DAY1

パンデミック後のライフデザインと建築を探る
Exploring Life Design and Architecture after the Pandemic

2020 年 12 月 10 日 (木) 15:00～17:30 | Dec. 10, 2020, 15:00-17:30

Nothing new? Architectural research for life (before and) after the pandemic
新しいものはないのか？パンデミック前と後の生活のための建築研究

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Summary　要旨

Life might not be radically different after the pandemic, but the pandemic has confronted us with the inefficiencies in the way our lives, and the built environment as an extension of this, have been organized. Why do we need to commute daily between residential, suburban neighborhoods and a Central Business District, when much of the same work can be done from the comfort of our home or distributed workplaces nearby. This question is not new, but the 'new normal' has prioritized it. When the School of Design and Environment at NUS conceived its new SDE4 building, it recognized that we must practice the sustainability we teach in Architectural education and designed and constructed a building that adopts, among other features, a hybrid cooling system where air is cooled to a higher degree, never recirculated, and ventilators assist in achieving a comfortable indoor climate. While increasing sustainability and improving well-being, it is also better adapted to the addressing the pandemic, with windows that can be opened and indoor air that is never recirculated but always drawn from the outside. None of

these ideas are new, but we have simply been too locked into our habitual ways of doing things. I will present a number of research projects that were all conceived off before the pandemic but will assist in designing for life and architecture after the pandemic.

パンデミック後の生活は根本的には変わっていないかもしれないが、パンデミックは私たちの生活とその延長線上にある建築環境の非効率性に直面している。同じ仕事の多くが自宅や近くの分散した職場で快適にできるのに、なぜ私たちは毎日、住宅地や郊外の住宅地と都心のビジネス街を行き来しなければならないのだろうか。この問題は新しいものではないが、「ニューノーマル（新常態）」はこの問題に優先権を与えている。国立シンガポール大学のデザイン環境学部が新しい SDE4 校舎を構想したとき、建築教育で教える持続可能性を実践しなければならないと認識し、他の特徴の中でも特に、空気をより高いレベルまで冷却し、決して再循環させず、換気装置が快適な室内気候を達成するために支援するハイブリッド冷房システムを採用した建物を設計・建設した。持続可能性を高め、幸福度を向上させる一方で、窓を開けることができ、室内の空気は決して再循環されず、常に外部から取り込まれるようになっているため、パンデミックへの対応にも適している。これらのアイデアはどれも新しいものではないが、私たちは習慣的なやり方に囚われすぎているだけである。私は、パンデミック前に考案された研究プロジェクトをいくつか紹介するが、パンデミック後の生活や建築の設計に役立つだろう。

Short bio　略歴

Rudi Stouffs is Dean’s Chair Associate Professor and Deputy Head (Research) at the Department of Architecture, School of Design and Environment, National University of Singapore. He received his PhD in Architecture from Carnegie Mellon University, an MSC in Computational Design, also from CMU, and an MSc in Architectural Engineering from the Free University Brussels. He has held previous appointments at Carnegie Mellon University, ETH Zurich, and TU Delft.

At NUS, he leads the Architectural and Urban Prototyping lab, is Research Thrust Leader for Parametric BIM in the NUS Centre of Excellence in BIM Integration, and a Principal Investigator in the Future Resilient Systems II research programme at the Singapore ETH Centre. He is also vice-president (elect) of eCAADe, the association for Education and research in Computer Aided Architectural Design in Europe.

His research expertise and interests include computational issues of description, modelling, and representation for design, in the areas of shape recognition and design generation, building information modelling and analysis, virtual cities and digital twins.

ルディ・スタフスは、シンガポール国立大学デザイン環境学部建築学科長准教授、兼副学科長（研究）。カーネギーメロン大学で建築学の博士号、同じくカーネギーメロン大学でコンピュテーショナルデザインの修士号、ブリュッセル自由大学で建築工学の修士号を取得した。カーネギーメロン大学、ETH チューリッヒ、デルフト工科大学を経て、現在に至る。

国立シンガポール大学（NUS）では、建築・都市プロトタイピングラボを率い、NUS センターオブエクセレンスの BIM 統合におけるパラメトリック BIM の研究推進リーダー、シンガポール ETH センターの Future Resilient Systems II 研究プログラムの主任研究員を務めている。また、ヨーロッパのコンピュータ支援建築設計の教育と研究のための学術組織である eCAADe の副会長（選出）も務めている。

彼の研究の専門知識と関心は、形状認識とデザイン生成、建物情報のモデリング（BIM）と解析、仮想都市とデジタルツインの分野での設計のための記述、モデリング、表現の計算問題を含む。

