THE UNIVERSITY OF HONG KONG 香港大學
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Department of Real Estate and Construction

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The urban big data lab

CIM-enabled quantitative view assessment in architectural design and space planning

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Plenary talk
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Outline

1. Introduction
2. Research Methods
3. The Integrated Model for View Assessment
4. Case study
5. Discussion and Conclusion

1. Introduction

1. Introduction

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- Typically, view is assessed manually by physical site observation, data collection, and data analysis.
- Such process is time-consuming, labour-intensive, and costly.
- The process needs assistive tools.

Traditional view assessment

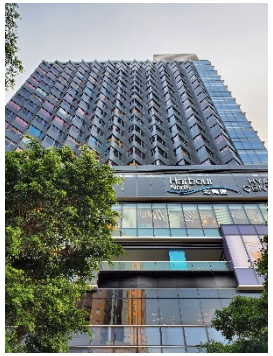
(1) Physical site observation

(2) Data collection

(3) Data analysis

Architectural space planning

Space planning, building form design, and furniture arrangement to maximize the benefits of good view



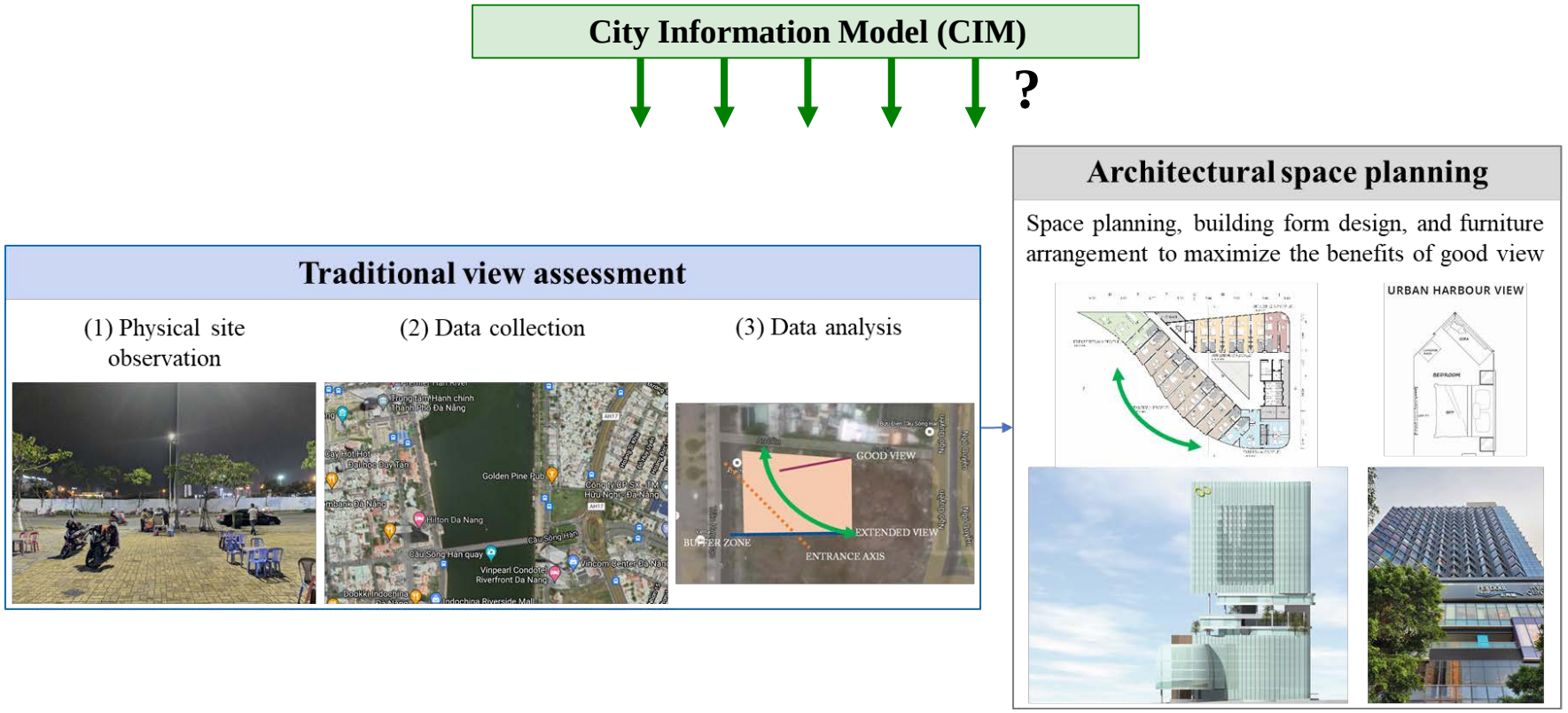
1. Introduction

- To facilitate the view assessment in architectural design, the simulation method has been adopted as a convenient and effective tool.

