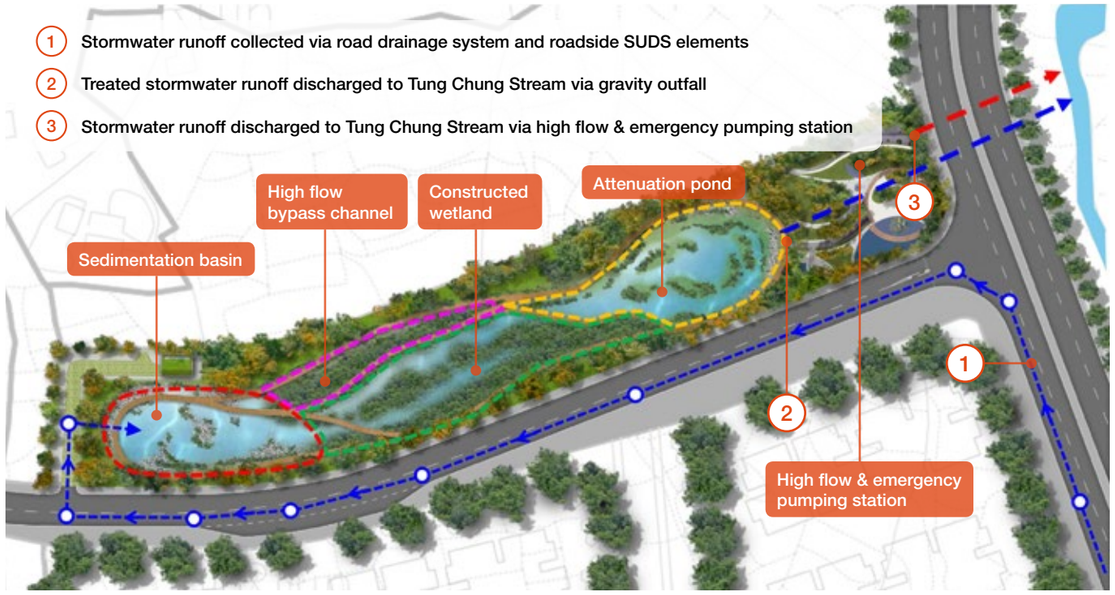
The proposed SUDS, the first to be extensively adopted for a new town in Hong Kong, will function through a series of treatment processes to remove pollutants in surface water before discharge to Tung Chung Stream. The polluted runoff at street level will be collected and conveyed by roadside bioswales (vegetated open channels) and infiltration planters

for pre-treatment to capture coarse to medium-sized sediment and the runoff subsequently discharged into the designated regional stormwater attenuation and treatment ponds for secondary and centralised treatment.

A total of seven regional stormwater attenuation and treatment ponds have been proposed. Each pond will consist of three zones:

1. Sedimentation zone: Receives polluted runoff from the road drainage system and allows deposition of sediment.
2. Biofiltration zone: Allows treatment action to occur while runoff travels slowly through dense wetland plantation to remove fine particulates and encourage the uptake of nutrients by the plants.
3. Attenuation zone: During minor rain events the attenuation zone will receive the treated runoff from the biofiltration zone for discharge by gravity into Tung Chung Stream. However, during extreme rain events high flows will bypass the sedimentation and biofiltration zones and be directed to the attenuation zone for stormwater detention.

The SUDS will also enhance biodiversity and amenity value within the Tung Chung Valley through the selection of plant species in the landscape design.



Conceptual layout of the proposed stormwater attenuation and treatment ponds

Pedestrian network at TCE

Green space

Provision of greening and open space is one of the key features for the urban planning of the area.

In total, approximately 20ha of green area will be provided in TCE, including the three linear parks connecting the proposed railway station to the new waterfront promenade and marina. Development plots along the linear parks will provide low-rise, street-facing shopfronts to create a more friendly walking environment.

In addition to the waterfront promenade that connects TCE with the existing TCNT and TCW, a 'Central Green' of nearly 5ha is proposed at the core. This Central Green will become the new mingling hub for local residents. The key district road running east-west across TCE will run beneath the Central Green to avoid the need for pedestrians and cyclists to cross the main road by flyovers or subways, a problem commonly found in the existing TCNT.

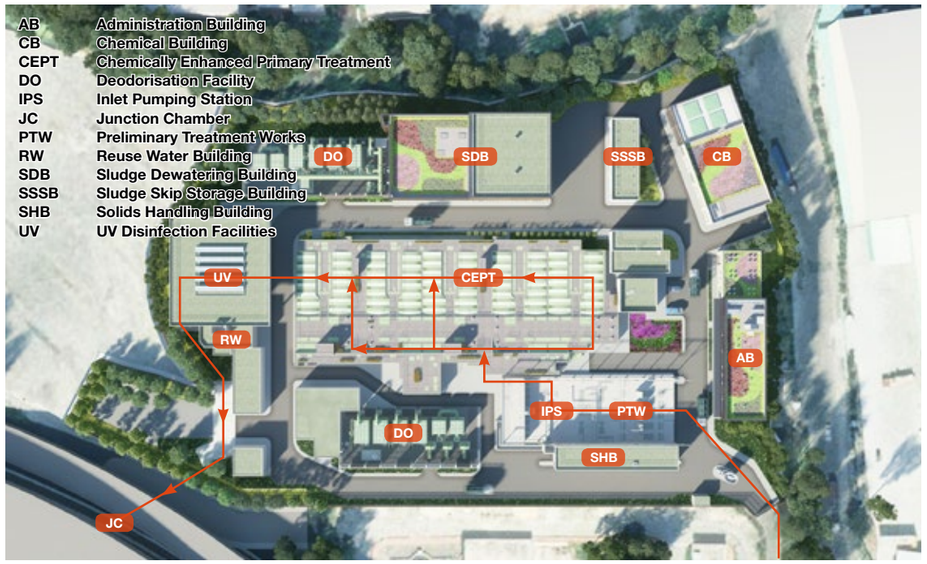
The P&E study was completed in 2018 and the project is currently in the design and construction (D&C) stage (Arup has been commissioned for the detailed design of TCW consultancy). The first population intake of Tung Chung New Town Extension is projected to start in 2023.

© CEDD

A stepped building height concept is adopted, where density of development descends from the railway station towards the waterfront.

© CEDD

Mixed residential and commercial uses will form a Metro Core Area with focus on TOD around the proposed railway station. And the commercial belt next to the station will help screen out noise from the railway and highway.



Site layout plan and flow of wastewater in the site

A sustainable upgrade:
San Wai Sewage Treatment Works

Client:
Joint Venture of ATAL Engineering, Degrémont (now Suez) and China Harbour Engineering Company

Owner:
Drainage Services Department of the Government of the Hong Kong SAR

Arup's scope of services:
Design of the site layout for regulatory compliance and detailed design for hydraulics, civil works, structures, geotechnics, architecture, landscape, building and fire services and BIM Management.

To cope with an increasing population, the Government of Hong Kong SAR is implementing a major upgrade to the existing San Wai Sewage Treatment Works (SWSTW) to serve new communities in the Northwest New Territories (NWNT). The project scope includes the replacement of the existing preliminary treatment works and the construction of a new chemically enhanced primary treatment works, ultraviolet (UV) disinfection and sludge dewatering facilities. Arup has been engaged by the Joint Venture of ATAL Engineering, Degrémont (now Suez) and China Harbour Engineering Company (the JV) design-build-operate (DBO) contractor as the main designer for the SWSTW after having successfully supported them through the competitive tendering process in 2014. Besides, China Harbour Engineering Company also engaged Arup to perform civil, structural and geotechnical engineering detailed design.

A compact site for a high volume of wastewater

Upon completion, the new facility will be able to treat a peak daily capacity of 494,000m³ of wastewater (equivalent to a population of nearly 1 million). The project is similar to Hong Kong's first DBO project, Pillar Point Sewage Treatment Works, another project in which Arup worked in a similar capacity but the site of SWSTW is 30% smaller.

