

Development of an optimal design aid system based on building information modeling

Yunting Diao¹, Shinsuke Kato², Kyosuke Hiyama² (✉)

1. Yamatake Co., Ltd, 2-7-3 Marunouchi, Chiyoda-ku Tokyo 100-6419, Japan

2. Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan

Abstract

This study proposes an optimal building design aid system that integrates computer aided design (CAD), building environmental simulation tools and an optimization algorithm, based on the concept of building information modeling (BIM). BIM is a process of generating and managing data during a building's life cycle. It can be used to demonstrate the entire building's life cycle, including its construction and operation. Because the design of a build d may vary from an abstract shape to precise details, the building's database should vary accordingly. To store, manage and utilize the building's data efficiently, we suggest an evolving database structure for our design aid system. A case study verifies that the system can acquire data from CAD, run a number of simulations and generate Pareto solutions automatically during several design stages.

Keywords

building information modeling (BIM),
design aid,
evolving database,
multi-object optimization

Article History

Received: 5 July 2011

Revised: 3 November 2011

Accepted: 7 November 2011

© Tsinghua University Press and
Springer-Verlag Berlin Heidelberg
2011

1 Introduction

With increasing global environmental concerns, the international community is united in seeking solutions to the environmental concerns. In Japan, some countermeasures have already been undertaken in industrial sectors (MLIT 2010). For instance, a series of laws have been revised to rationalize energy utilization. As a result, the laws have been enforcing requirements for building designs as well. With the development of computer technology and modeling methods in recent years, environmental simulation tools, such as computational fluid dynamics (CFD), can be used. Consequently, design quality can be expected to improve by integrating environmental simulations in building designs.

In order to utilize environmental simulation tools in design process, firstly, design drawings and information about materials and facilities should be integrated. This process is complicated and often becomes an obstacle for integrating environmental simulations in the design process. Building information modeling (BIM) is, as well as a 3D-CAD software

that can generate floor plans and facade plans automatically from a 3D model, an integrated database of design, structure and facilities. All the building information and the traces of design and construction process is preserved in BIM. Therefore, BIM is expected to facilitate the integration of environmental simulations in design process, besides to improve design quality and efficiency. This study proposes an optimal design aid system that integrates database, environmental simulation tools and an optimization algorithm, based on the concept of BIM. The design aid system provides a useful tool that activates and operates several environmental simulations automatically to assist architects and engineers in creating a reasonable design plan. While future research will include a framework and specifications for this environmental planning-oriented BIM technology, this paper focuses on data inheritance among several design procedures of the design aid system. To further explain data inheritance and to prove the effects of our system, a case study on multi-object optimization problems is presented.

E-mail: hiyama@iis.u-tokyo.ac.jp