Methods	Forms	Advantages	Disadvantages
Process modelling	1) Projection 2) Raytracing on hand-made models 3) Fish-eye lens	1) Quantified analysis	1) Time-consuming and unscalable 2) Insufficient 3D details
View assessment based on existing City Information Models (CIMs)	1) Visibility analysis 2) View image capture		

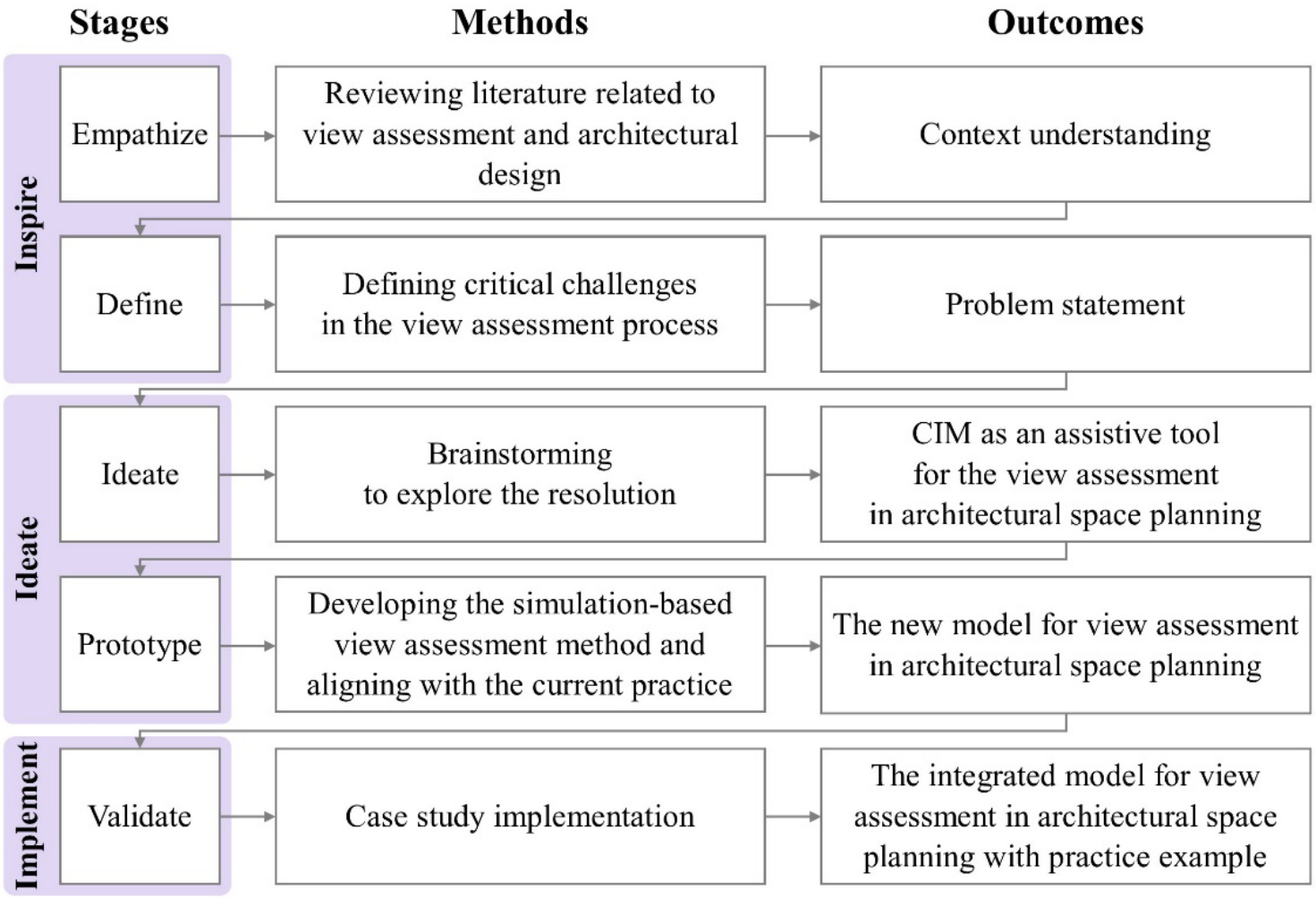
1. Introduction

- However, the CIM-enabled approach for architectural space planning has not been realized in both research and practice.
- This research, therefore, aims to develop a model through which CIM can be extended to assist view assessment in architectural space planning.