NOTHING NEW?
ARCHITECTURAL RESEARCH FOR LIFE (BEFORE AND) AFTER THE PANDEMIC

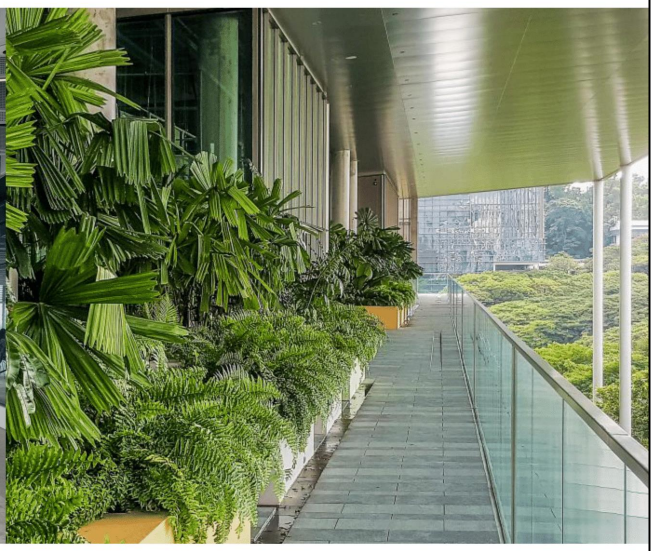
AIJISA – 10 DECEMBER 2020

Rudi Stouffs

Dean's Chair Associate Professor

WELL Building Standard

A COMPREHENSIVE
APPROACH TO **WELL**-BEING



REPURPOSED SDE1 AND SDE3

CONTENT

- data integration (GeoBIM)
- energy performance
- pedestrian comfort

VIRTUAL SINGAPORE

- dynamic 3D city model and collaborative data platform

SLA
SINGAPORE
LAND AUTHORITY

GOVTECH
SINGAPORE

BIM SUBMISSION

- not yet obligatory in IFC-compatible form
- nevertheless, BIM models are becoming more widespread

compliance checking –and– development

Building and Construction Authority
We shape a safe, high quality, sustainable and friendly built environment.

