One-to-one (1:1) modelling in architecture and beyond

Oxford mathematician CL Dodgson, author of *Alice Through the Looking-Glass*, famously quipped that the best scale at which to make a map is one-to-one:

There's another thing we've learned from your Nation - map-making. But we've carried it much further than you. What do you consider the largest map that would be really useful? About six inches to the mile. Only six inches! We very soon got to six yards to the mile. Then we tried a hundred yards to the mile. And then came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile! It has never been spread out, yet. The farmers objected: they said it would cover the whole country and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well.[1]

A successful designer recently commented to me that one difference between architectural and other types of design education is that the latter work by inducting students into the art of 1:1 prototyping, while architecture, by necessity, generally cannot. This was a hindrance in his view, in developing the true skills of design, which is *designing within constraints*. It's a challenging thought.

How do you learn to design within constraints at less than or more than 1:1. Select one answer:

[A: imagine constraints / B: ignore constraints / C: model constraints at the same scale]

Traditional architectural education seems to have chosen a mixture of these. For some dimensions of constraint, and types of building, this works well. Gravity works in the same

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[1] https://gisandscience.com/2009/10/28/quote-of-the-day-lewis-carrolls-paradox-of-the-complete-map/

direction and with the same force, whatever the building scale (allowing the designer not to explicitly analyse the gravity constraint within certain bounds of weight, length etc). Heuristic assumptions and vernacular experience with construction techniques and materials means that adjustments can be made with an expert eye when making marginal adaptations to familiar shapes, materials and size (allowing an approach that merely imagines or intuits the constraint). Filippo Brunelleschi used scale models (including 1:1) when designing Florence cathedral's self-supporting herringbone brickwork, metal bands, ox-hoist and lateral castello crane. Without this modelling, the dome design would not have been realised. Indeed, his detailed dome design *emerged* from his experimentation with both materials and construction techniques. Emergent (generative) design was there in the Renaissance.

In the era of buildings that are overwhelmingly complex in shape, structure, function, size, environmental performance, costs, construction techniques, stakeholder interests, materials and construction management, how can the architecture student effectively learn to design with a scaled-down model? There is only one really satisfactory answer to this and it is [C] above.

How is this possible with all this complexity? There is only one answer to this too: *in-silico*. Computer modelling. Only via computer simulation and analysis can a student learn to design buildings and cities that *perform* in desired ways, since only in the abstracted scale of a CAD, BIM or GIS model can the constraints be simulated in any detail and with requisite accuracy. As far as I can see, this is an unassailable argument, but I invite colleagues to try and assail it, so that as a faculty we can have a debate to guide teaching innovation in the coming years.

The closest counter argument I have heard recently is that when an experienced teacher views a scaled architectural model, they can intuit the 1:1 with a high degree of accuracy and with sensitivities learned over the years since their own first architectural studio and subsequent teaching and practice. I accept this and am sure it is true. But consider what is being said. For the sake of maintaining the old ways of scaled modelling as a principal teaching pedagogy, the teacher has to spend a lifetime developing an intuitive mapping between a scaled model of the design and the real world 1:1 constraints that should shape the design. It's a tall order. The more so the more complex the design. It requires the imagination of relationships between constraints and design options. In today's complex construction context, it's not unlike asking a student to design a moon-landing module, with only a loose understanding of how physics works at 1/6th of the Earth's gravity.

If it takes a teacher decades to achieve this mapping well, what are students learning in their studios? The first steps in acquiring the same skills, yes. But only the first steps. What are they learning about real constraints-based designing while they do not yet have a sophisticated command of imaginative constraints-based designing? Their designs will tend to be formalistic and naïve. We have learned to make something of the naivety, to hone students' creativity in conceiving 3D shapes. But is it the best way?

With more performative dimensions now being assessable by computer simulation, what is the argument *against* transferring the basic language of architectural design teaching from analogue hand-made models to BIM?

Where physical models are required, they can be printed. Students can learn tactile design at the 1:1 scale in woodwork and metal fab labs, using hand craftsmanship as well as robotics. The arrival of a 1:1 form-finding, parabolic, parametrically designed metal façade unit on the steps to Sun Yat Sen Square outside FoA's building recently, made me feel differently about architectural education. It made me wistful, excited, hopeful, more ambitious. As when I have viewed other 1:1 designs by our esteemed architectural colleagues: John and Josh's rural houses perched on the side of a Szechuan mountain, Donn's sublime rain bridge and sun shelter in a Fujian field, Juan's architectural furniture cum furniture architecture for poor HK workers. And now Eike's beautifully formed stainless steel façade skeleton.