As the designer for the overall site arrangement, a major technical challenge for Arup was to arrange all the required facilities into the limited space. The small size (26,500m²) makes the conventional water treatment process impossible since it would require a series of settlement tanks with a total area larger than the site. A chemically enhanced primary treatment system using Degrémont's Densadeg® technology was, therefore, adopted giving a higher rate of settlement, thus reducing the tank footprint. Densadeg, a compact and efficient physical-chemical settling tank, includes stages of coagulation, flocculation, water clarification (lamellar zone) and settling/thickening of sludge.

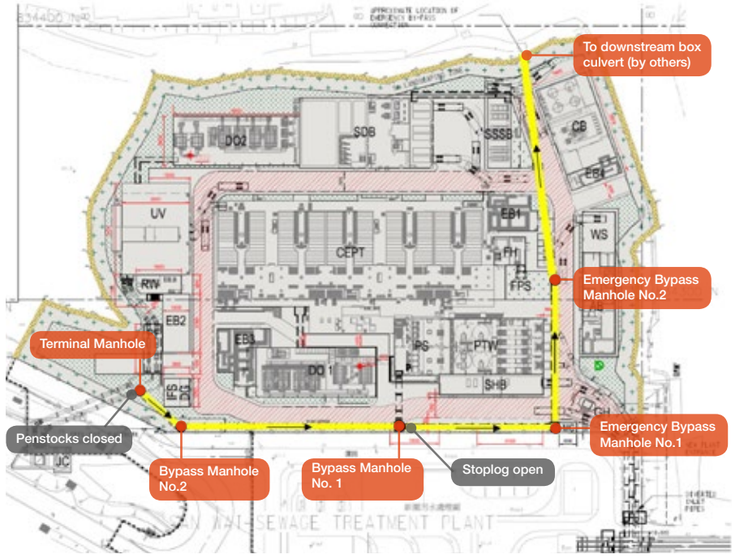
The new preliminary treatment works inlet will be used for grit removal and screening for foreign objects. Wastewater is then pumped to the chemically enhanced primary treatment system for settlement and then subjected to UV disinfection before discharge to the existing outfall tunnel.

Besides the small site area constraint, Arup also needed to ensure the site arrangement would meet the contract specification, town planning and regulatory constraints, including structures not exceeding 13.9m high, and avoid the use of above ground pipes and duct work. The site layout enables the provision of a circulatory access road suitable for plant operation while still meeting statutory requirements for emergency vehicle access for fire-fighting.

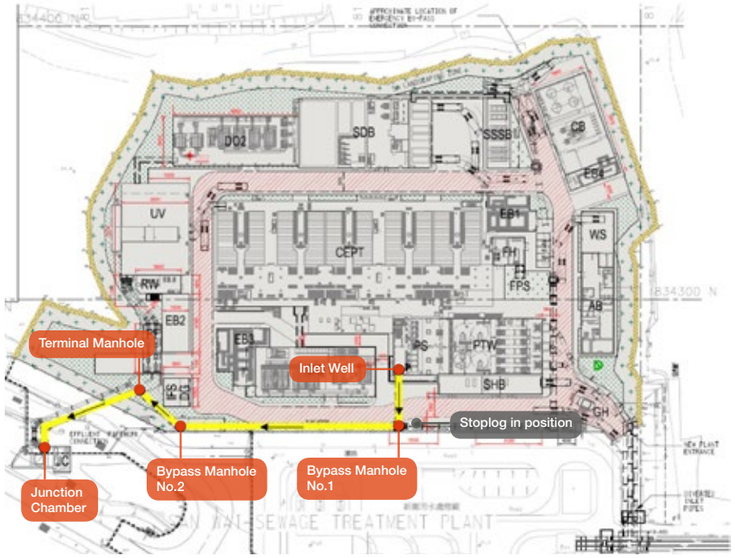
Dual direction bypass

While the sludge will be transported to the nearby T • PARK, Hong Kong's first sludge treatment facility where Arup was also a lead designer, the treated effluent of SWSTW will leave the treatment plant through the junction chamber leading to the NWNT Sewage Tunnel for discharge into the sea.

As an alternative discharge route, for when the NWNT Sewage Tunnel is out of operation for inspection or maintenance, the contract requires the provision of an Emergency Bypass connection. In addition, the specification requires a bypass at the Preliminary Treatment Works(PTW) to prevent flooding of the facilities in the event of a power or inlet pump failure.



■ The emergency bypass connection will direct the treated effluent to the northern part of the site when the NWNT Sewage Tunnel is out of operation



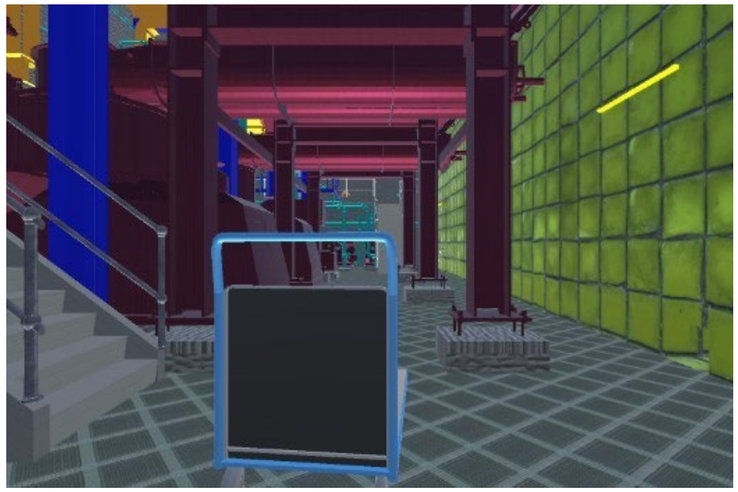
■ The PTW bypass will direct preliminary treated sewage to the terminal manhole in case of power or pump failure

Both bypass pipes are 2m in diameter and their provision occupies significant underground space in the already congested site. Aware that the emergency bypass and PTW bypass could not occur at the same time, Arup proposed an innovative 'dual-direction' bypass arrangement instead. The two bypasses are combined in one section where they share the same 2m diameter pipe for a length of 97m. By calculating the hydraulic head required for each flow scenario direction, it was demonstrated that the dual direction bypass can operate successfully by gravity in both directions. The flow of water is controlled by opening and closing penstock valves and application of stoplogs at manholes along the pipeline.

This solution successfully avoided the use of two bypasses saving about 300m of additional pipework plus time and materials for the contractor, thereby reducing cost. At the same time, other services and utilities can be installed at a shallower level saving further cost and time.

Designing with digital

This project also marks the first time Arup has been employed as BIM Manager for additional work in an infrastructure project. Arup has taken the opportunity to demonstrate interactive use and possibilities using virtual reality technology such as allowing future operators to experience a virtual walkthrough within a plantroom with tools (e.g. trolley) to demonstrate sufficiency of space for operation and maintenance activities.



■ Testing virtual reality technology for facility management

■ The site has 1,200m² of green roofs, 4,800m² ground level planting and 2,000m² vertical greening and is surrounded by a 5m green perimeter strip.

Achieving BEAM Plus Bespoke sustainable design

The SWSTW Administration Building is required to achieve BEAM Plus Platinum rating, making this project a pioneer of special building types such as wastewater treatment plants to fulfil the BEAM Plus credit requirements.

A number of environmentally beneficial features have been implemented, including porous pavements to enhance capture of surface runoff, 500m² of photovoltaic panels (exceeding the minimum requirement of 250m²), extensive greening and the adoption of natural lighting. Arup's design creates an overall environment and aesthetic reflective of the aspirations of the client with sustainability and harmony in the design.

SWSTW showcases Arup's expertise in utility infrastructure projects and continues our excellent track record in an industry that supports Hong Kong's development into a more resilient and sustainable city. The design work of SWSTW is complete and the plant is scheduled to start operations in 2021.