2. Research Methods

- This research comprises five stages to both resolve real-world challenges and constitute knowledge contributions.



3. The Integrated Model for View Assessment

- After reviewing the literature, redefining the real-world challenges, and brainstorming the potential solutions, the new view assessment model is generated.
- It is the consolidation of simulation-based view assessment and traditional site observation and evaluation.

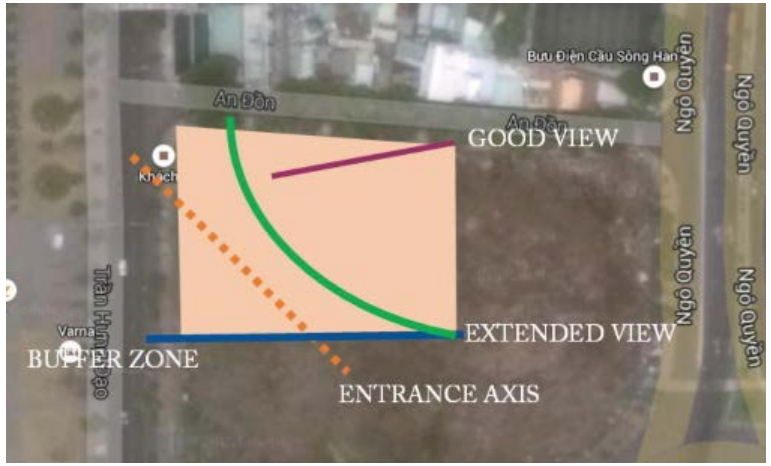
3. The Integrated Model for View Assessment