In all other forms of physical design training: industrial design, engineering design, product design, stage design, fashion design, car design, 1:1 modelling with 1:1 constraints is crucial. Without it, a student would not graduate and the skills would not be acquired. The acquisition of knowledge and skills by matching the scale of the 'model' (abstracted) problem or phenomenon with the scale of constraints, is *de rigueur* in most other domains of knowledge, professional practice, teaching and learning. Consider economics. Let the scale of the 'design' problem be the firm. Say a construction firm. The problem is 'to make or buy' (a façade component). *Making* would mean expanding the size and scope of the firm and raising the internal costs of organisation, control, quality and coordination. *Buying* requires no change to the design of the firm but involves higher uncertainty and higher cost. Imagine solving this production and company design problem without modelling the constraints at the same level as the design object. The costs and benefits would be merely imagined from experience, or averages used from the whole industrial sector. The ensuing decision is unlikely to be well fitted to the realities of the particular firm and the result is likely to be messy. Like scaling up an architectural design idea tested only with imagination and analogue experimentation, and finding that the 1:1 house (or, heaven forbid, bridge or tower) does not really work, functionally or even perhaps aesthetically. Shift the scale of the economic problem to the city, nation or household. To help monitor and meet China's ambitious poverty reduction target, Beijing officials regularly re-design the absolute poverty definition formula. To do this effectively they need to model the household budget using household data with which they mathematically, graphically and statistically model preferences, wages, spending patterns, nutritional patterns, saving patterns, rental rates and so on – all at the household level. Economic models are not 1:1 models. They are scale models, representing a household, firm or government as a concept operationalised by data (variables) measured at a certain common unit of analysis and using performance analytical models suited to that scale (calibrated for behaviour of a household or behaviour of a firm or politician). The point is that the behavioural constraints are modelled at the same scale as the design problem. They have to be.

The designers of Pfizer's new vaccine that UK health care workers will start receiving next week, modelled vaccine design using both reduced scale *in-silico* simulations and 1:1 physical experiments. The physical experiments were performed in the lab and then in the community (phase 3 trials). Computer-based design-testing used computer simulations driven by statistics and also computational analytical mathematics driven by deterministic equations. Phase 3 experiments tested the vaccine in the context of real 1:1 constraints in human bodies living in the community.

My proposal: make BIM the fundamental language of architectural education, as it is increasingly becoming in the profession; develop ubiquitous teaching and learning platforms to support same-scale constraints-based architectural design-learning on all major performance dimensions (energy, structure, thermal comfort, circulation, emissions, economic value, cultural value, environmental services, aesthetic value, construction costs, running costs, whole-life carbon costs, etc); print scale models only where and for as long as is necessary (printed scale-models may turn out to be a legacy pedagogic method that can be gradually replaced); teach students the physical intuition about architectural design via 1:1 structures that mix craft and traditional materials with robots and novel materials and shapes; have all students design and build a 1:1 bridge in a Fujian field; have all students build a HK pencil tower *in silico* with full financial, structural, environmental, circulation, energy and aesthetics constraints (scaled and abstracted for pedagogical tractability just as the economics student's model of a complex national economy is appropriately abstracted by same-scale equations and data sets).

Professor Nasrine Seraji has agreed to respond to this piece. I do not know what she will say. Nasrine and I agree on more things about architecture than we disagree on. She is a famous architect and far more experienced with this long-standing debate than I am. So I am interested to see where she will take it. Maybe others can follow.

One line of argument against my proposal might be as follows, drawing again from economics. There are two kinds of mathematical economic modelling: general equilibrium and partial equilibrium. The former tries to model the whole system and the latter, sub-systems or sectors. The latter tends to yield more useful insights than the former. Whole-system models also turn out, arguably, to be no more accurate in prediction than heuristic expert decisions made with insights from partial models. Architects are educated to be holistic designers, imagining solutions before testing them with selective formal and informal analyses. Economists are trained to be analysts first and creative problem solvers second. Economists find that they also have to be designers (of production plans, company accounts, industrial sectors, firm restructuring, contracts, taxation instruments etc.) only on the job. Perhaps architectural design needs to be learned as a holistic experience. But my designer friend who triggered this DRup blog would probably argue that holistic design by intuition – like the equation-based general equilibrium model of an entire economy – is too blunt an instrument. I would counter, suggesting that architectural education needs the equivalent to partial equilibrium models; analytical or simulation performance models that test one aspect of a design rigorously, while holding other dimensions constant. That is how knowledge is acquired in many, if not most fields. Materials and structural testing may happen with 1:1 experiments, like Eike's façade module (holding environmental and overall visual performance constant). Environmental performance of the overall façade system can be evaluated with computational models, holding structure, costs and other dimensions constant.

Another line of argument might be that buildings, like nuclear reactors and airplanes, need to be tested with whole-system models. In engineering, this is achieved by close coupling with what I have called partial equilibrium models, rather than building a unified model of the whole system in the tradition of general equilibrium modelling in economics. But this would be an argument, not for the continued use of holistic model building via analogue scale models but for close-coupled building performance models for multiple dimensions.

Maybe Professor Chau or Professor Wong (applied economists) can respond to Nasrine? FoA, with its unusually talented mix of academic architects and its strong and growing interdisciplinary culture, can, I think, make a major contribution to resolving some of the pedagogic and other tensions facing the global architectural education community.

Congratulations to colleagues whose work is featured below. A lot is happening in FoA at the moment. Three research grants >10M HKD (1M USD/GBP/Euro projects) have come in this year: Wilson and Anthony's ITF construction supply chain and blockchain project; Juan's BoC-Habitat for Humanity subdivided uber-high density architecture project; and now, Anthony, Jiangping's and Weifeng's Guandong province smart city lab (more next DRup).