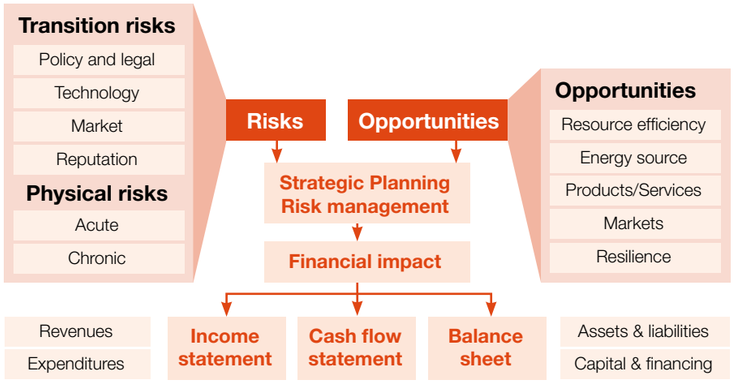
Climate change action: getting private developers prepared

Clients:
Swire Properties,
New World Development

Arup's scope of services:
Climate risk and resilience

Climate change: a commercial reality

Climate events such as storms and floods pose a significant risk to cities, the infrastructure and buildings, leading to significant financial loss to investors and large payouts by insurers. Superstorms affecting major cities every year serve as a harsh reminder that climate change is already affecting lives today. Research by the World Meteorological Organisation has concluded that 80% of natural disasters between 2005 and 2015 were in some way climate-related.



Climate-related risks, opportunities and financial impact are assessed under the TCFD recommendations. (Source: Recommendations of the TCFD Final Report)

Arup has been delivering climate risk and resilience services, supporting both the private and public sectors to develop resilience enhancement plans and business continuity/adaptation strategies to face the changing physical environment.

Supported by Arup's multidisciplinary expertise, specific climate hazards are modelled, mapped and assessed, including sea level rise, flooding, storm surge, wind, heat stress and water stress, to understand the vulnerabilities in a group's portfolio, down to the individual asset level.

Using this approach, we recently helped two Hong Kong-based developers assess the risks of climate change to satisfy the recommendations issued by the Task Force on Climate-related Financial Disclosures (TCFD) under the Financial Stability Board, an international body that monitors and makes recommendations about the global financial system. The inclusion of disclosures on climate-related risks will allow investors to make better informed financial decisions and more transparency on companies' actions to combat climate change.

The TCFD recommendations

In 2017, the TCFD published its recommendations on how organisations should evaluate and disclose the climate-related risks and opportunities that are most pertinent to their business activities. There is a growing demand for these climate-related financial disclosures for more informed and reliable decision making and will, very soon, become the new normal.

TCFD categorises the climate-related risks into 'transition risks' related to a shift towards a lower-carbon economy and 'physical risks' due to the physical impacts of climate change. It also looks at opportunities when assessing the impact on their financial performance.

The Task Force structured its recommendations around four themes that represent core elements of how organisations operate: governance, strategy, risk management, and metrics and targets.

Governance
The organisation's governance around climate-related risks and opportunities.

Strategy
The actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning.

Risk management
The processes used by the organisation to identify, assess, and manage climate-related risks.

Metrics and targets
The metrics and targets used to assess and manage relevant climate-related risks and opportunities.

(Source: Recommendation of the TCFD Final Report)

Arup's approach

Arup has provided advisory services to several multinational retailers to carry out climate assessments according to the TCFD recommendations, looking at both transition risks and physical risks. We looked at how their physical stores could tolerate extreme flooding and heat stress, as well as how these events might affect customer behaviour.
The Arup team in Hong Kong recently carried out two climate risk studies for Swire Properties and New World Development covering more than 80 properties in Hong Kong, China and the US. A 3-stage approach is adopted for the studies:

Stage 1: Scenario analysis

Arup consultants first identify potential impacts to the business operations, including climate projections (e.g. flooding, extreme wind, heat stress and drought) for physical risk and assessing socioeconomic trends (e.g. policy, market and technology) for transition risk.

Stage 2: Climate risk assessment tool

Stage 2 covers the detailed risk and resilience assessment to evaluate the vulnerability and criticality level of various business and operation areas under the potential effect of the identified climate hazard projections and scenarios. An in-house climate risk assessment tool is used to identify and rank climate hazards to each specific building in the developer's portfolio.

Stage 3: Resilience enhancement plan

Finally, corresponding adaptation actions to mitigate the risks assessed under a resilience enhancement plan are proposed and further opportunities for the companies to explore are identified. These may range from retrofitting plans on a building level, a new direction for R&D investment or new governance models for supply chain management and procurement.

Discovering opportunities while managing risks

Measuring the impact of climate change is a challenge for many corporations as there are so many uncertainties associated with it: timeframe, climate projections, magnitude and the inter-relation between the risks – all these make the future climate scenarios extremely complicated.
Arup's study approach provides a science-based method to assess the climate related risks and produces results that can satisfy TCFD requirements, ultimately providing input into financial disclosures that can be relied on by investors.
Although currently voluntary, the disclosure is being adopted by many organisations because the exercise allows them to evaluate their fixed asset vulnerability and resilience to extreme climate hazards. Like a regular body check, the assessment exercise identifies the asset portfolio's strengths, along with the crucial areas where a company may need to provide urgent attention and specialist action; in addition, it helps the firm to discover new opportunities in the daunting face of climate change.

© Santiago Felipe

A “divine collaboration” in sound with Björk

Client:
Björk Tours Inc

Arup’s scope of services:
Acoustic consulting, SoundLab

Arup worked with the Icelandic singer-songwriter Björk to create a reverberation chamber (RC) for her new concert, called Cornucopia.

In her music, Björk often explores the possibilities of the human voice, including how her environment changes the way she performs. In her latest concert tour, Björk pushed the boundaries of the live concert experience. She sought to capture the intimacy of singing live in a small room, unaided by traditional stage amplification and audio processing. She commissioned Arup to design an onstage RC, with acoustic functions, as part of the touring set — a unique approach to live stage performance — that projects an encapsulated and solacing moment to a large audience. The RC becomes both sanctuary and instrument, enabling Björk to sing in a naturally enveloping acoustic environment.

Arup acoustic designers in America worked iteratively with Björk and her creative team to develop a form that achieves a lush and enveloping natural reverberation for the touring production. For the shape, material and size of the chamber, Björk and her team worked with us using the Arup SoundLab in their design process to develop and deliver the final form.

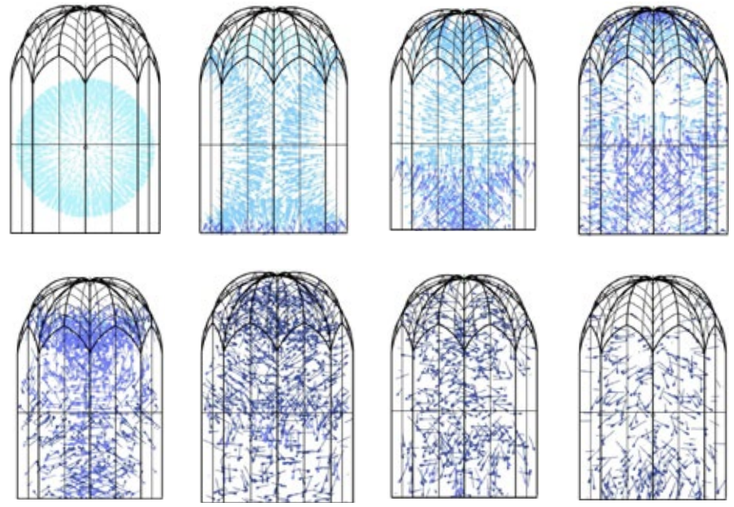
Björk approached Arup because of our ability to model and immersively simulate the experience of singing in the chamber. She challenged our team to evaluate a wide variety of shapes and materials and relied on us to consider every implication of the chamber form: acoustics first but also audience sightlines, weight, portability and durability in a touring environment.

Designing a form driven by sound

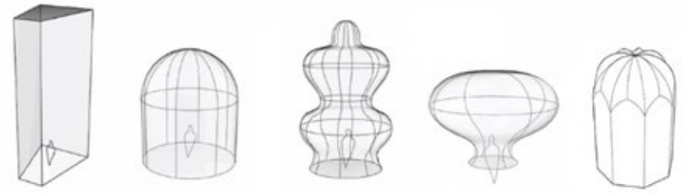
Björk was inspired by small chapels, natural forms and sound sculptures like Tvisöngur in Iceland for their lush reverberation and organic quality. Because this chamber would have to be portable for touring, common materials such as stone and masonry could not be used. To evaluate materials, Arup designers first calibrated the modelling process to measurements of spaces of a similar size and shape, such as the Sound Column at the Palace of Fine Arts in San Francisco, and the Integratron sound bath in the Mojave Desert. Using the calibrated modelling process, Arup designers were able to explore many new forms based on our library of materials.