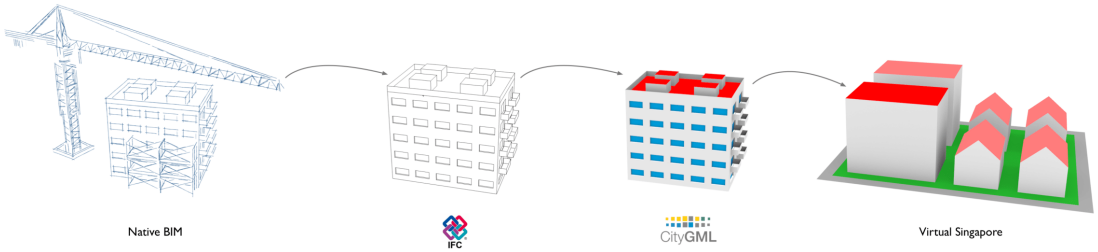
HOUSING & DEVELOPMENT BOARD

URBAN REDEVELOPMENT AUTHORITY

jtc

DATA FLOW

Native BIM → export → IFC → convert → CityGML → use → Use cases



NUS National University of Singapore

Ordnance Survey

USE CASES

Native BIM → export → IFC → convert → CityGML → use → Use cases

HOUSING & DEVELOPMENT BOARD

URBAN REDEVELOPMENT AUTHORITY

SLA SINGAPORE LAND AUTHORITY

Building and Construction Authority

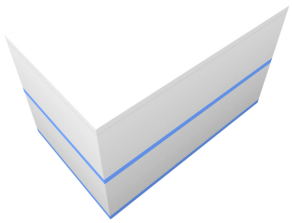
jtc

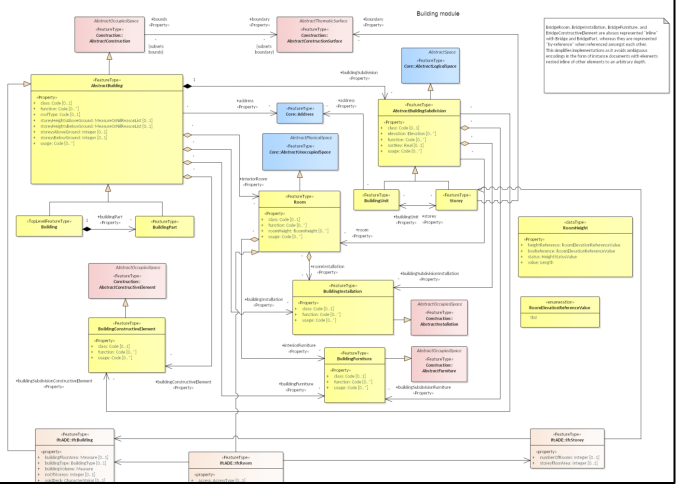
GOVTECH SINGAPORE

CITYGML – IFCADE

Native BIM → export → IFC → convert → CityGML → use → Use cases

– application domain extension

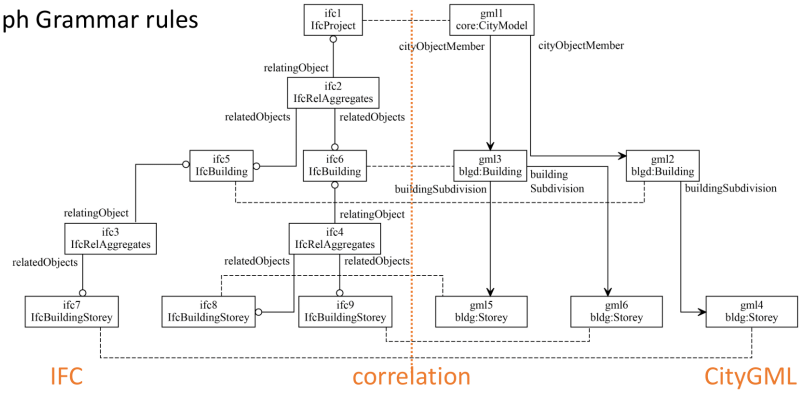




IFC – CityGML

Native BIM → export → IFC → convert → CityGML → use → Use cases

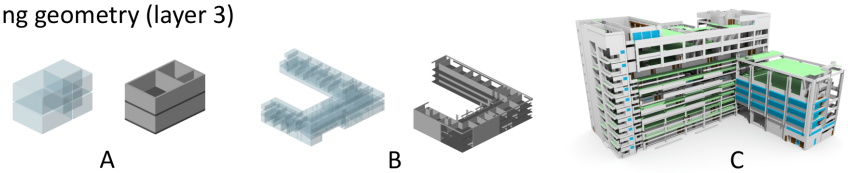
– Triple Graph Grammar rules



IFC – CityGML

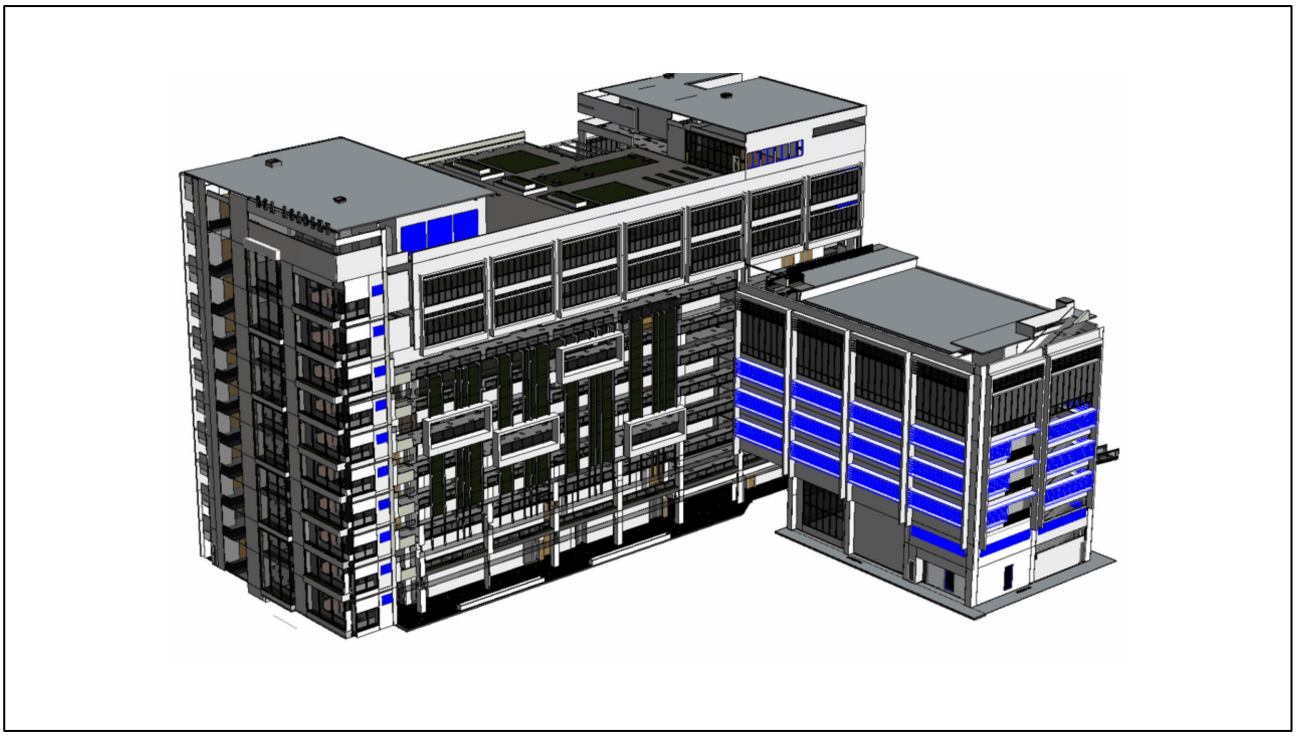
Native BIM → export → IFC → convert → CityGML → use → Use cases