Chris

Teaching and other Achievements

DoA

1. Anderson Lee

   - Index Architecture Limited founded by Anderson Lee is delighted and honoured to have received a **2020 AIA International Region** Commendation Award for Urban Design with the project entitled "Time Axis", in Shanghai, China.

     This professional award programme attracted entries from all over the world. Index is one of the two Hong Kong practices received an award this year. Other award winners came from practices in the USA, Canada, Australia, Japan, Norway, the UK, Germany, France, Latvia and Sudan.

     The Jury made the following remarks to "Time Axis":

     "...this quiet little oasis in the city invites passersby to come in and take a moment out of their busy day. Its connection to the site's history and the clock tower both

connects this project to the past and the future. The beautiful brick work adds a level of detail that can be appreciated both from afar and up close..."

Project Description: "Time Axis" is a small memorial park located at the corner of Baoding Road and Kunming Road. It reveals three layers of time: Artificial Time, Absolute Time and Historical Time. **Artificial Time** is the clock tower. The tower itself acts as a sundial that represents **Absolute Time**. Three low walls pointing towards historical buildings with collective memory in the neighbourhood reflect **Historical time**. The design translates the definition of these three layers of time into a built environment. It provides a resting place for residents and responds to the unique history of the North Bund District in Shanghai.

For more information about the project, please visit:
https://vimeo.com/483892875
https://indexarchitecture.com/en/works_post/time-axis/
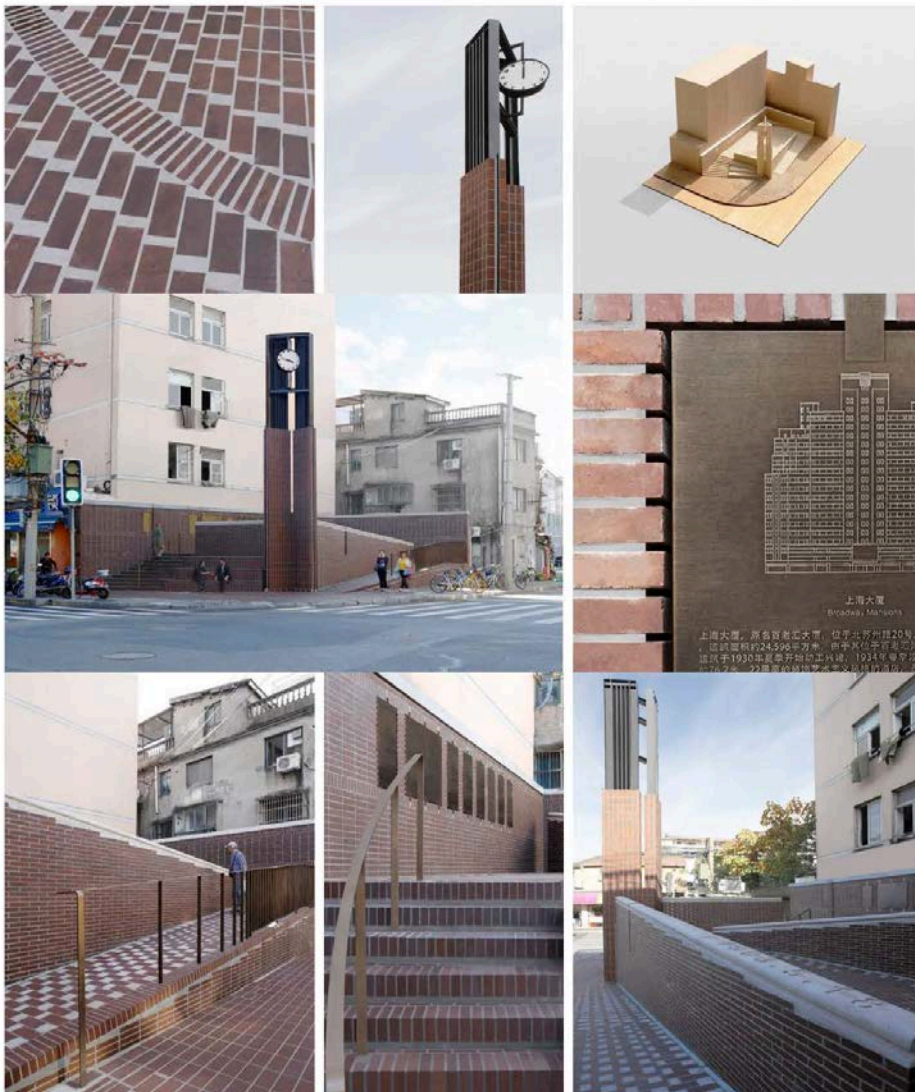
REC

1. Professor K W Chau

   - has been appointed by the Policy Innovation and Co-ordination Office of the Government of HKSAR to serve on the [Assessment Panel of the Public Policy Research (PPR) and Strategic Public Policy Research (SPPR) Funding Scheme](#), for a period of two years until 2021.

DUPAD

1. Professor Rebecca Chiu

   - has been appointed by the Policy Innovation and Co-ordination Office of the Government of HKSAR to serve on the [Assessment Panel of the Public Policy Research (PPR) and Strategic Public Policy Research (SPPR) Funding Scheme](#), for a period of two years until 31 March 2021.