Björk sketched many potential shapes, inspired by anything from orchids to the Sydney Opera House. As such the design process was highly collaborative and iterative, with the Arup team modelling many shapes for Björk to evaluate using headphones. Once we settled on a suite of final options, Björk and the production team met in London’s SoundLab to listen critically in our purpose-built 3D sound studio, where she also sang through some of the models in real-time. The final design has an octagonal shape in plan to create strong reflections from many directions, with a vaulted ceiling inspired by medieval chapels, to create a diffuse and blended sound quality.

In designing an acoustic RC for Björk’s Cornucopia tour, Arup modelled how sound would reflect and reverberate within several different shapes. Arup and Björk ultimately selected the vaulted shape.



Interaction between sound and chamber boundaries over a one second period



Five of the 12 shapes being evaluated

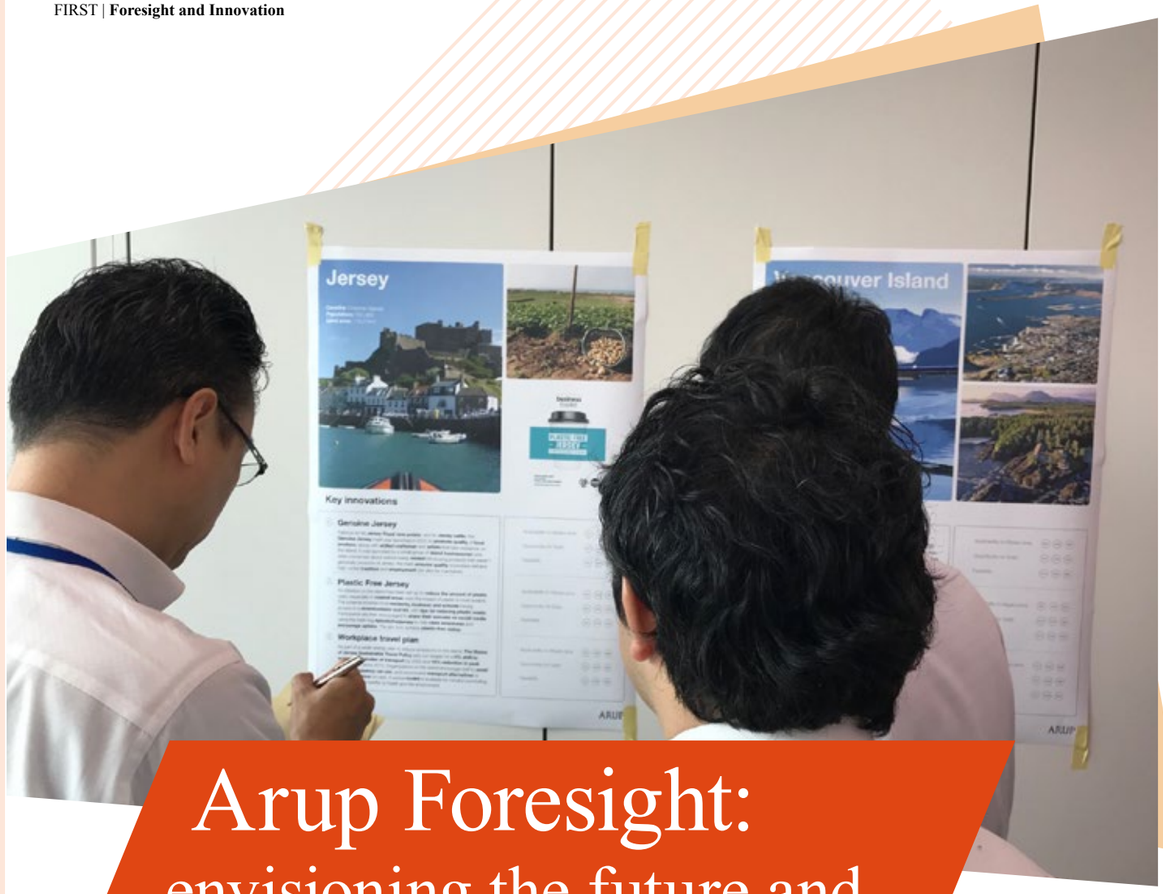
Material matters

The material for the RC had to perform acoustically first and foremost but also required portability, durability to last the tour and visibility for audience sightlines. While our original assumption was that a clear acrylic would be preferred for its transparency, it does not have the weight to contain lower frequency like concrete which was preferred by the client. At the end, the chamber was constructed with a wooden frame coated in a thick mineral powder and acrylic resin composite. This combination produces good sound and is easy to maintain.

After only ten weeks of design, the Arup team was able to achieve the lush and enveloping natural reverberation Björk envisioned. The design was then issued for fabricators to use as their basis of design for bid. The chamber was built by Irma Studio in Iceland, a frequent set builder for Björk’s touring productions. The chamber was constructed months in advance of full ensemble rehearsals to allow enough time for Björk to experiment with its acoustic response and be comfortable performing inside before her tour began.

The first performance of Cornucopia was in New York City in May 2019 and the concert tour is still going till end of the year.

Arup SoundLab
SoundLab’s sound simulations (auralisations) demonstrate the impact of our projects. It is a powerful tool enabling our clients to hear, at the design stage, what their projects will sound like when complete, so as to enable people to make objective decisions. Arup has used SoundLab to inform the design of arts and culture venues, railway and airport projects and also wind farms.



‘Reimagining a small island’ workshop, Tokyo, 2019

Arup Foresight: envisioning the future and facilitating decision making

Change is constant, context is variable. We are all impacted by the same megatrends but the various contexts of our organisations, locations or interests require a unique approach to identify the correct specific recommendations.

Arup Foresight helps organisations understand change, explore emerging trends, ideas and opportunities to radically rethink the future their business. Here are some recent examples.

Arup Foresight
We developed the concept of ‘foresight by design’ which uses innovative design tools and techniques to bring new ideas to life and to engage all stakeholders in meaningful conversations about change. Through our tailored and outcome-driven approach we help individuals and organisations of all sizes make decisions that build resilience for the future.

Driving change for workplaces

In East Asia region we have recently helped a Korean tech company articulate a vision for their future campus. Together with their architect they needed to define the function and the value of the building. We designed a programme of activities that brought people from across the company, partners and investors to explore trends and facilitate conversations on topics such as technology breakthrough, spatial design and shifts in people demographics and behaviour.

In this case the workshop unveiled strong cultural aspects to be considered which would directly influence the workplace design. The value to our client, the architect and the Korean firm was a better framing of the scope in which to operate and a better understanding of future needs. This gave them the confidence to make decisions today to build the case for change.

Rethinking the environment of learning

We previously helped the Vocational Training Council (VTC) in Hong Kong to define a long-term vision and set their ambitions in the planning of the construction of a new world-class campus. As a public body, it was critical to create the case for change as part of the wider approval process.

Some of the insights were drawn from our *Campus of the Future* research developed by Arup Foresight. We outlined what the future campus should provide for students, teachers and visitors and how facilities should be designed and operated. These design principles were used to develop the architectural brief for the new building and a tool for decision makers.

Exploring the future of mail and delivery

Arup Foresight delivered a programme of research and workshops for Hong Kong Post to explore the future of mail and parcel logistics and the implications for their Air Mail Distribution Center (AMC). We explored a broad range of trends, combined with market research and benchmarking, on current innovation and best practice. The outcomes were analysed to identify specific implications for the design, operation and experience of the new centre.

‘Future campus’ workshop, San Jose, 2019

Reimagining a small island in Japan

For the redevelopment of a small island in southern Japan, we presented vision and ideas as the result of a process of research, expert consultation and a stakeholder workshop with further refinement by Arup Foresight and the client’s project teams. The client wanted to explore themes and trends around transport, water, waste & energy, agriculture, retail & tourism and education & community. As a result of the workshop we provided recommendations to the client’s executive team for opportunities for future development.

In a world where change offers such vast challenges and opportunities, it is more important than ever to try to understand and explore what is relevant to us. Managing change requires a team of professionals that have the capability and resources to help explore, navigate and shape an increasingly complex future. This is the role of Foresight.

