Knowledge-based Expert System for Strengthening Measures of Road Bridges

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Summary

In this paper the conception of a knowledge-based expert system (XPS) for the “Systematic Strengthening of Concrete Road Bridges” is presented. Subsequently, it is defined how the XPS should be designed to support the German authorities in planning and accomplishing strengthening measures for concrete bridges in technological and economical aspects more efficiently.

Keywords: expert system, knowledge-based, ontology, concrete, road bridge, strengthening.

1. Introduction

The incentive for the development of the expert system covered by this paper is caused by the increasing traffic on the entire road network in Germany due to the fall of the Berlin Wall and the following German reunification in the year 1990. In the subsequent years Germany has become the main transit country for the transportation of goods between Western and Eastern Europe due to its central location. Recent investigations show that the traffic and, especially, the heavy vehicle traffic on the road net will further rise within the following decades.

Consequently, the loads on bridges in the course of highways and roads will also increase. Though, many bridge designs were based on codes with traffic load models that do not represent the traffic loads which will occur in the future. Since the main construction method of existing road bridges is (reinforced or pre-stressed) concrete, there is an urgent demand by the German authorities concerning the evaluation of the load-bearing capacity of existing bridges.

2. Knowledge-based Systems

2.1 Basics

The comparison between knowledge-based systems (KBS) and conventional software systems clarifies the meaning of the term “knowledge-based”.

Conventional software systems possess build-in knowledge regarding their domain of application. It is implemented by the programmer in the algorithms and data structures within the software. Moreover, the knowledge is not separated from the data processing and, thus, can not easily be located. In difference to that, in KBS the knowledge is strictly separated from the algorithms used for problem solving, i.e. separated into the “knowledge base” and the “knowledge processing”.

Expert systems (XPS) are specialized knowledge-based systems. They refer only to a very specific domain of knowledge. Classical XPS were mostly rule-based systems like the famous MYCIN [1] which was used for decisions on the effective medication of patients with antibiotics. The medical expert knowledge was implemented in the form of rules inside the system.

Since then, the developments made use of methods of artificial intelligence (AI). They implemented self-learning algorithms to improve the problem solving capabilities of the expert systems. Methods

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