2. Dr. Roger Chan

   - Mr. Ng Si Leong Hugo, an MUD and MUP graduate, recently received an interview by [Hong Kong Economic Journal](#) (HKEJ) about his new book entitled《誌同道合 – 香港標牌探索》and the design of road signs.

     More interesting concepts and facts of road sign/logo can be found at https://designagehk.org/.

3. Alain Chiaradia and Jason Hilgefort

- supervised two graduates of the Master of Urban Design (MUD) Programme (Class of 2020), Liu Moxin and Ye Dan, who have received a Gold Award and a Commendation Award respectively at the inaugural Greater Bay Area Urban Design Awards – Student Category, for their projects developed in the Design Thesis courses.

  The Gold Award went to Liu Moxin, for her vision of Lantau Tomorrow entitled "New Brand for Hong Kong – City Images Practice". A Commendation Award went to Ye Dan, for her entry entitled "Cheung Sha Wan's Social Hub – Blue Space for Well-being and Social Interaction-integration of People Diversity". Both projects were developed as part of MUD's Research Methods and Research Dissertation – Design Thesis courses.
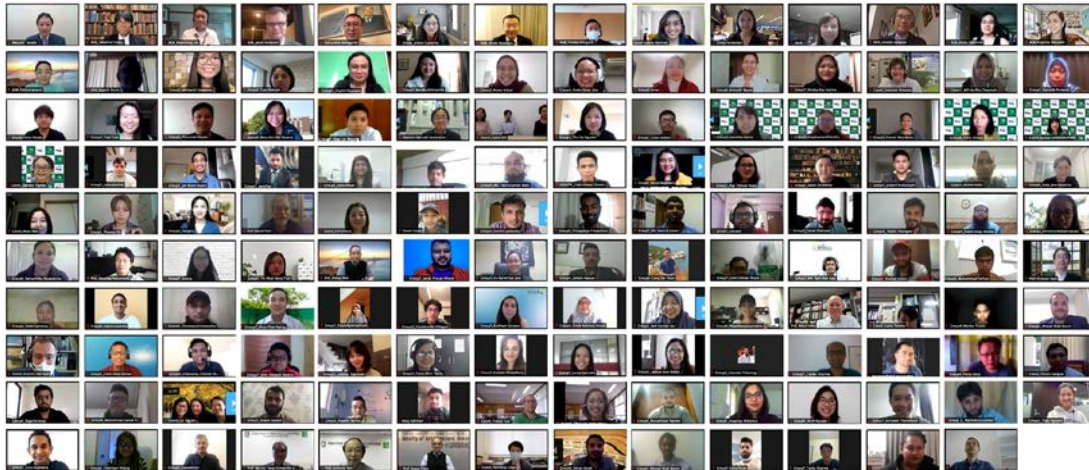
  Liu's vision of Lantau Tomorrow questioned the notion of the singular "Image of the City" to generate a ringed archipelago that actively clean the sea around Kau Yi Chau and form a series of lush and evolving ecological landscapes. The proposed urban morphology embraced a dynamic reading of the urban form of Hong Kong's heritage, re-interpreted into eight distinct character districts forming a biodiversity network of urban and ecological habitats.
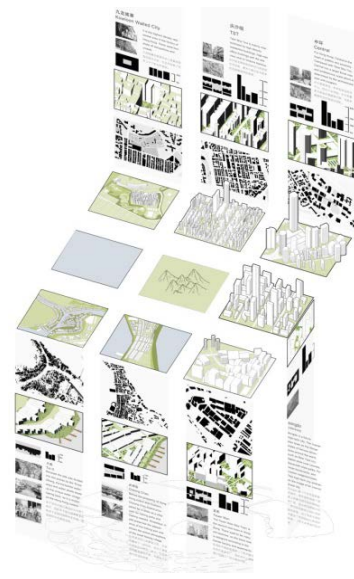
GBA UD Gold Award (Student Category): Liu Moxin, "New Brand for Hong Kong – City Images Practice"

Ye's proposal disentangled a thick multilayered barrier of Railway and Property – a very tall tower and mall, expressway, and rail infrastructures – to deploy volumetric urban design strategies that open the waterfront to Cheung Sha Wan. The mixed social hub programme creates a prototype of waterfront settlement.

GBA UD Commendation Award (Student Category): Ye Dan, "Cheung Sha Wan's Social Hub – Blue Space for Well-being and Social Interaction-integration of People Diversity"

The GBA Urban Designer Alliance was established in June 2020 by five founding member institutes: Hong Kong Institute of Urban Design, Center for Architecture and Urbanism – Macau, Guangzhou Urban Planning Association, Urban Planning Society of Shenzhen, and Zhuhai Planning Exploration and Design Industry Association, as a professional platform for the promotion of collaboration among urban design professionals, practices and organisations in the Greater Bay Area, including urban designers, architects, landscape designers, town planners and engineers, subsequently establishing the professional recognition for urban design practitioners in the Greater Bay Area.

4. Dr. Guibo Sun

- has been appointed by the Director of Buildings of the HKSAR Government Buildings Department to serve as a member to the Technical Committee on Design Manual: Barrier Free Access, for a term until 31 May 2023.

