

# Specifications for computer-aided conceptual building design

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*The relative absence of computer support in conceptual building design deprives designers of advanced capabilities for the manipulation, organization and representation of design data. Such capabilities would be highly beneficial to the design process, particularly when designers from different specialties must work together to provide the best possible design solution. We look into how designers work during conceptual design with particular attention on how information is manipulated and organized. We then draw specifications for the creation of a computer tool to support such an early design stage.*

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**B**uildings represent a complex assembly of many different systems such as the enclosure, structure and ventilation systems. Designers determine the scope of construction in the early design stage by introducing the initial data that all other stages are completed against. The early design effort starts with a minimum number of professionals who make relatively isolated decisions on important parts of the design problem<sup>1</sup>. The success of the final design solution therefore depends not only on the successful interpretation of these decisions by other professionals who become involved at different times in the process, but also on how easily all designers can coordinate/combine knowledge at the earliest possible time<sup>2</sup>.

One of our goals at the Center for Building Studies (CBS), is to encourage the collaboration of building designers in maximizing the generation and sharing of knowledge and expertise for the design and construction of buildings. Spurred on by a recent survey showing increasing use and

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demand of computers at the early stages in design firms<sup>3</sup>, we investigate what specifications would be required for an early design computer-based tool. Two important issues must be addressed in the development of such a tool. The first issue can be derived from the reasoning that design is a process of capturing and organizing design information in such a manner that it can be retrieved and reused at a later time. The success of a design project depends largely on how well the designer manages such information<sup>4</sup>. The second issue is concerned with the need for an integrated design process, i.e. where technical knowledge is brought into the building design process as early as possible in order to improve the overall building delivery process<sup>5–8</sup>.

Our plan for an early design computer tool is therefore two-fold. Primarily, we want to help the designer (architect) manage the data that comes out of the early design process without disrupting their preferred method of design. Such a software tool shall only manage the data produced by the designer and not necessarily redefine the manner in which data is produced. For this reason our focus in studying the design process remains mainly on the workspace activity, not in explaining how the designer is thinking about design. Second, we want to integrate the workspaces of architects and engineers so that early design data created by the architect is accessible to the engineer without loss in meaning or context. Although very important to the overall goal of this research, the focus of this paper is on the first issue which is to capture the architect's early design data manipulation and organization methods.

We provide the results of a design protocol study of eight individual designers in which we concentrate on the activities and events over time on the workspace. We consider how or why the designer operates to enable us to understand what the drawing depicts and identify the means required to support its development. Combining literature survey and observations we then draw specifications for developing a computer tool that would provide valuable assistance at the conceptual building design stage.

## *1 Review of the design process*

Early design for buildings invariably starts with a single designer (architect) who works using brief notes of requirements and sketches<sup>9</sup>. A lot of sketches are used which provide a means with which the designer clarifies the characteristics of the design, logs their design process, stores ideas and reveals the mechanics of their thinking process<sup>10–12</sup>. In particular, the sketch is the most important tool<sup>13</sup> for communicating design at the early stage and have associations with hidden meanings in the designer's imagination<sup>14</sup> which most likely will not be fully or easily understood by others.

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