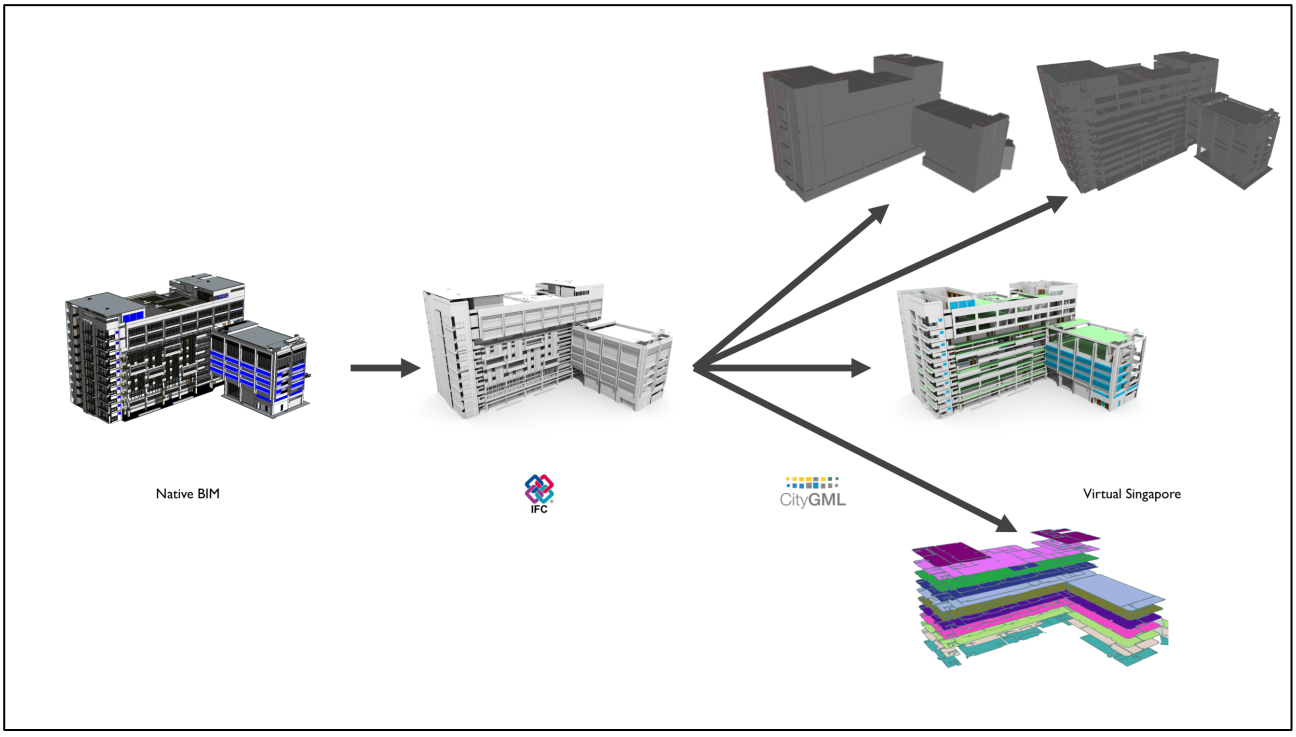
– Triple Graph Grammar rules
- structural rules (layer 1)
- creating objects (layer 2)
- adding geometry (layer 3)