Traditional view assessment

(1) Physical site observation

(2) Data collection

(3) Data analysis



3. The Integrated Model for View Assessment

Simulation-based view assessment

(1) Input

Criteria

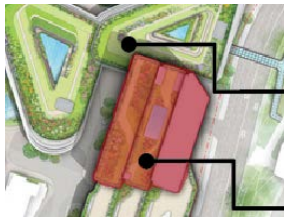
View type

3D CIM

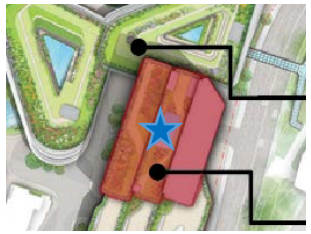
2D site

(2) Data preprocessing

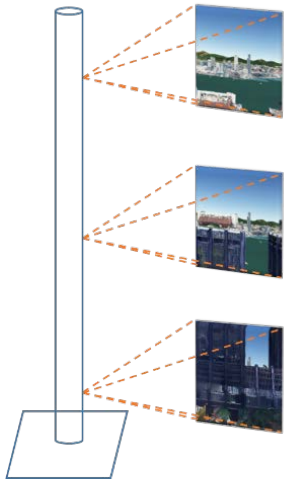
Geographic registration



Observation site determination

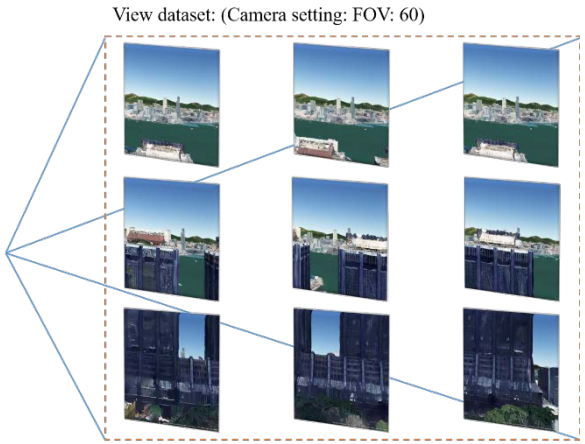


View site sampling

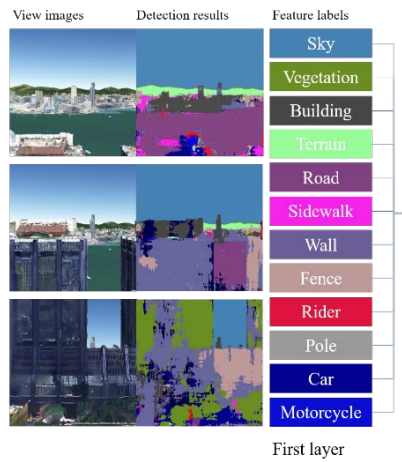


(3) Semantic extraction and mapping

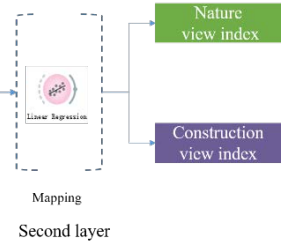