If you would like to explore future opportunities, check with your Arup contact or email ea.arupuniversity@arup.com.

Maintaining our innovative culture: every idea counts

The ultimate goal of these workshops is to turn unmet needs into ventures. Funding and a team of specialists are in place to support the development of novel ideas. We also explore venture opportunities with external parties – for instance, we have co-organised with the Project Moses Initiative and The Hong Kong University of Science and Technology.

To date, we have organised a total of 11 internal and collaborative innovation workshops attended by 200 Arup colleagues from various business groups in the East Asia region. We have harvested more than 70 ideas over a broad range of topics aligned to Arup's business interests, our core vision for sustainable development and our strategy for digital transformation. These topics span across BIM, indoor and outdoor air quality, waste management, resilient infrastructure and, more recently, climate change action.

Contact us if you would like to leverage on Arup's domain knowledge and specialism in your innovation journey. Our facilitators will design and run a successful workshop for you with the theme of your choice. We can also explore opportunities to co-develop new products and services.

Arup is widely recognised for our innovative solutions. We invest in innovation, turning our people's ideas into commercial products that will improve the built environment.

We are organising a series of Innovation Workshops to spark creativity and maintain our innovative culture and entrepreneurial spirit in the region. We are providing attendees with keys to design thinking and design doing; turning their ideas into commercial reality.

Each Innovation Workshop features interactive exercises to identify and define problems and, subsequently, create solutions and, with people from diverse backgrounds, foster fresh perspectives and ideas. Most importantly, the workshops help broaden the ways we understand and approach problems and their solutions.

"It was a very informative workshop that taught us how we can break down the very large issue of resilience into small actionable items that we can address through innovation. Innovation can be a product or a service that we offer. The activities were inclusive and diverse for it accommodates the insights and ideas of our colleagues from all disciplines and grades."

Edmond Asis, Arup Manila

Resilience by design:
seismic resilience assessment of buildings

With rapid urbanisation and population growth, Chinese cities are increasingly concerned about urban resilience and are more willing to invest for a quicker recovery from disasters. Devastating earthquakes such as those hitting Tangshan in 1976 and Sichuan in 2008 have made quake preparedness a major priority for the Chinese government, and a new seismic resilience assessment standard for buildings is therefore introduced.

The seismic resilience of a building refers to its capacity and duration to recover from an earthquake to normal operations or functions. Resilience-based design is believed to be the next generation code of practice for buildings. Unlike strength-based design systems, a resilience-based design gives owners more information regarding the investment in and the performance of their buildings.

A national standard committee to develop the new standard was set up, led by Tsinghua University, with supporting members from China Academy of Building Research (CABR), Tongji University, Harbin Institute of Technology, Beijing University of Civil Engineering and Architecture. Arup was pleased to be invited to join the committee as well and was the only foreign company involved due to our reputation on structural design in China and worldwide plus our involvement in prompting resilience-based seismic design and assessment criteria.

Arup's structural, MEP and fire engineers shared their knowledge and experience in seismic design in the committee. A review on related literatures, including research papers and relevant design standards, was conducted and a non-structural component database was proposed. Arup also developed a benchmarking case to compare the China national code against the Resilience-based Earthquake Design Initiative Rating System (REDi™) – an Arup-designed framework for implementing a holistic 'beyond-code' approach to facility resilience.

Resilience-based Earthquake Design Initiative (REDi™) Rating System

The REDi™ aims to allow owners to resume business operations and provide liveable conditions quickly after an earthquake. A three-level rating – Platinum, Gold, or Silver – is established to facilitate selection of earthquake performance objectives in accordance with the desired risk. To qualify for a REDi™ rating, it is necessary to meet the requirements in the four categories in the framework.

REDi™ framework

Rating	Re-occupancy	Functional Recovery	Financial Loss	Occupant Safety
Platinum	Immediate	<72 hours	<2.5%	Injuries unlikely
Gold	Immediate	<1 month	<5%	Injuries unlikely
Silver	<6 months	<6 months	<10%	Injuries possible

Ratings in a design level earthquake according to the REDi™ resilience objectives

Non-structural component list

A key characteristic of REDi™ is that both structural and non-structural elements on site are considered in the assessment; non-structural elements refer to architectural components and MEP systems. Under the current China code system, the focus is usually on life protection and minimising direct loss; the new seismic resilience standard aims to extend the coverage to losses due to failure of non-structural elements. Arup, therefore, studied and developed an assessment list for non-structural components, with descriptions of different levels of damages given to help classification. This list is now part of the new national code.

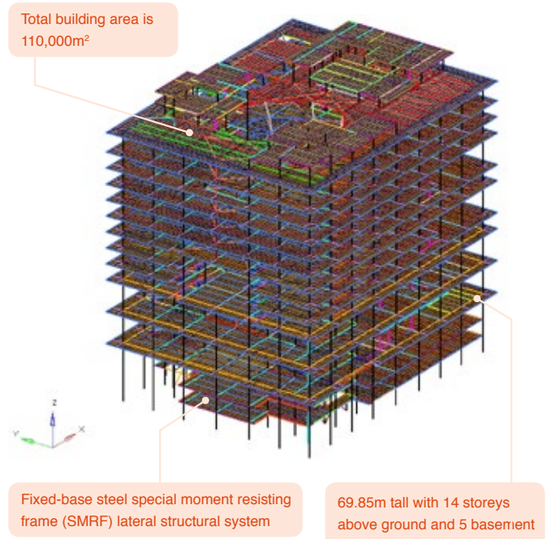
Seismic performance assessment benchmarking

Another Arup contribution in the new standard was to provide a benchmark seismic resilience assessment case study of a real building according to the two different systems, REDi™ and China national code.

A high-rise office building located in Beijing CBD area was used in the assessment. This building will serve as a stock trading centre thus it has high requirements for business continuity. Its structural analysis model and its non-structural components as shown in the construction drawings are used in the assessment. Aspects, particularly direct financial loss and loss incurred by delays in downtime due to repair, were investigated for thorough and practical assessment.

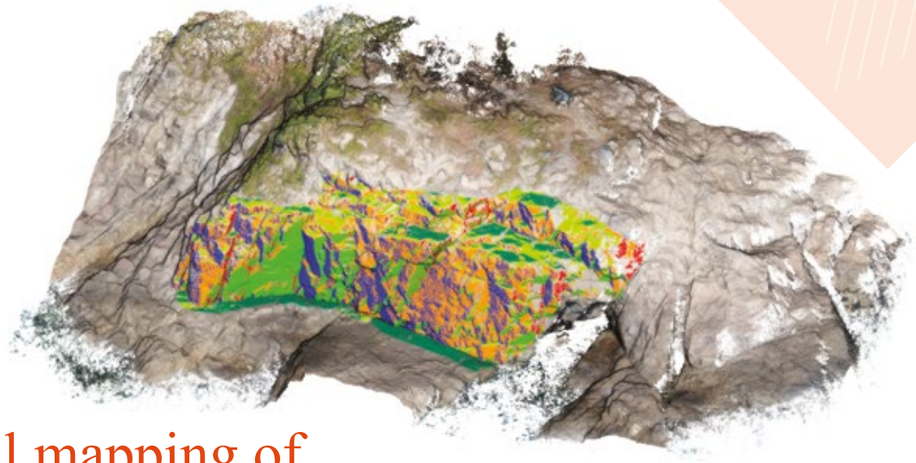
Since the two resilience assessment systems are designed for different purposes the analysis results are different but reasonable. REDi™ was meant to provide clients with information on the likely cost and business downtime when a design earthquake occurs. It considers non-engineering constraints to the recovery of the building including municipal conditions, financial conditions and contractor mobilisation. On the other hand, the China national standard emphasises more on relative performance, providing a framework where the earthquake performance of various buildings can be compared. The analysis result shows the China national code assessment framework serves its purpose. The rating from the assessment is appropriate and comparable to REDi™.

The new China national standard on seismic resilience will be formally issued soon. The code is expected to serve as a 'translator' between building owners and design teams on the relationship of investment amount and building performance.