5. Professor Bo-sin Tang

- attended together with the teaching colleagues in DUPAD, an online Welcome Gathering which was organised by the Asian Development Bank-Japan Scholarship Programme (ADB-JSP) on 20 November 2020, for all the 2020 new scholars who had received the ADB-JSP Scholarships, including three new students of our MUP and MUD programmes. About 150 participants attended the gathering.
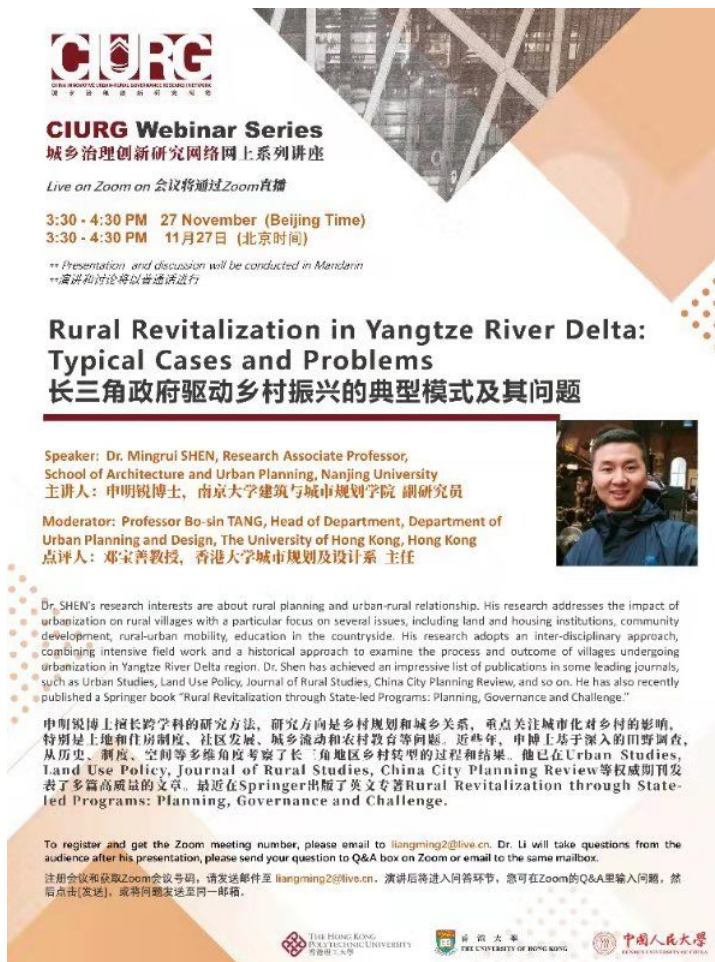

- led together with K K Ling, Dr. Kenneth Tang, Dr. Roger Tang, Christina Lo, Dr. Guibo Sun and Dr. Jun Ma, a group of MSc Urban Planning Year 2 students in organising the Kowloon City Community Planning Workshop at the SKH Holy Carpenter Church and Community Centre on 21 November 2020. This workshop was part of a public engagement exercise in their Community Planning Studio course with a view to formulating an age-friendly district improvement plan for Kowloon City.

- served as the moderator and discussant of the presentation by Dr. Mingrui Shen, Research Associate Professor, School of Architecture and Urban Planning of Nanjing University, on the topic: "Rural Revitalization in Yangtze River Delta: Typical Cases and Problems" in the CIURG Webinar on 27 November 2020.

<u>Research Achievements</u>

Centre of Urban Studies and Urban Planning

1. Alain Chiaradia

- co-authored a paper with MUD graduates, Meng Shan Shan, Mostofa Rifat Ara, and Zhang Songyang:

  Meng, S., Rifat Ara, M., Zhang, S., **Chiaradia, A.**, 2020, TOD, Volumetric TOD, Destination, Public Space and Community Cohesion, <u>HKIUD Journal Urbanie & Urbanus</u>, Issue 4: The Liveable City, pp. 33-49.

  The publication is an extended version of Meng's Research Dissertation, as part of MUD's Research Methods and Research Dissertation and Design Thesis courses. https://www.hkiud.org/articles/uu/202011-UU.pdf

  Abstract: Transit Oriented Development (TOD) has become an urban planning and design policy and practice approach to sustainable transport across the world. TOD as infrastructure contributes to urban liveability in determining way of life and well-being of the inhabitants of a city. Urban liveability can be understood as a perceived notion of well-being and social cohesion among residents of an urban area. TOD has been hypothesised to create gentrification. Does gentrification impact negatively on social cohesion in high density TOD-led cities? We address this question by deploying an exploratory qualitative analysis of the relationships between measures of involuntary residential displacement and 'built environment' indicators. These are proxies for 'gentrification' and 'social cohesion' respectively. This investigation examines displacement indicators before and after the opening of three new MTR stations in 2014, using a control neighbourhood which has an existing station. It also analyses BE dimensions related to social cohesion such as 'destinations' and 'public space provision'. The displacement indicators have variable trajectories when details are compared. There is limited evidence of systematic displacement, although there are other more prominent and dynamic changes in those destinations. The provision of new public space is associated with the most dynamic changes. From a placemaking point of view, further detailed studies to better understand the role of development drivers of gentrification are required.