A B C

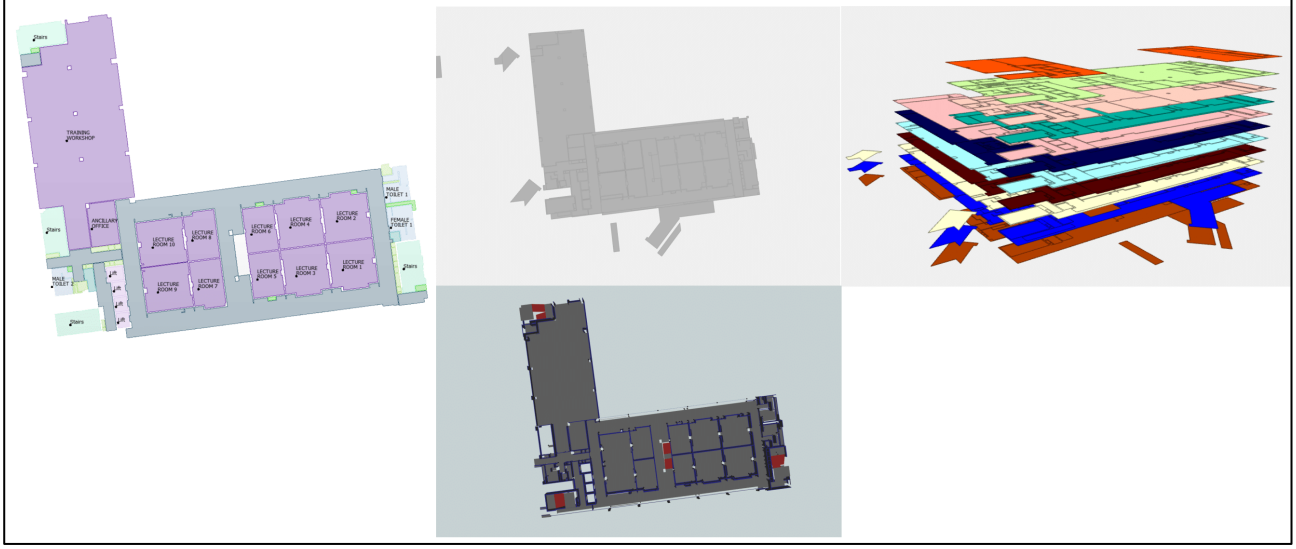
	Layer 1				Layer 2								Layer 3												
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13
A	1	0	3	6	15	1	1	1	8	3	9	24	27	24	2	2	1	12	47	27	12	3	6	3	6
B	0	1	5	91	460	0	0	0	0	0	91	509	5411	5355	29	29	6	172	924	5411	172	5	91	0	91
C	0	1	16	709	11634	0	0	0	0	28	1533	6604	21970	21648	1400	1400	11	7555	11596	21970	7555	16	709	0	709