Three-dimensional structural analysis model used in the seismic resilience assessment

Scan QR code for more details about the REDi™ Rating System



Digital mapping of discontinuities in rocks

Rock discontinuities are cracks in a rock mass which exert significant control on the stability, deformation and hydraulic conditions of rock slopes or underground excavations. To enhance the current data collection method, Arup's geologists have investigated digital means to improve the efficiency, effectiveness, accuracy and safety of rock discontinuity surveys.

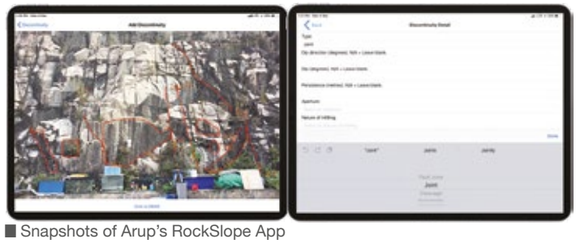
The collection and analysis of discontinuity data are a fundamental component of any rock mass assessment. During these surveys, measurements of the geometric properties (e.g. orientation, persistence, etc.) and non-geometric properties (e.g. roughness, aperture, etc.) are taken using clinometers and measuring tapes, with pro-forma sheets to record the observations and measurements.

Traditionally, the data is collected by engineering geologists, who are required to make measurements manually. For large rock slopes, this will necessitate the use of double layer scaffolding or 'cherry picker' type mobile platforms to provide safe access throughout the entire slope area. Such measures, when combined with the manual surveys, mean that the data collection process can be rather biased, time consuming and costly.

Enhancements

1. Apps on mobile devices

Various mobile applications have been developed to take measurements of discontinuity oientations using accelerometers installed inside mobile devices. However, apps existing in the market only record the basic geometric properties (e.g. orientation) without capturing any other geometric/non-geometric data needed for a thorough assessment. To overcome this limitation, Arup's geologists developed the RockSlope mobile app, which records comprehensive geometric and non-geometric details and links the data to annotated rock slope images indicating the discontinuity locations. The end result is the semi-automated production of mapping reports that enable the detailed rock mass and stability assessment.



Snapshots of Arup's RockSlope App

2. Point cloud technology - data collection and assessment tools

Comprehensive reviews of the potential to use point cloud data derived from 3D laser scanning (LiDAR) and digital photogrammetry for the analysis of rock mass conditions were also undertaken. Point cloud datasets were collected for various rock slopes and processed to generate Digital Outcrop Models (DOMs) to provide virtual 3D representations of the actual geological outcrops.

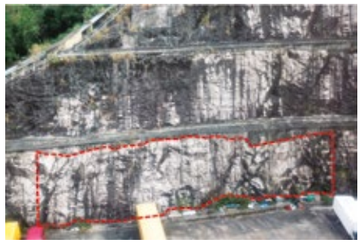
A variety of open-source point cloud assessment tools were then used to directly extract rock discontinuity information from DOMs. Foremost amongst these packages were the FACETS and Discontinuity Set Extractor (DSE). Both of these are widely recognised semi-automatic discontinuity identification packages that are favoured due to their user-friendliness and ease of application, as well as the reported high degree of result accuracy.

Comparative assessment

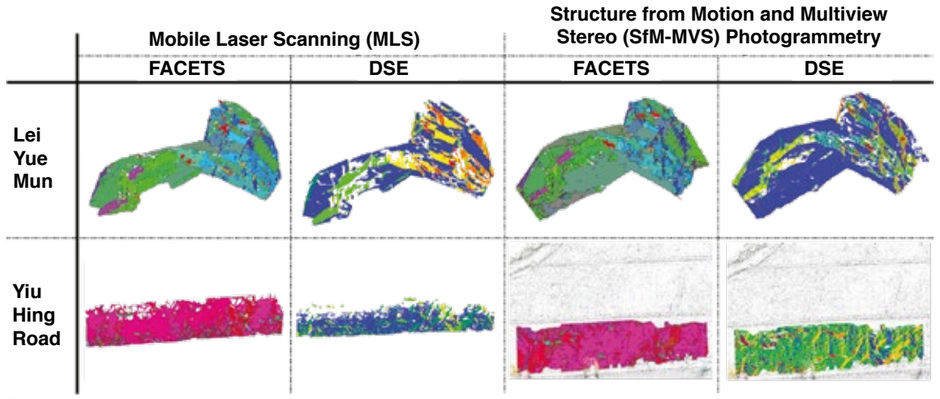
To verify the claimed accuracy and reliability of the analytical tools, conventional measurements and point cloud surveys using mobile laser scanning and digital photogrammetry were undertaken for two distinctly different rock slopes in Hong Kong for a thorough comparative assessment.

Analytical models, colour-coded according to discontinuity sets, were generated from the point clouds (as displayed below) and compared with the manual survey data obtained effectively using Arup's RockSlope App. The comparative assessment revealed that the use of point cloud provides an extremely rapid and convenient means of surveying rock slopes with the extracted data providing accurate and reliable measurements that were typically more comprehensive than those derived from traditional surveys.

Trial site 1: natural coastal slope at Lei Yue Mun



Trail site 2: Engineered rock cut slope at Yiu Hing Road



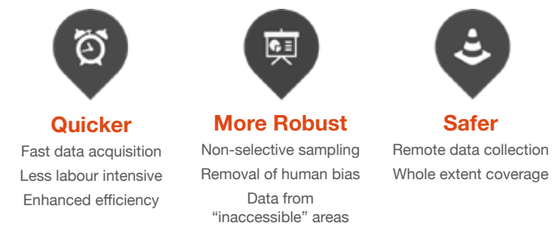
Analytical models of two test sites for comparative assessment

Conclusion and way forward

With assistance from mobile apps the efficiency of traditional discontinuity surveys can be greatly enhanced such that it is now possible to automatically generate full mapping reports including detailed information on discontinuity locations and conditions directly from the data collected in the field.

The assessments further reveal that both laser scanning and digital photogrammetry can provide quicker, more robust and safer mechanisms for the collection of basic geometric discontinuity data. The output from point clouds contains nearly all necessary spatial and geostatistical information to assist reasoned engineering assessments. This means that instead of spending long periods of time on site collecting data, we can use the time saved to study the models and confirm the presence of potential failure areas.

Given the significant benefits identified from the use of point cloud data, Arup is further investigating the potential to semi-automate the generation of 3D discrete fracture networks (DFNs) of the overall rock mass condition. This would enable the point cloud data to be used not only for the assessment of rock slopes but also directly for the generation of the numerical models used to assess the stability and deformation characteristics of underground rock excavations.



Key benefits of the enhancements

Spreading the power of knowledge management: new workshop series launched

"Knowledge and innovation are fundamental to efficient business operation. Although new technology provides handy tools to assist organisations, only a corporate knowledge management strategy will ensure the right tools are adopted to address the firm's demands and challenges."

Nicole Sy, East Asia Knowledge Manager, Arup

Arup has launched a new series of workshops, open to all those who are interested, to enable more organisations to better manage their knowledge.

At these workshops participants learn about knowledge management (KM) strategy planning and the relevant tools from case studies with a look at various types of technologies that support knowledge sharing. Successful and unsuccessful examples of how companies encourage creativity, capture innovative ideas and empower their talented workforce to carry out experimental initiatives are also covered in the series.

"Arup formalised its KM strategy about 20 years ago and over the intervening years our KM approach has been widely recognised in the industry and beyond with top awards. This workshop series is another endeavour in our commitment to knowledge sharing and collaboration, not only within the firm but also in the wider community" said Ricky Tsui, Director of East Asia Arup University – the firm's KM arm.

The KM workshops enable multi-dimensional conversations across industries where a range of enterprise KM in different organisations can be analysed, focusing on their impacts. Through facilitated discussions on various KM tools and techniques, participants can then aspire to new KM capabilities in their own enterprises.

The first KM workshop was held in November 2019, on scoping, design and development of taxonomy (knowledge content categorisation). It was well-received by the participants who came from various organisations and actively shared their experience in KM implementation.