2. Professor Rebecca Chiu

- delivered an online public lecture on "Urbanism and Older People's Mental Wellbeing: Reflections on Compact Hong Kong", for University College London, Bartlett School of Planning, on 28 October 2020.

- delivered an invited presentation on "Housing in an Ageing Community – Understanding the Potential Demand for Purpose-design Elderly Housing", at the

Housing Conference 2020: Beyond the Pandemic, Reshaping Real Estate, organised by the Real Estate and Housing Developers' Association Malaysia, on 26-27 November 2020.

3. Dr. Derrick Ho

- delivered a talk on "Built Environment and Health", in a seminar organised by Kwun Tong Methodist Social Service on 25 November 2020, to support the residents living in Kwun Tong Garden Estate who are expecting the deal with urban renewal and relocation. This talk provided information regarding built environment and social service that could support quality of life among the residents, including how they could maintain their livability when moving to a new home after estate re-development.

- published a peer-reviewed article as the first author. This study found that urban compactness and greenness in Hong Kong were associated with lower dementia mortality among older adults, while air pollution could be associated with higher dementia mortality. Community planning to improve urban resilience should consider the above factors.

Hung Chak Ho, Kenneth Fong, Ta-Chien Chan, Yuan Shi, 2021. The associations between social, built and geophysical environment and age-specific dementia mortality among older adults in a high-density Asian city. DOI: 10.1186/s12942-020-00252-y.

Background: Although socio-environmental factors which may affect dementia have widely been studied, the mortality of dementia and socio-environmental relationships among older adults have seldom been discussed.

Method: A retrospective, observational study based on territory-wide register-based data was conducted to evaluate the relationships of four individual-level social measures, two community-level social measures, six short-term (temporally varying) environmental measures, and four long-term (spatially varying) environmental measures with dementia mortality among older adults in a high-density Asian city (Hong Kong), for the following decedents: (1) all deaths: age >= 65, (2) "old-old": age >= 85, (3) "mid-old": aged 75–84, and (4) "young-old": aged 65–74.

Results: This study identified 5,438 deaths (3,771 old-old; 1,439 mid-old; 228 young-old) from dementia out of 228,600 all-cause deaths among older adults in Hong Kong between 2007 and 2014. Generally, regional air pollution, being unmarried or female, older age, and daily O_3 were associated with higher dementia mortality, while more urban compactness and greenness were linked to lower dementia mortality among older adults. Specifically, being unmarried and the age effect were associated with higher dementia mortality among the "old-old", "mid-old" and "young-old". Regional air pollution was linked to increased dementia mortality, while urban compactness and greenness were associated with lower dementia mortality among the "old-old" and "mid-old". Higher daily O_3 had higher dementia mortality, while districts with a greater percentage of residents whose native

language is not Cantonese were linked to lower dementia mortality among the "old-old". Economic inactivity was associated with increased dementia mortality among the "young-old". Gender effect varied by age.

Conclusion: *The difference in strengths of association of various factors with dementia mortality among different age groups implies the need for a comprehensive framework for community health planning. In particular, strategies for air quality control, usage of greenspace and social space, and activity engagement to reduce vulnerability at all ages are warranted.*

- co-authored a peer-reviewed article regarding the impacts of objective and subjective environment on quality of life across urbanised areas in Hong Kong. This study found that greenness in urbanised areas could only affect physical aspects but not psychological aspects of quality of life among HK residents, while perceived environment could affect both physical and psychological aspects of quality of life. Therefore, urban planning should aim to improve both objective and subjective conditions of the built environment to maintain quality of life among urban individuals.

Katherine Chang, Frances Wong, Ka Long Chan, Fiona Wong, **Hung Chak Ho,** Man Sing Wong, Yuen Shan Ho, John Yuen, Judy Siu, and Lin Yang, 2020. The Impact of the Environment on the Quality of Life and the Mediating Effects of Sleep and Stress. International Journal of Environmental Research and Public Health, Volume 17, Issue 22, 8529. DOI: https://doi.org/10.3390/ijerph17228529.

Background: *Environment is an independent factor that affects one's quality of life (QoL), where studies suggest that health behaviours also affect one's quality of life. The purpose of the present study is to examine the association between environmental conditions and QoL and how individual health behaviours affect this association.*

Methods: *Participants aged 20 or above were recruited from 11 tertiary planning units in the central part of Kowloon. These tertiary planning units were selected as they represented the overall living environment in Hong Kong, with a mix of the poorer urban areas alongside relatively affluent districts. A mediation analysis was implemented using multiple linear regressions to examine the effects of environmental conditions on QoL.*

Results: *Of the 607 eligible participants included for analysis, 390 were female and 217 were male, with a mean age of 47.4 years. Living within 500 m of a green space area had benefits on the physical aspect of QoL and physical activity but no effect on the psychological aspect of QoL. Moderate satisfaction with public spaces affected QoL positively. In contrast, less satisfaction with public spaces affected QoL negatively in both physical and psychological aspects through the mediating effect of stress. Poor environmental quality affected all domains of QoL negatively through the mediating effects of increased stress and poor sleep.*

Conclusions: *Environment is an important factor that affects individuals' overall well-being. The interaction between environmental conditions and individual*

variables, especially perceived stress and sleep, is extremely important when assessing its impact on QoL. The findings of this study support the importance of individual stress and sleep in mediating the relationship between the environment and QoL for health. Further studies should be conducted to include objective measurements, such as those of cortisol levels for stress and physical fitness tests.

