



Title:

A BIM Inspired Supporting Platform for Architectural Design

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Introduction:

In conventional design process, a professional consultant always performs an accurate assessment of the model until the architect almost completes the design. When the feedback provided by consultants cannot satisfy the requirements of the architectural plan, architects face the following two alternatives if they wish to preserve design quality:

1. They can either perform large-scale revision of the design based on the assessment data in the feedback, and thereby simultaneously satisfy price, physical environment, and structural requirements;
2. Or they can only attempt to satisfy one requirement, such as by meeting structural and physical environment requirements, while sacrificing budgetary requirements.

But while the first alternative will increase design cost, waste time, and reduce efficiency, the second alternative cannot meet all the goals of the architectural plan. It is clearly apparent that, during the early design stage, consultants' assessments provide little timely assistance to architects who must make correct decisions, and instead chief constitute a format of presenting information.

There are many conventional aspects when it comes to evaluating a model, which includes cost, physical environment and building regulation review. To comply with the architectural plan, LOD100 model [1] contains information in the table below:

Aspect	Information
Physical	<ul style="list-style-type: none"> • Building massing Geometry form (natural ventilation of major interior spaces of building) Construction type General functional layout • Envelope of building Orientation of facades Construction type of envelope Window percentage • Surrounding buildings Planting Landform
Estimate	Building massing Structural type Construction type of envelope Total construction area
Building regulation	Planning layout Building massing

review	Building Coverage Ratio Greening Rate
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Tab. 1: Information which an LOD 100 model should contain [2].

Main Idea:

Business Process Modeling Notation provides clear ways to describe activities and the information flows between activities in what is called a Process Map [3]. In the field of BIM design processes, the communication between the architects and other consultants form a cycle. A smaller work cycle exists within early design stage, and chiefly involves communication between architects to themselves. There is a close relationship between design and modeling. This study chiefly proposes the use of a "dashboard" employing generative modeling technology [4] in the early design stage of architectural projects employing BIM design process in order to help architects make correct decisions. The dashboard can effectively present the information included in the LOD100 model in an intuitive manner. It is also worth noting that the dashboard must comply with the following requirements:

- To ensure that architects do not make subjective judgments based on their limited personal experience, the dashboard must provide architects with quantitative, highly visual, and high intuitively feedback information.
- In fact, architects do not need and cannot obtain precise feedback information during the early design stage. A dashboard therefore needs only to present estimated information.
- When many proposals have been thrown out during the early design stage, a dashboard can promptly provide design feedback information to architects, facilitating their decision-making.

With the lighting as example, this paper attempts to illustrate that it is possible to make further analysis of building massing model which is streamlined in the early stage of design. The Monte Carlo method is a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results [3]. We can simulate the lighting in the early stage of design by Monte Carlo Method with the help of a computer, and timely provide the feedback of relationship between building massing and lighting to the architect. The application of this tool is illustrated for a design practice, with specific reference to a bachelor apartment building which locates in Xiamen, China. This case study is derived from a strategic decision which deals with building massing regulation in order to balance the estimate, heat gain and natural light by dashboard in the early stage of design.

The architect has to make choices in the early stage of design. In order to meet the internal functional layout, the building massing has to be regulated on the west orientation (Fig.1). The architect either takes account of the local specifications to regulate building massing and reduce the cost or applied expensive materials to meet the energy conservation requirement. The dashboard was applied to present the information on various aspects to help the architects make the right decision, and to ensure proper direction of the design. Moreover, how the dashboard influences the strategic decision made by the architect in the design process will also be discussed.



Fig. 1: The massing of the apartment on the west orientation.

Conclusion:

In the field of BIM design processes, this study used generative modeling technology to propose the use of a dashboard to achieve the real-time presentation of assessment and analytical information. The

study also used the Monte Carlo method to analyze the lighting and functional layout of an apartment building. The results of this study indicate that a generative modeling tool can perform analysis of a model, even when there is only a simple building massing, during the early design stage, and yield useful information that can help architects make decisions during this stage.

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