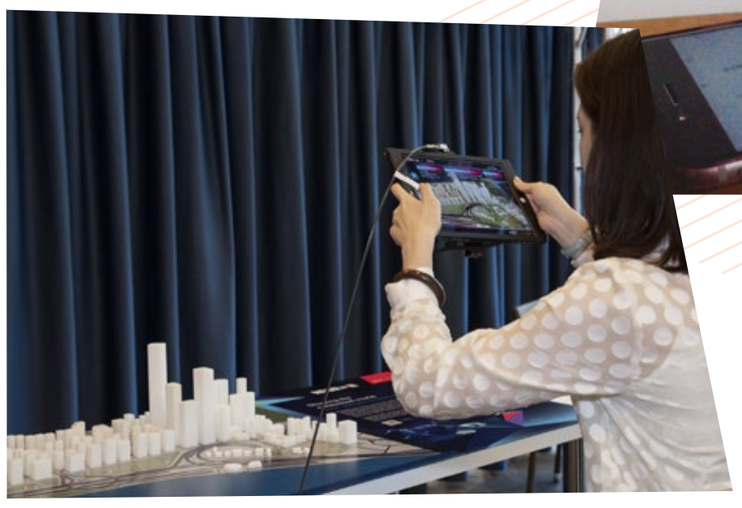
Upcoming topics include knowledge audit, story-telling, after-action reviews, gamification, and digital KM. Scan the QR code for more information.

Scan QR code for
Arup University Masterclass

Digital transformation: starting with people

Sharing session of new digital initiatives in business groups

Digital Training Series in Arup's Innovation Studio



Various AR applications developed by Arup staff

Digitalisation is a global trend across all industries. To keep our global leadership in design excellence and enhance our competitive edge in the industry Arup provides the Digital Training Series to staff as a fundamental step in digital transformation.

The training series will equip engineering staff with the skills needed to excel in the field of automation and data-driven design. It consists of training modules on Rhino, Grasshopper, Revit, Dynamo and Python, all of which are applicable to most of our projects. To ensure new graduates are empowered with the necessary digital skills early in their careers to face these new challenges, the series is mandatory to all new technical graduates in East Asia.

In addition, there are more advanced digital programmes available along an Arupian's career journey. For example, the Secondment Programme provides Arup staff with an opportunity to take on a full-time position in the Digital Design team for a certain period of time. Colleagues can enthusiastically engage in many digital transforming activities while implementing new digital initiatives for their business groups. Working alongside digital transformation experts and like-minded colleagues, they will become digital integrators driving digital transformation within their teams on their return.

Other opportunities include the Digital Lunchtime Bootcamps, some intensive lunchtime sessions to practice scripting skills and the ArupREAL AR & VR Bootcamp – a one-day hands-on workshop on XR (virtual reality, augmented reality, mixed reality and more) devices and applications, with speeches by guest speakers and brainstorming sessions. We also invite external companies to support the training delivery. For example, Nvidia co-delivered a machine learning workshop with our in-house experts.

Arup believes that suitable training is a catalyst for our digital transformation journey.

Arata Oguri
pursuing thoughtful excitement

"We are always ready to evolve further to serve the changing needs of the market and society."

© Katsuhisa Kida

■ Arata views the fabrication and erection process of Osaka Maritime Museum's dramatic dome as his best design solution.

"As one of the three technical members of this small office, my individual performance would have a significant impact on the office's performance", says Tokyo office leader, Arata Oguri, reflecting on the moment he decided to join Arup. "It was only the second year for Arup in Japan and the future was uncertain – that prospect excited me a lot."

The exciting journey began in late 1990.

■ At Channel 4 Television Headquarters Building site

Early adventure

Four months after joining the Tokyo office, Arata was assigned to London for three years of training. He describes this period as "the most challenging time" in his life.

"It was a period of learning, networking and 'brain washing'! That was when I learned how to design beams and columns, when I got to know colleagues from around the world and when the firm's ethos – quality, innovation and total engineering – were imprinted on my mind," he says.

In London, he worked on the first project in his career, Channel 4 Headquarters, where he dealt with people with all kinds of accents in a language not his mother-tongue. Arata feels extremely lucky that he had the opportunity to witness design from paper to reality before he returned to Japan.

More importantly, the people he met and the connections he built nourished his career. Many of the friends he made in the early days are still with the firm in senior positions now. "I love the people at Arup," says Arata, noting that it's all those people he's met and collaborated with that have made him stay with the firm.

A deliberate move

Back to Tokyo, Arata got involved in a number of signature building projects, from the Fruit Museum in Yamanashi to the National Theatre Okinawa.

The highlight was, no doubt, the Osaka Maritime Museum – a 4-storey building enclosed in a 70m diameter dome structure. The 25-month construction programme meant that erecting the dome after completion of the internal structure would not be possible. So, the decision was made to fabricate the dome offsite while the internal buildings were being constructed. The dome, weighing 1,200 tonnes, was fabricated, placed on a barge, towed all the way across Osaka Bay, lifted by giant crane and placed on the completed internal structure.

Career in projects

Channel 4 Headquarters, London

Arata's first project, the 25,000m² headquarters building features reinforced concrete wings that are fronted by exposed steelwork cores and a curved glass entrance restrained by a grid of tensioned cables.

Fruit Museum, Yamanashi Fuefukigawa Fruit Park

Arup's first project for full structural design and site supervision in Japan. The museum features three separate and distinctive glazed steel shell dome structures up to 20m high and 50m wide plus a conservatory for growing plants and a lecture theatre.

© PIXTA

The National Theatre Okinawa

The theatre contains two auditoria and research facilities for the traditional Kumiodori dance. The elevations of the building, square on plan, are covered with precast concrete cladding units forming an angular grillage, creating an overhanging shading effect.

Veloqx Meiji Dori Development (Audi Forum Tokyo)

Arata's first project management commission in Japan. The upper floors of the 7-storey building are enclosed by a distinctive inclined glazing system supported by a steel structure cantilevering from the slabs on the main façade.

Arata views the dome's fabrication and erection process as his best design solution. "It was thanks to the collaborative effort, not just among Arup but with all the collaborators from the design phase," he says with pride and gratitude.

After almost 10 years as a structural engineer, Arata faced another crossroads in his career. At that time all the Tokyo office did was structural engineering for special buildings. "There were heated discussions: Should we expand our client base and do something different for new clients?" he reflects. Eventually the team decided to diversify their business beyond structural engineering to include other services including MEP, façade and lighting design.

Arata volunteered to develop the project management (PM) services. He then set off for a one-year training in London PM team in 2003. From design management of the landside bridges for Heathrow Terminal 5 to office fit-out for Credit Suisse First Boston to bid management for Shanghai Pudong Airport Phase 2, Arata was exposed to different aspects of PM with various projects, both big and small.

"Cities Alive: the new urban in Asia" event in Tokyo last year, targeting Japanese clients looking for opportunities overseas

Arata with colleagues at the Tokyo office

"That's where Arup fits in - serving clients in Japan and the target countries as well."

Returning to Tokyo, his first PM project was the Iceberg commercial development for a Hong Kong-based developer whose general manager was an ex-Arupian. "It was not easy working with a client who knows everything about us. The process was extremely challenging and luckily the outcome was great – a happy client and a successful project," he recalls.

Arata shares his tips to survive and thrive: "You need to be honest and open; be prepared to confront wisely but don't take it personally. After a big fight, you go out and drink together," he laughs.

More excitement ahead

Over recent years, due to the shrinking domestic market, local clients including private companies and contractors are looking beyond Japan for opportunities in Southeast Asia, China and Africa. "That's where Arup fits in – serving clients in Japan and the target countries as well," he says. One recent example is the V&A Museum in Dundee – the project was initiated in Japan and passed on to colleagues in Scotland.

"Admittedly, we have a very limited skillset in Japan but, if we can identify some client needs around their cross-border endeavours and bring new skills and services from our regional and global networks, we can create unique value for those clients," says Arata.

Looking into the future, Arata believes that Japanese companies will continue to pursue opportunities overseas. "It would be really exciting if Arup, being virtually the only locally established international player with a global network, could play a meaningful role there."

After working on building projects for almost 30 years, the office is now developing into the infrastructure market especially the rail and offshore wind businesses.

"We are always ready to evolve further to serve the changing needs of the market and society." Arata says with confidence.

VC Cheong
start slow, stride strong

"Always remember you have strong support from Arup globally – find resources, seek collaboration and use the information and technology available to solve problems."

"I think I am still holding a record that no one wants to contest!" says VC Cheong, Director and Building 2 Group Leader in Hong Kong. I am probably the 'oldest' graduate engineer Arup Hong Kong has ever recruited."