View photo generation



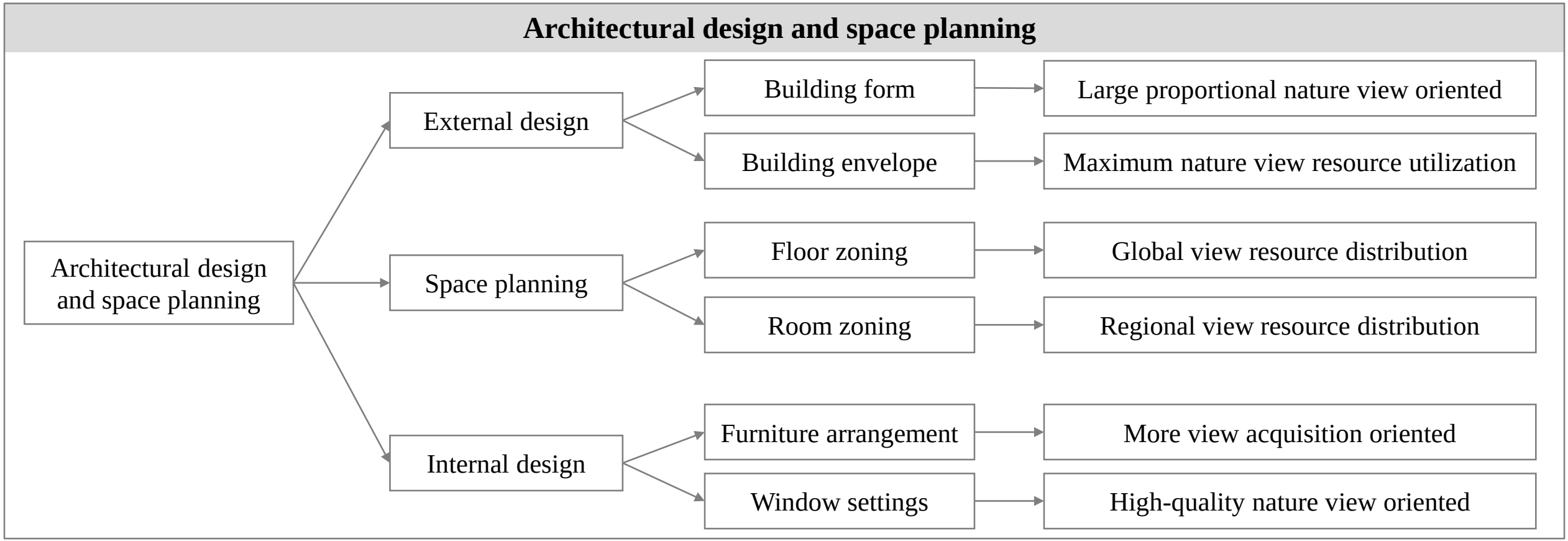
Semantic segmentation



Multimodal regression



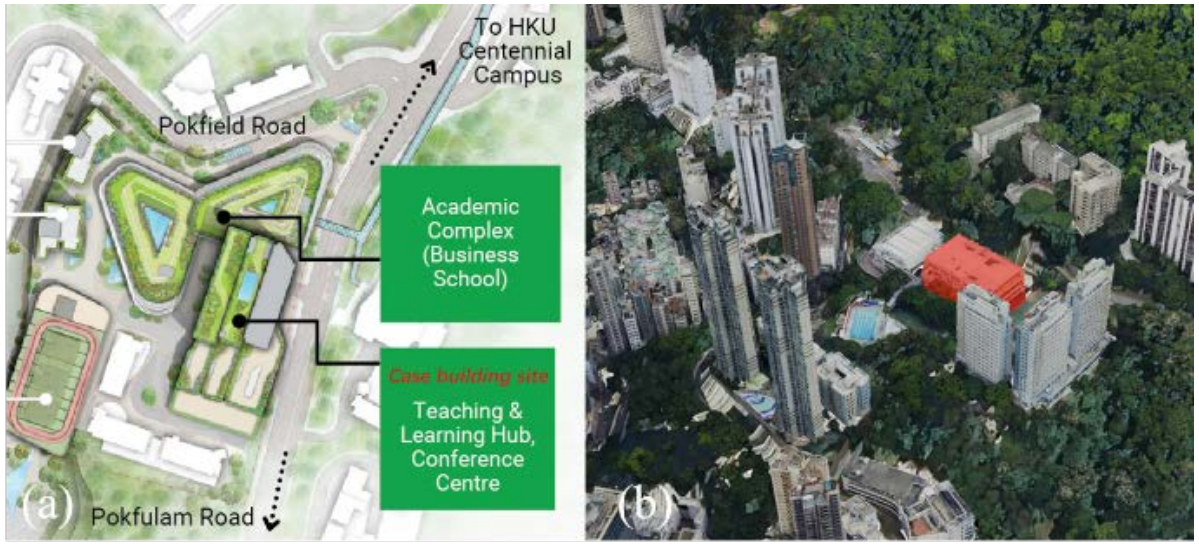
3. The Integrated Model for View Assessment



4. Case study

- To validate the feasibility of the integrated approach, the Pokfield campus, the University of Hong Kong, Hong Kong SAR, was selected to be a case study.

Case area



Experimental environment

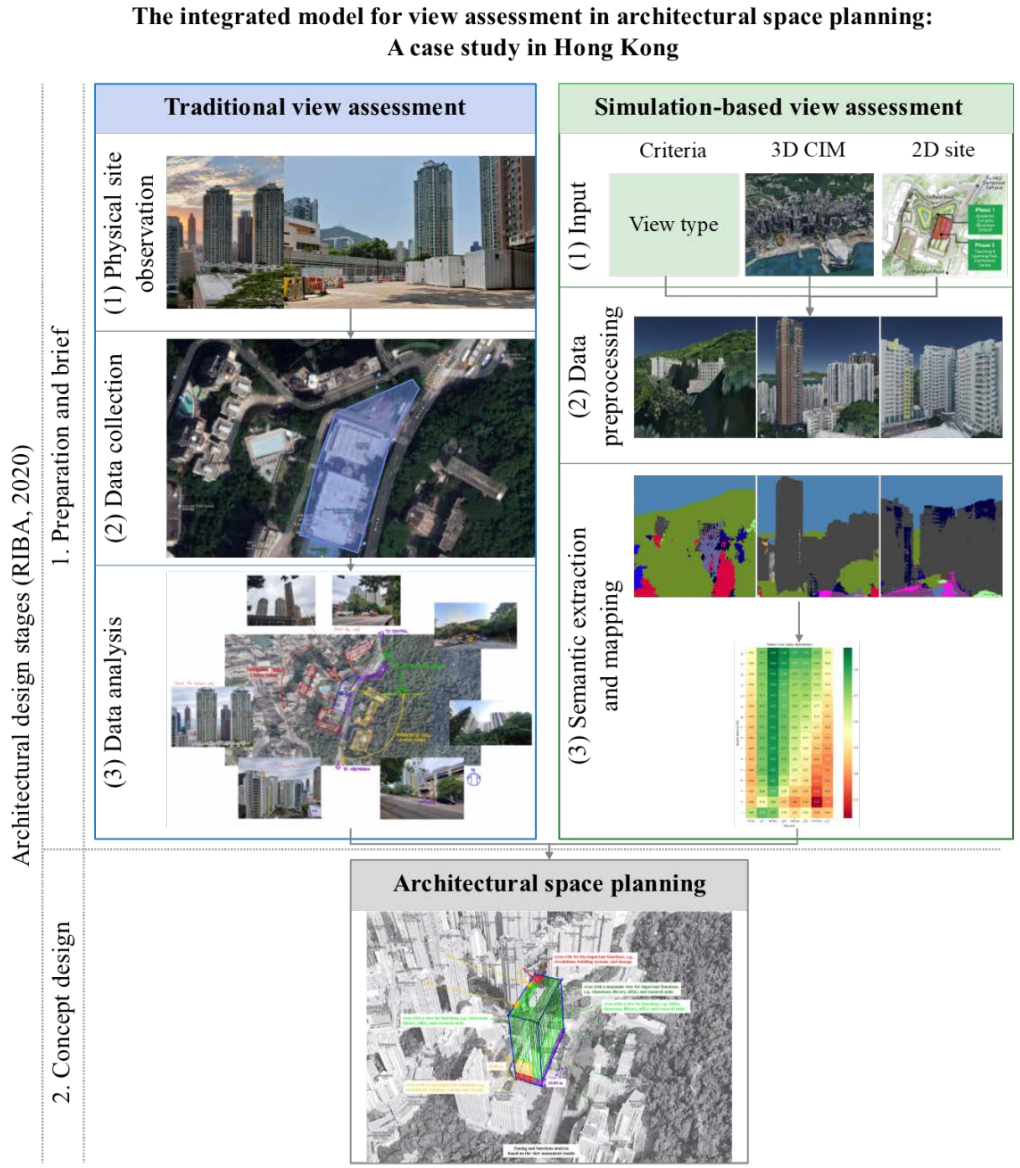
Workstation: two Intel XEON E5-2690 v4 CPUs (2.6GHz, 28 cores),
64 GB memory,
Nvidia Quadro P5000 GPU,
Windows 10 Enterprise 64-bit.