- co-authored with Huagui Guo and Dr. Weifeng Li, a peer-reviewed article regarding the effects of air pollution on lung cancer incidence in China. This study found that submicron particulate (PM1) pollution could have stronger influences across urbanised areas and regions with more low-educated individuals. Regional planning and strategies for air quality improvement should be aimed to reduce urban-rural and educational disparities.

Huagui Guo, Jing Wei, Xin Li, **Hung Chak Ho**, Yimeng Song, Jiansheng Wu, **Weifeng Li**, 2020. Do socioeconomic factors modify the effects of PM1 and SO2 on lung cancer incidence in China? <u>Science of The Total Environment</u>, 143998, ISSN 0048-9697, DOI: <u>https://doi.org/10.1016/j.scitotenv.2020.143998</u>.

Background: *It remains uncertain whether socioeconomic factors modify the effect of air pollution on human health. Moreover, studies investigating socioeconomic modifying roles on the effect of PM1 are quite limited, especially in developing countries.*

Objective: *The present study aims to investigate socioeconomic modification effects on the associations of the incidence rate of male lung cancer with ambient PM1 and SO2 in China.*

Methods: *We conducted a nationwide analysis in 345 Chinese counties (districts) between 2014 and 2015. In terms of multivariable linear regression models, we examined the modification effects of urban-rural division, education level and the proportion of construction workers in the stratified and combined datasets according to the tertile and binary divisions of the three factors. Moreover, we performed three sensitivity analyses to test the robustness of socioeconomic modification effects.*

Results: *We found a larger effect of PM1 on the incidence rate of male lung cancer in urban areas than in rural areas. The association between PM1 (or SO2) and the incidence rate of male lung cancer was stronger in counties with low education levels than in those with high education levels. The findings of the significant modification effects of urban-rural division and education level were robust in the three sensitivity analyses. No significant modification effect was observed for the proportion of construction workers.*

Conclusion: *To our knowledge, this is one of the earliest studies in China suggesting that male residents in urban areas have a high risk of lung cancer incidence associated with ambient PM1; male residents with low education levels suffer from larger effects of PM1 and SO2 on the incidence rate of lung cancer. Area- and population-specific strategies should be developed to reduce the urban-rural and educational disparities in air pollution effects, thereby alleviating air pollution-*

associated health disparities in China.

4. Dr. Kyung-min Nam

- has been featured in the cover story of the HKU Bulletin, titled "Airborne Solution", November 2020, volume 22, issue 1, pp 12-13, for his research study on the link between climate change and air pollution, particularly in Mainland China.

- presented his co-authored paper titled "Effects of Transboundary Pollution on Housing Prices in Korea: Focusing on Fine Particulate Transported from China" at the 67th Annual North American Meetings of the Regional Science Association International, Global Externalities session, which was held online through Zoom, on 12 November 2020.

5. Dr. Kyung-min Nam and Dean Webster

- co-authored a paper that has been accepted for publication:

Yue Wang, Niven Winchester, **Christopher J Webster**, **Kyung-Min Nam**, Impacts of China's emissions trading scheme on the national and Hong Kong economies: a dynamic computable general equilibrium analysis, Frontiers in Environmental Science, Environmental Economics and Management section, in press. DOI: 10.3389/fenvs.2020.599231. (Manuscript ID: 599231)

Abstract: *In this study, we estimate the economic impacts of China's official carbon-mitigation targets, in connection with Hong Kong's potential participation in a proposed national emissions trading scheme. We find that moderate intensity-reduction targets emulating China's pledged Paris Agreement commitment would incur much higher policy-compliance costs in Hong Kong (0.1% - 2.5% of baseline gross domestic product) than in Mainland China (0.1% - 0.7%) in each of the modelled years from 2021 to 2030 when each economy operates its own independent carbon market. By comparison, an integrated carbon market enables Hong Kong to achieve the same reduction goal at up to 78% lower costs compared to an independent market, and this is achieved without significantly affecting the Mainland's economy. These savings in compliance costs for Hong Kong are greater when pre-integration local carbon prices in both economies are subject to a larger gap. Effectively, the cheaper pre-integration carbon prices in the Mainland indirectly subsidise the Hong Kong economy in the initial years of the integration scenario, buffering the policy shock. In sum, an integrated carbon market in China would improve overall efficiency at the national level, but the benefits are biased toward Hong Kong. This finding suggests that it is in the city's interest to play a more active role in cross-border collaboration on climate mitigation and emissions trading.*

iLab

1. Dr. Fan Xue, Frank

- was invited by China Graphics Society (CGS,中國圖學學會) to give an online lecture at The 6th China BIM Conference, entitled "Blockchain for Construction in the Post-COVID-19 Era [後疫情時代的建築區塊鏈：原理、案例和新機遇]". The Conference took place in Taiyuan, China, on 7 November 2020.