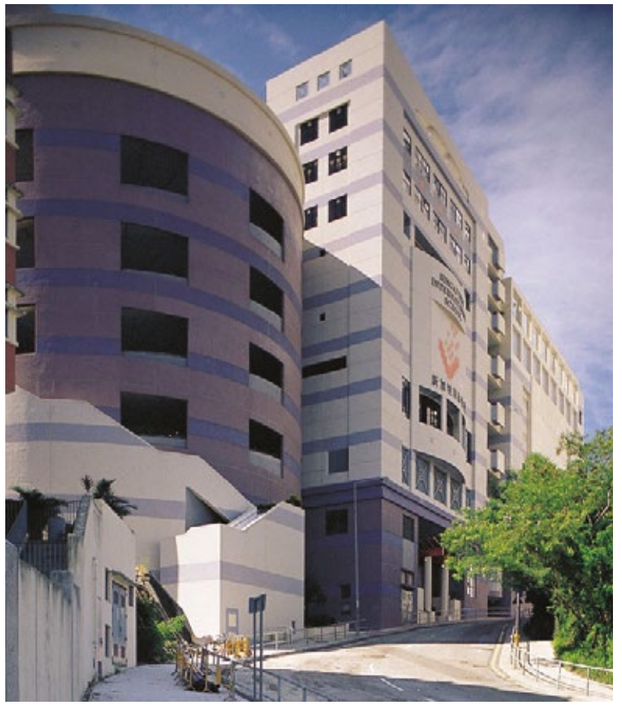
A fast-tracked development

"I've been fortunate in Arup to have enjoyed a very fulfilling development. I've worked on different projects, taken up various responsibilities and continuously developed my capabilities and work approach. I've done so many things that I'd never have imagined," VC says, reflecting on his journey at Arup.

Though a graduate engineer, VC assumed responsibilities corresponding to his professional maturity from his very first project in Arup – he was responsible for the detailed design of the 8-storey Singapore International School in Hong Kong. About a year later, he played a key role in running the Hong Kong Institute of Education Tai Po Campus project – he coordinated various external parties as well as different disciplines within Arup to oversee the programme of work and resolve a range of design and site problems.

The Hong Kong Institute of Education Tai Po Campus

Sands Macao



Singapore International School (Hong Kong)

In 1997, VC was offered an overseas assignment opportunity in the Sydney office and he moved there with his family. "It was a rewarding learning experience, especially in the field of pre-stressed concrete design, which was the Sydney office's strength," he recounts. During the two years, he also got to know many good friends at work who are now top leaders in the firm. "This direct personal touch builds intangible bonds which often make cross-office, cross-region work easier," he says.

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■ Marina Bay Sands Integrated Resort

A few years after returning to Hong Kong came another catalyst project in his career – Sands Macao, the first American-style casino complex in the region. As the project manager, VC led the design and construction which was completed in just 18 months despite the fact that the programme included land reclamation as the site was partially under water at high tide. The marine mud also caused difficulties in foundation construction. With his untiring effort in refining the structural designs in order to save construction time, VC's team overcame the crippling pile-driving problems to claw back some much-needed time in the programme.

"This not only started Arup's venture into Macau but also our fruitful partnership with this client," he says.

A once-in-a-lifetime project

The partnership brought Arup the formidably challenging Marina Bay Sands (MBS) Integrated Resort in Singapore. In 2006, VC was assigned to lead a multidisciplinary design team from various Arup offices including Boston, Brisbane, Hong Kong and Singapore to deliver this highly complex, iconic project.

MBS sits on deep soft clay which makes excavation very difficult. With over 40% of the resort's concrete construction activity taking place 15m to 35m underground and with an average basement depth of 20m, one of the main considerations was to develop a safe and quick method of excavation.

Working with the geotechnical team, VC played a big part in designing the innovative solution – five giant reinforced concrete cofferdams in the ground within which piling and substructure construction could take place without the need for conventional temporary strutted supports. These cofferdams are some of the largest in the world and, sinking up to 18m below ground with diameters up to 165m, they allowed work to progress across the site simultaneously.

"The solution accelerated the construction programme and minimised the temporary support, which in turn reduced steel requirement. This is the fastest and safest solution," says VC, who describes himself as a practical problem-solver and views the solution as his most satisfying so far.

The excavation solution for MBS perfectly illustrates the idea for the best structural solution: being as simple and direct as possible for the desired outcome and being appreciated by industry professionals and, in particular, architects and clients.

On the edge

The MBS project won a number of awards regionally and internationally. While recognition is the best reward for an engineer, VC also admits that the project put him under enormous pressure and had him on the edge of burning out.

"The project was extremely challenging from all aspects, technically and managerially, mentally and also physically." VC recounts that during the four years, he made more than 300 trips between Hong Kong and Singapore, flying back and forth during weekends.

"I'm glad that I didn't give up. It was a once-in-a-lifetime project," says VC and credits much of the success to the support from the management, good collaboration with other regions and committed team members. He was especially appreciative of the great support from his family. "My wife picked me up at the airport every time I came back from Singapore except for one or two times due to extremely bad weather."

Surviving extreme tension himself, VC shares his tips for stress relief: "Stay positive – this allows you to see opportunities – and always remember you have strong support from Arup globally – find resources, seek collaboration and use the information and technology available to solve problems."

Digital is the new literacy

From starting his career using stencils, VC sees digital transformation as the biggest trend affecting the way we design buildings. "Digital tools and technology allow us to do work more efficiently and to realise more possibilities," he says. He believes that digital will continue to make a significant impact on structural design. "The principles won't change, but new tools and new workflow will help us find better solutions that were not possible before. Going digital enables more innovative approaches to project design and delivery amid the increasing size and complexity of our projects."

He encourages everyone to learn about digital tools. "Be passionate about digital development, keep pursuing it and prepare yourself to survive the future competition," he advises.

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■ Excavation in 120m diameter circular cofferdam

■ Sharing his story with young engineers

At a glance. . .

Meet new Arup Fellow: Alice Chow

Huge congratulations to Alice Chow on being named as Arup Fellow! Alice is the first expert from the Advisory Services field in East Asia to clinch the honour that represents the highest technical and professional achievements – not just within the firm, but across our industry globally.

Alice heads Arup's Advisory Services in East Asia, helping clients to think long-term, design for success, invest wisely and manage for better business performance. With a passion to combine engineering expertise with commercial and operational know-how, she has managed numerous award-winning projects ranging from strategic airport gateways to mission-critical systems and much-needed education and healthcare facilities.

Beyond career accomplishments, Alice has also joined various missions to underdeveloped countries such as Afghanistan and Ethiopia and provided relief work in Banda Aceh, Indonesia and Sichuan, China after devastating natural disasters, making a meaningful impact with her professional knowledge.

Scan to read the full article

Bricks, data and mortar: it's time to build in the intelligence

"The next generation of building design will take place in an era marked by AI," says Sankar VS, Arup's East Asia Digital Services Leader, in his latest Perspective piece on arup.com.

He points out that the real challenge is to integrate data and AI in a flexible, intelligent way, that generates real value for developers, owners, tenants and users. He cites some successful cases of establishing value and power for intelligent assets, ranging from real-time sensors in bridges that power autonomous operational systems to Arup in-house developed smart building console Neuron which provides a new level of real-time control over the building's many systems.

"Digitally designed, data-ready structures will be able to achieve the kind of performance gains that meet sustainability targets, lower costs, and raise revenues from users. It's time for our industry to seize the opportunities in front of it." he urges.

Designing for ageing communities

For the first time in history, there are now more people aged over 65 than there are children under the age of five. By 2050, the global population over 60 years of age is expected to reach 2.1 billion, more than double what it is today. The ageing of the global population and increasing urbanisation will be one of the defining megatrends of this century.

Our new report, *Cities Alive: Designing for Ageing Communities*, examines what built environment professionals can do to cultivate fulfilling, happy lives for older people. The report identifies four central needs of the ageing population – independence, wellbeing, social connection, and security – when developing a framework for the cities of the future. Fourteen strategies and 28 actions are proposed to meet these needs. Forty case studies serve to inspire and inform readers on how to include this work in their practice.

Scan to read the full report

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