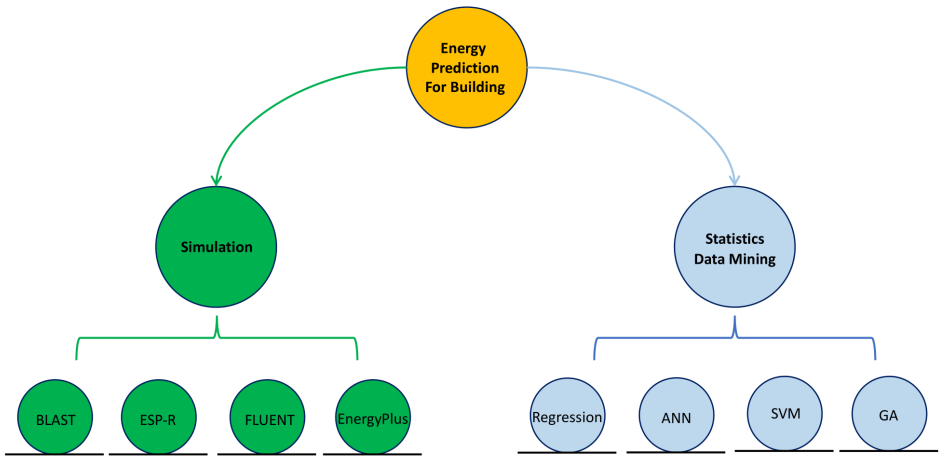

Native BIM
IFC
CityGML
Virtual Singapore

ANALYSES

– indoor navigation and mobility



ENERGY PERFORMANCE PREDICTION

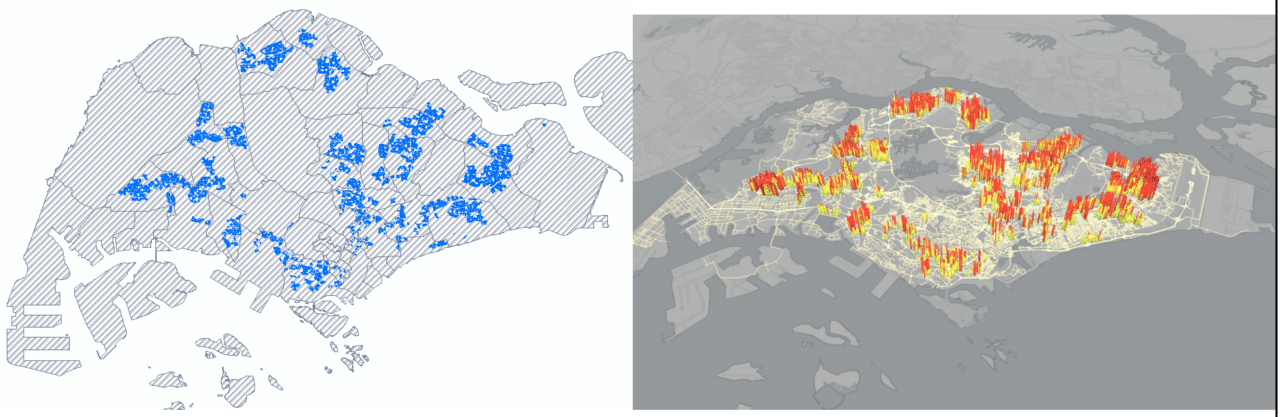


need extensive knowledge on the physical system, especially on the mechanisms occurring inside and outside the building geometry

require a large amount of learning data and mainly a relevant and completeness database

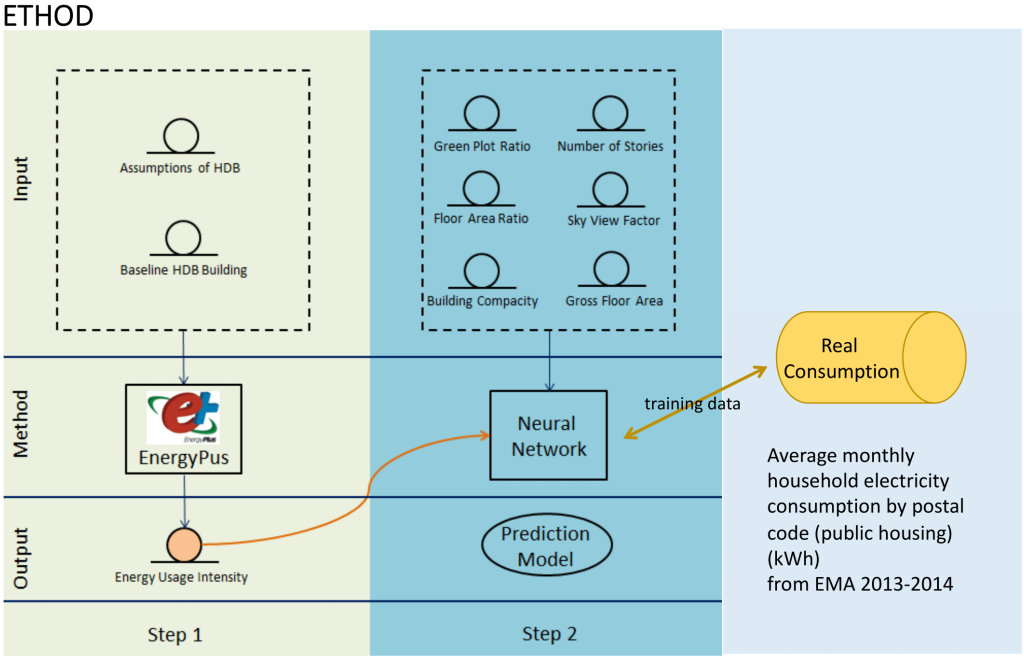
ENERGY PERFORMANCE OF RESIDENTIAL BUILDINGS

– Singapore public housing stock



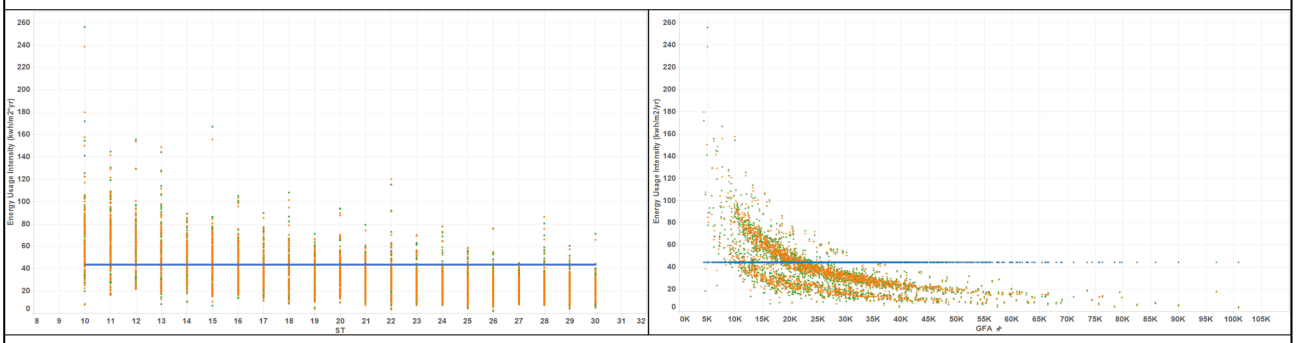
Data source: Energy Market Authority (EMA) Singapore

