Use of digital 3D urban models for view evaluation in building envelope design

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1. Objectives

This Paper Proposes

- a basic framework for obtaining visual information using a 3D urban model
- two different viewpoints at the façade and in the interior to consider the building design and the indoor visual environment design

Visual Function of Windows

to provide outdoor views and daylight to people indoors

To Design Windows for Quality Views Out

→ obtain visual information about the building's surroundings using a 3D urban model

2. 3D Urban Models

Features

- do not merely reproduce the three-dimensional geometry of the objects
- link attribute information to the object data

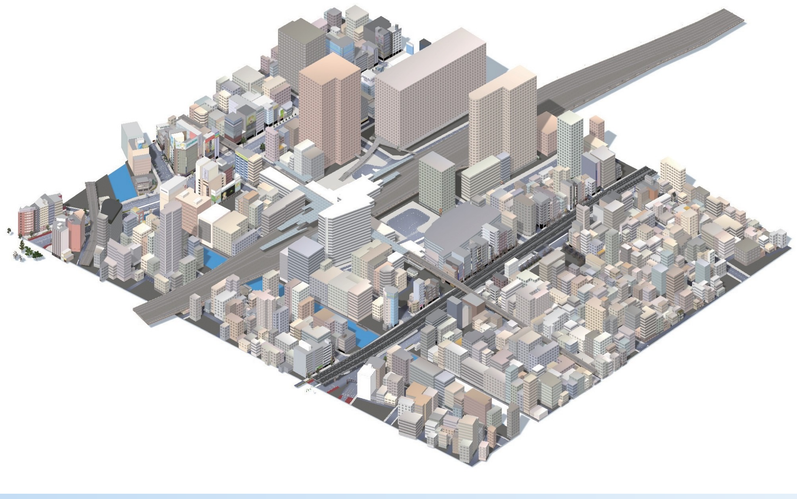
3D Urban Models have enabled …

- various simulations that reflect actual surrounding conditions in building design

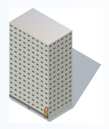
3. Extraction of Outdoor Visual Information

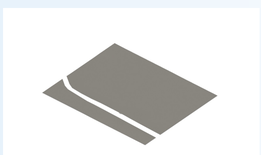
This Study Used …

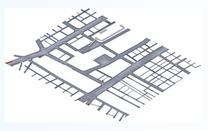
Unity : a cross-platform game engine to render 3D models and make a calculation
ZENRIN City Asset : 3D urban model, Akihabara area in Tokyo, Japan



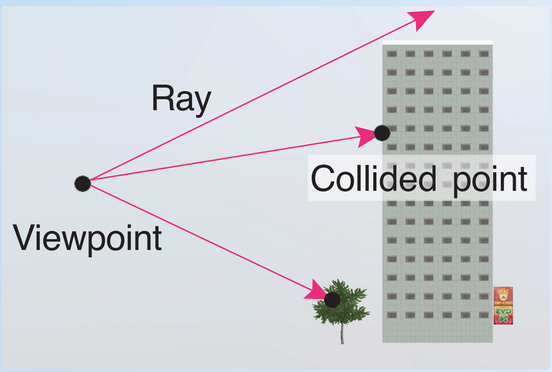

Green


Building


Ground


Road

▲ **Added street trees;**
▲ **Classified objects into four types**



Ray emission and collision detection

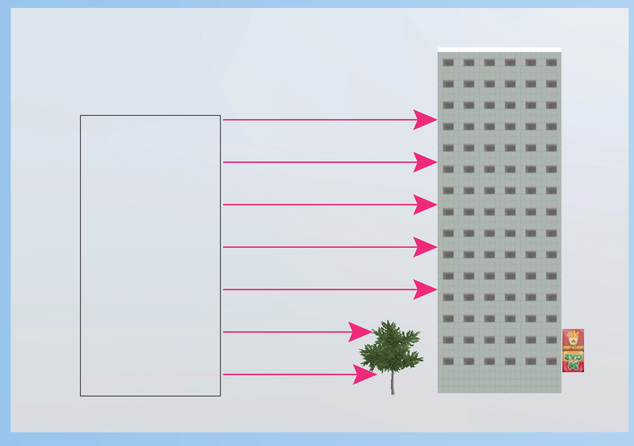
- get the type of collided object
- measure the distance between the viewpoint and collided point
- If nothing was with the detection range, the collided point was considered as sky