- has been appointed by CGS as a Professional Member to the BIM Chapter of the CGS Committee, for a service period of 6 months starting from November 2020 to May 2021.
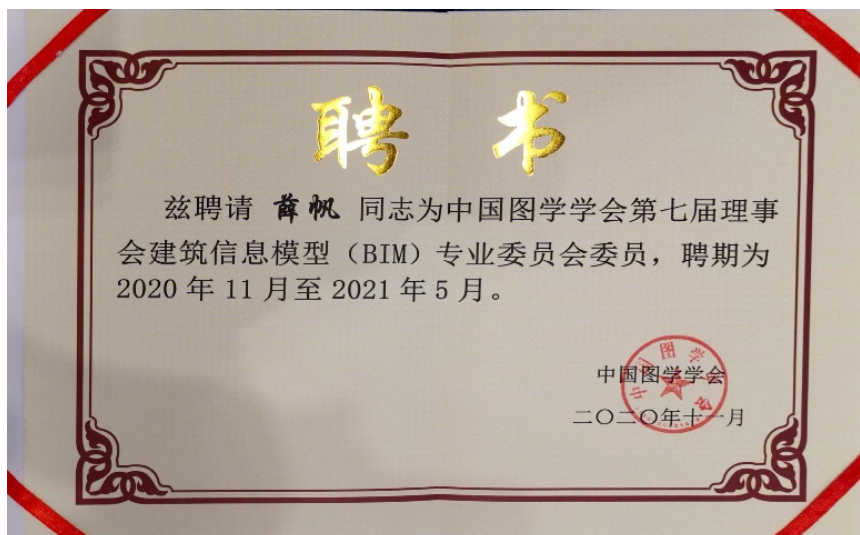
Urban Ecologies Design Lab

1. Dr. Juan Du

   - received a competitive grant from the BoCHK Centenary Charity Programme at the amount of HKD10.11 million, with UEDL's research project "Housing in Place: Quality Homes for Sustainable Hong Kong" [以家為本：營造本港可持續居所]. The application and review process spanned over a year and was conducted by The Hong Kong Council for Social Service (HKCSS). In collaboration with the Habitat for Humanity (Hong Kong), the project will be launched by December 2020 for a period of 3 years.

     Project Objectives: *Hong Kong is in need of 450,000 new public housing units, for an estimated population of over 1 million, most of whom currently live in cramped substandard housing and are more exposed to Hong Kong's severe challenges of high urban density and subtropical climate. Thus, beyond the quantitative need for additional housing units, there is also an urgent need for qualitative solutions for non-public housing provisions for Hong Kong's low-income working population. This project aims to generate an environmental and socially specific Quality Homes Design and maintenance demonstration for affordable housing, through providing new social housing, improving existing housing conditions, and empowering a wider housing need-specific population with community resources and support.*

Virtual Reality Lab of Urban Environments & Human Health

1. Dr. Bin Jiang and Dean Webster

   - co-authored the following paper which has been accepted for publication:

   Dorita H.F. Chang, **Bin Jiang**, Nicole H.L. Wong, Jing Jun Wong, **Chris Webster**, Tatia M.C. Lee (2021). The human posterior cingulate and the stress-response benefits of viewing green urban landscapes, <u>NeuroImage</u>, Volume 226, 117555, ISSN 1053-8119, DOI: <u>https://doi.org/10.1016/j.neuroimage.2020.117555</u>.

   Abstract: *The mechanistic and neural bases of why green environments drive positive mental health outcomes remain poorly understood. We show that viewing green urban landscapes that vary in terms of green-space density elicits corresponding changes in the activity of the human ventral posterior cingulate cortex that is correlated to behavioural stress-related responses. We further show that cingulate responses are engaged early in the processing cascade, influencing attentional and executive regions in a predominantly feedforward manner. Our data suggest a key role for this region in regulating (nature) dose-dependent changes in stress responses, potentially through its extensive connections to the prefrontal and hippocampal regions which in turn project towards the neuroendocrine system. As the posterior cingulate cortex is implicated in a variety of neurological diseases and disorders, these findings raise a therapeutic potential for natural environmental exposure, highlighting green-cover as a modifiable element that links to changes in limbic responses, and has health consequences for practitioners and city-planners alike.*

   - submitted the following paper for publication:

   Bin Jiang, Yi Lu, Long Chen, Xueming Liu, Yuwen Yang, Wenyan Xu, **Chris Webster**, William C. Sullivan. A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. <u>Nature Communication</u>. [Manuscript number: NCOMMS-20-45798]

   Abstract: *There is striking racial disparity in the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection rates in the United States. We hypothesise that the disparity is significantly smaller in areas with a higher ratio of green spaces. County level data on the SARS-CoV-2 infection rates of black and white individuals in 135 most urbanised counties across the United States were collected. The ratio of green spaces by land-cover type in each county was extracted from satellite imagery. A hierarchical regression analysis measured cross-sectional associations between racial disparity in infection rates and green spaces, after controlling for socioeconomic, demographic, pre-existing chronic disease, and built-up area factors. We found a higher ratio of green spaces at the county level is significantly associated with a lower racial disparity in infection rates. Four green space factors have significant negative associations with the racial disparity in SARS-CoV-2 infection rates.*