METHOD

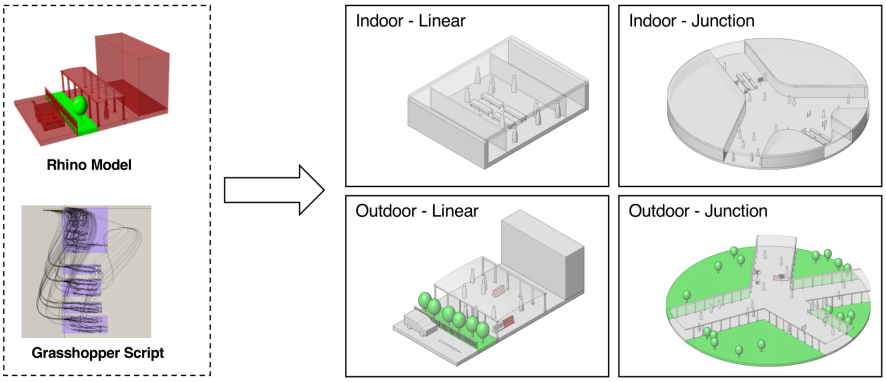


ENERGY USAGE INTENSITY

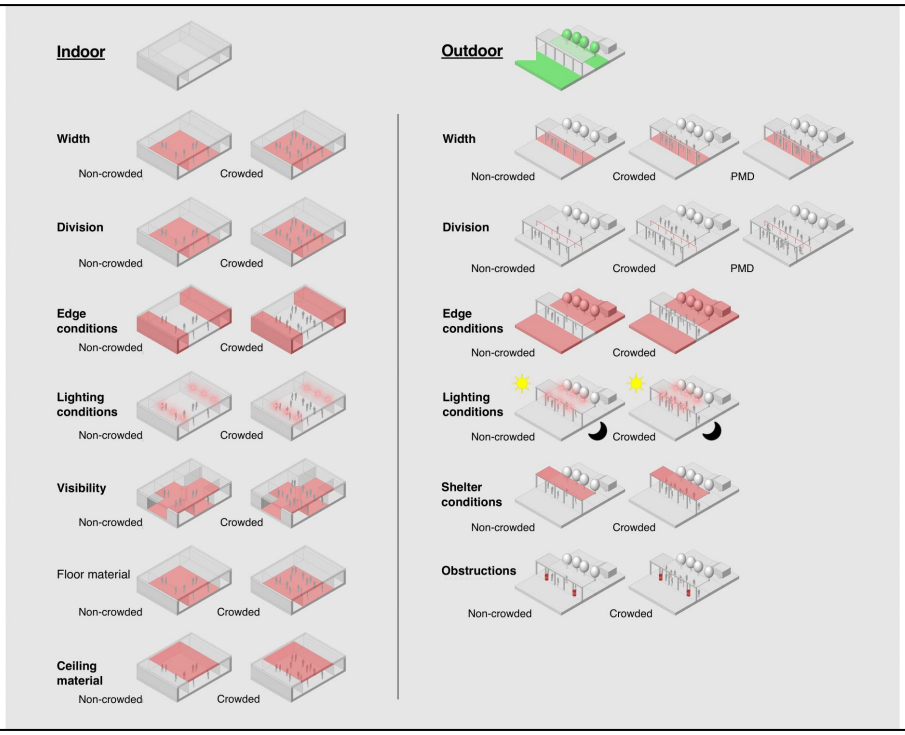
- varies by number of stories
- varies by GFA
- varies by building compacity



WP5.2
Parametric (generative) model



Associative model of all boundary conditions developed in Rhino & Grasshopper:
Determine variation generation combinations and ranges
Generate alternatives for various link combinations from the inventory
Non-geometric attributes:
Crowd count