View visualization platform: Cesium (1.73)

Deep transfer learning model: DeepLab V3

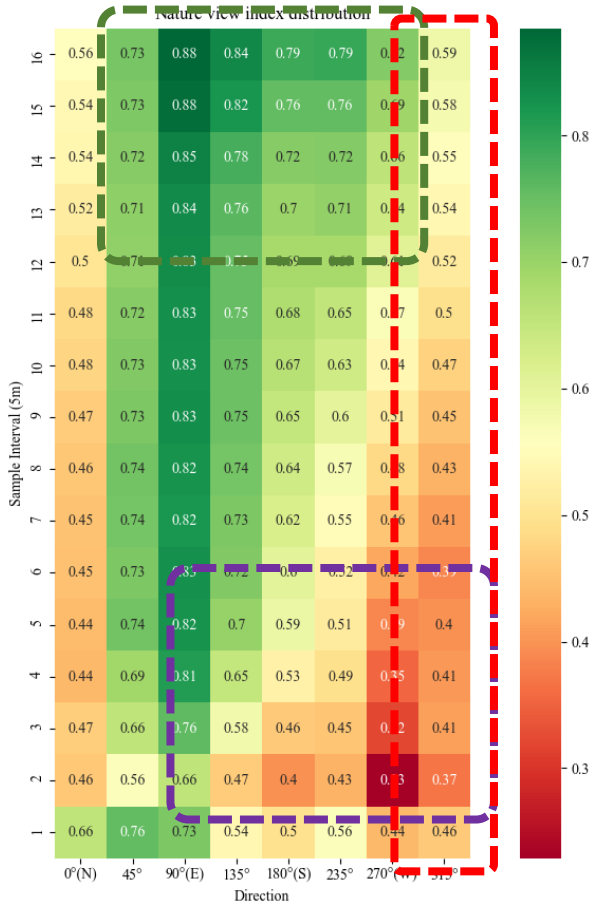
View prediction platform: Orange3 (3.26.0)