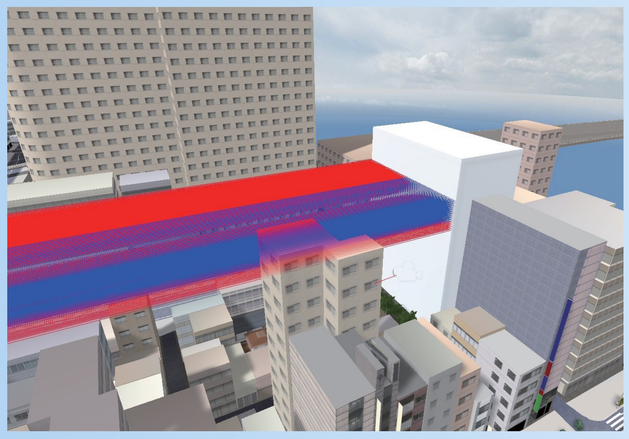
This study set the detection range to 600m due to the size of the 3D urban model.

3-1. Outdoor Visual Information Used for Designing Buildings

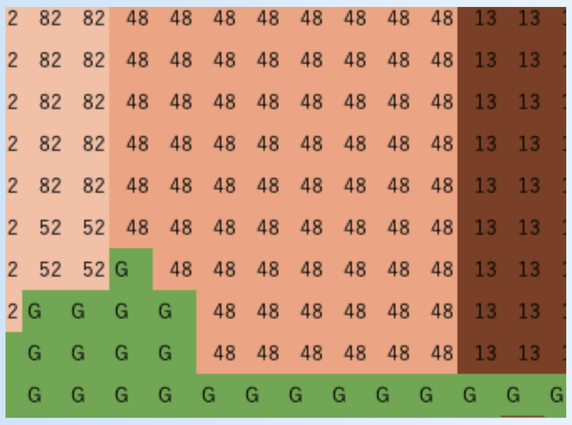
In the design stage of site planning and architectural massing

This information is useful to know which direction and which floor will have the quality view.

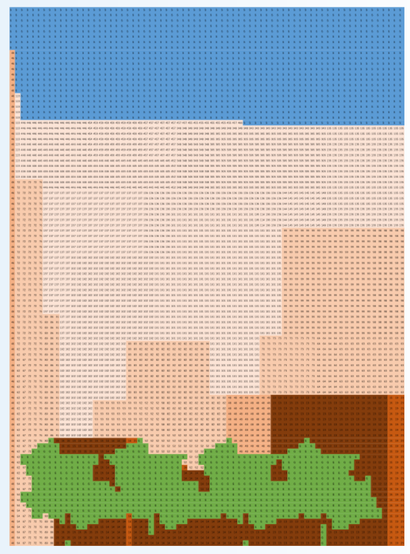




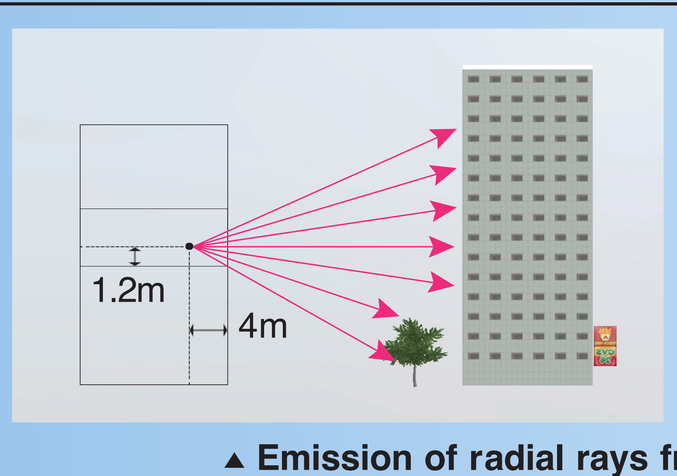
▲ **Emission of horizontal rays from a façade** ▲
(red: buildings; blue: sky or out of range)