WP 5

Online Survey
Design parameters

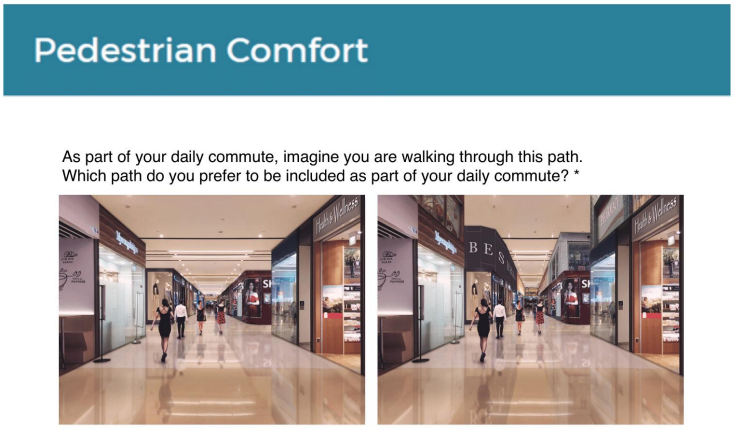
Brainstorming and sharing sessions with the various agencies. Identified a number of variables for each of the following categories:

- Width
- Division
- Edge conditions
- Lighting conditions
- Visibility
- Floor and ceiling material
- Shelter conditions
- Obstructions

WP 5

Online Survey
Design and structure

Each question presents two images and asks the respondent to select which one they prefer.



- Total of 430 different questions
- Each question has a crowded and non-crowded variant
- Survey split into three
- Each survey includes almost equal number of questions from each category
- Each respondent answered 133 questions (with video pauses)

Choice		1	2	3	4	5	6	7
Width		Wide	Tapering (Inverse Y)	Tapering (Y-shaped)	Normal	Narrow		
		74.00	68.75	51.25	45.50	4.00		
Division		No Barrier	Seating	Arrows on Floor	Planters	Arrows on Ceiling	2 Floor Textures	Handrail
		78.00	64.50	56.30	49.20	49.10	49.10	30.25
Edge Condition		Curtain Wall	Commercial no Queue	Commercial with Queue	Seating	Blank Wall		
		76.13	64.63	56.88	38.25	14.13		
Visibility	Path Type	4 Point Cross Junction	Curved	3 Point T-Junction	Straight	Straight with stairs		
		56.00	54.88	53.50	47.75	37.88		
	Path Condition	Sky	Normal	Double height ceiling	Obstruction			
		68.17	59.20	49.03	23.60			
Lighting	Brightness	High	Normal	Low				
		64.50	51.75	33.75				
	Colour	Normal	Warm	Cool				
		58.75	62.25	29.00				
Floor	Material	Marble	Timber	Carpet	Concrete Imprint	Grass		
		70.50	68.50	56.50	37.13	17.38		
	Colour	Light	Dark					
		72.00	28.00					
Ceiling	Material	Plaster	Timber	Concrete Imprint				
		70.50	55.25	24.25				
	Colour	Light	Dark					
		81.50	18.50					

WP 5

Survey Analysis & Results
Indoor Ranking

Aggregated responses

Each number represents the percentage of responses that chose that option over any other option compared to it.

WP5.3

Design Variations
VR Demo

Link to video
https://nextcloud.fcl.sg/nextcloud/index.php/s/pAwrKqbstH8X4ac

Aggregated Values for **edge conditions** (%):

open edge	commercial edge	wall edge
		
76.13	64.63	**14.13**
		
73.50	52.27	**13.18**

Correlation between **age** and **open/enclosed edge condition** (outdoor non-crowded)

	Enclosed Edge	Open Edge
<30	**365**	779
30-39	**432**	1140
40-49	**389**	866
50-65	**412**	1017
P-value	0.04826	

WP 5

Key Findings
Edge conditions

Trends for edge conditions (indoor and outdoor)

- People prefer open edge conditions that provide a connection to the outdoors/surroundings more than edge conditions that provide enclosure or other functionality like shopping or seats
- Stronger preference in younger respondents in outdoor environments

Correlation between **gender** and **lighting condition** (indoor non-crowded)

	Brightness (High)	Brightness (Normal)	Brightness (Low)
Female	**78**	**65**	**12**
Male	64	53	28
P-value	0.00638		

Correlation between **gender** and **lighting condition** (outdoor non-crowded)

	Day	Night with light	Night with no lights
Female	**80**	**72**	**3**
Male	61	71	13
P-value	0.00154		

Correlation between **age** and **lighting condition** (outdoor non-crowded)

	Day	Night with light	Night with no lights
<30	30	29	4
30-39	38	44	6
40-49	37	28	5
50-65	36	42	1
P-value	0.03662		

WP 5

Key Findings
Lighting

Trends for lighting conditions (indoor and outdoor)

- People generally prefer brighter lighting in all conditions
- Females and Older respondents have stronger preferences, especially in non-crowded conditions suggesting that it may be due to perceived safety

International Journal of Geo-Information

IMPACT FACTOR 1.840

Aims and Scope

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