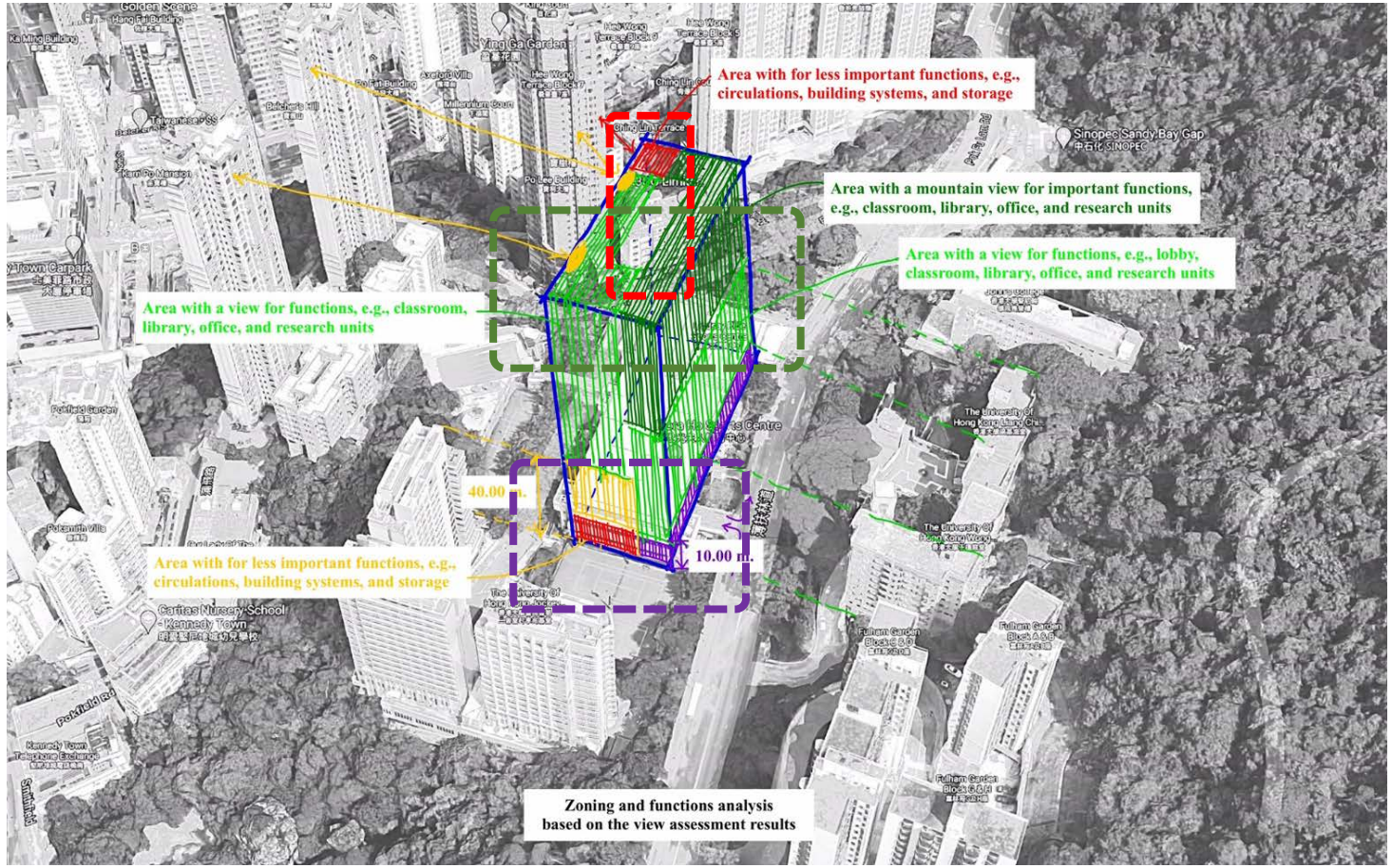
4. Case study


The integrated model for view assessment in architectural space planning:
A case study in Hong Kong
Architectural design stages (RIBA, 2020)
1. Preparation and brief
2. Concept design
Traditional view assessment
(1) Physical site observation
(2) Data collection
(3) Data analysis
Simulation-based view assessment
Criteria
3D CIM
2D site
(1) Input
View type
(2) Data preprocessing
(3) Semantic extraction and mapping
Architectural space planning

4. Case study

- The design team can use this quantified view result as an accurate indicator to guide the space planning.





5. Discussion and Conclusion

Significances

1. Revealing difficulties in the conventional site observation, which support the promising approach of using computational technologies
2. Validating that
   - CIM can be a less expensive virtual platform supporting view assessment in architectural design and space planning.
   - Its outcome can confirm the qualitative result from physical site observation and add more details to facilitate precise and rapid decision-making throughout the entire architectural design process.
3. Confirming that its integration with the conventional assessment approach transforms the view assessment process from qualitative to mixed methods: combining qualitative and quantitative data.

5. Discussion and Conclusion

Industry contributions

- Developing CIM to be an assistive tool for quantitative view evaluation in architectural design
- Providing the integrated model with practice examples

Limitations

- The proposed model is especially efficient for a site renewal or design within a less-changed complicated environment and area, like Hong Kong.
- A view is merely one of numerous architectural design criteria. It therefore must be weighed and balanced with other factors.

Recommendations

- The CIM-enabled quantitative view assessment model can be considered as a part of generative design. Future research is recommended to integrate the proposed model with other criteria and computational tools to advance the computer-aided generative design further.

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