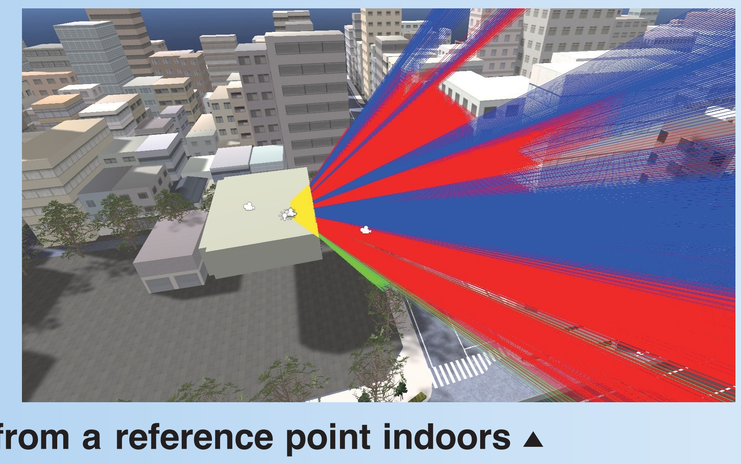


▲ **Calculation result** ▶
Color-coded according to the object type and distance



3-2. Outdoor Visual Information Used for Designing Interiors and Windows





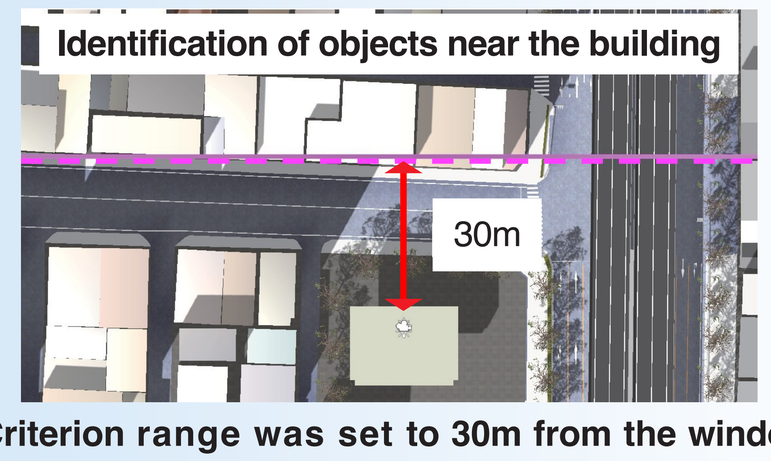
▲ **Emission of radial rays from a reference point indoors** ▲
(red: buildings; blue: sky; yellow: Indoors; green: street trees)

▲ A view of the window from the reference point

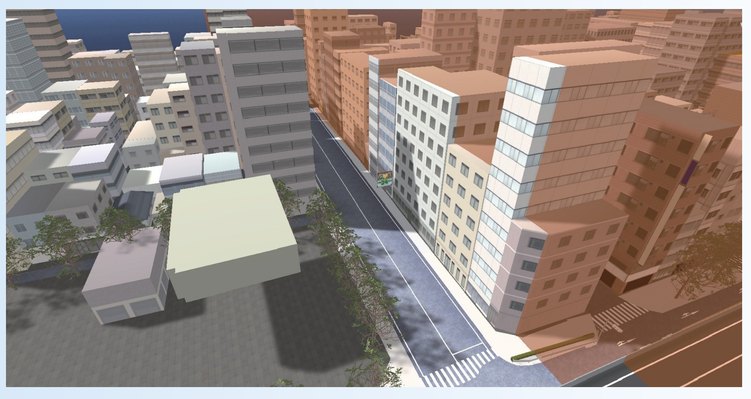
▼ ***A result***

Sky VIew Factor : 8%
Green View Factor : 17%
Near Object Ratio : 19%

Identification of objects near the building



Criterion range was set to 30m from the window.



4. Conclusion

View Evaluation with 3D Urban Models

- a method of detecting objects and their distances around a building to be designed using the 3D urban model
- the object information to be used for view evaluation in building envelope design

Setting Two Different Viewpoints

- at the façade level → to consider the building design
- at the interior level → to consider the visual environment design

Using the Game Engine

- to visually consider design options in 3D space
- to consider possible future changes in the neighboring environment