

MULTIDISCIPLINARY PRODUCT MODELS FOR BUILDINGS

by

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ABSTRACT

A building is an entity that is multidisciplinary by nature. Traditionally drawings have been used as the medium of communication between the various disciplines. With the advent of microcomputers, professionals from different disciplines have made use of computer software for their work. One of the major obstacles has been the exchange of data between such software.

This thesis presents a practical product model of a building which addresses these issues. It is based on an object oriented design. A primitive composite scheme is used to reduce the complexity of the model and to make it flexible. Two object hierarchies are presented. The building elements hierarchy consists of architectural, structural and service elements of a building. The multidisciplinary attributes of a building are captured by the primitive object hierarchies. Geometry however is implemented directly in the building elements and not as a primitive, as geometry is seen as a fundamental and integrating property of all aspects of a building.

The primitive properties can be attached dynamically to the building elements, thus creating composites. Primitive objects could be declared globally and shared among several building elements to improve efficiency. They could also be defined locally to individual building elements.

Three generic classes junctions, paths and outlets were proposed to represent service type elements. This allows a diverse range of services to be accommodated without complicating the model.

All building elements were represented as lines, and subsequently fleshed out according to their cross sectional dimensions. Wherever possible local geometry was used (e.g. for contained elements such as doors and windows with respect to the containing wall). The semantic relations "components", "component_of", "parts", "part_of" and "connected" were used to define relationships between instances of building elements.

A software called PROMOD was developed based on the proposed product model. The implementation was carried out in Delphi (an object oriented programming environment). The building is drawn using the 2D graphical input module of PROMOD. The input module automatically establishes the various relationships between the elements. Using PROMOD, different 2D views of the building can be generated.

Data entered into the product model was successfully exported to AutoCAD, to generate 3D views, and also to PROKON, to carry out structural analysis. In addition, the possibility of using the product model as a rich database was explored. It is shown that the semantic data stored within the model is sufficient to answer a varied range of queries (including cross disciplinary ones).

The thesis demonstrates the application of the model using the example of a two storey office cum residential reinforced concrete frame building with masonry infill walls.

Key Words : Product Models, Object Oriented, Services, Buildings, Structural, CAD



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DECLARATION

This thesis is a report of research carried out in the Department of Civil Engineering, University of Moratuwa, between September 1997 and June 2003. Except where references are made to other work, the contents of this thesis are original and have been carried out by the undersigned. The work has not been submitted in part or whole to any other university. This thesis contains 131 pages.

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