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KNOWLEDGE-BASED SYSTEMS FOR PRELIMINARY DESIGN OF STRUCTURES

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ABSTRACT

This thesis concerns methods for the application of knowledge-based techniques to preliminary structural design. A practical study of these methods is done by developing a prototype for preliminary design of highway bridges (called PREBRI). The prototype has been used to examine and test different methods and techniques of how to build knowledge-based systems for preliminary design. This report points at methods which can be used to improve software for computer aided design and engineering. When building the prototype PREBRI a Lisp-based tool (ART) was used.

The use of an object-oriented approach to organize and store knowledge combined with production rules has proved itself to be suitable to describe the field of structural design. For the representation of knowledge in form of experience, heuristics, codes etc in PREBRI production rules have been found to be a suitable technique. The use of simple if-then constructions is a surprisingly strong and useful way to describe experience-based knowledge.

In order to allow the design engineer to test different alternatives and to see the consequences of a certain design choice or design step a method to enable the user to make assumptions (hypotheses) has been implemented. The engineer can make an assumption concerning a design parameter in a certain design phase and see the consequences of that choice. This technique also allows the engineer to work with different alternative design solutions simultaneously. The possibility for the engineer to use this technique is powerful and useful in design.

An example is also given how a product model for structural components can be defined. The product model suggested is organized in such a way that it relatively easily could be realized with the use of a knowledge-based tool (such as ART-IM). An object-oriented approach has been used to define this model. Computer programs that can access such a product model can be programmed to act "intelligently". This is especially true, if a knowledge-based tool is used to implement the model. The product model can in the latter case act as an "intelligent" database. A computer environment for the building process that uses such a shared database is discussed.

A section is also devoted to the structural design process for buildings and different computational methods that can be used to solve problems within this field.

Keywords: *Knowledge-Based Systems, Preliminary Design, Bridge Design, Product Models, Highway Bridges, Knowledge-Based Design, Computer-Aided Design, Case-Based Reasoning.*

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