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USING THE KNOWLEDGE-BASED SYSTEM (KBS) TO IMPROVING SYSTEM FOR CRACK DIAGNOSIS IN R.C COLUMN

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ABSTRACT

Over the last several years, many concrete structural have been constructed. For safety in concrete structure, periodic inspection has been conducted using many testing technologies and techniques. However, these technologies cannot replace visual inspection because of their slow and complicated procedures. For this reason, the Knowledge-Based Systems (KBS) are used to diagnose RC .Column crack damage (ISFCDFRCC). In this paper, we attempt to propose an alternative to the human expert, to give technical decisions in diagnosing crack damages in a beam. To overcome this requirement, an expert system is developed to achieve the research aim. This proposed system was constructed on a knowledge base that incorporates with the gathered information in the form of rules, which is suitable to implement in an expert system environment to diagnostic advisory nature. The proposed application results show an easy, fast and satisfactory answer to engineering needs.

Keywords: knowledge base system, R.C Beam Crack Damage

INTRODUCTION

In the recent researches and developments in science and technology, many attempts have been made to overcome the problems of people. The advancements made in the discipline of Artificial Intelligence and Computer Science and Engineering to tackle the problems related to mental and intellectual processes of the people. Gradual advancements in these disciplines have enhanced our cognitive capabilities. A knowledge-based system is a computer-based program that uses knowledge, facts and different reasoning techniques to solve problems that normally require the abilities of human experts.

In particular, serviceability and safety of existing structures need to be evaluated for a variety of reasons. Such as: changes in use or increase of loads, new regulations with higher load requirements, effects of deterioration, and damage as result of extreme loading events, unusual events (flooding, wind, earthquake, fire, bomb attack, vehicular collision, plane crash), and concern about design and construction errors and about the quality of building material and workmanship [Rücker, W.; Hille, F. and Rohrmann R 2006, Jeppsson, J,2003].During the assessment of existing structures, it is of importance that the procedure used is formulated to make sure that no legal difficulties arise [Schneider, J.: 1994]. The investigation process may involve a preliminary visual survey, followed by inspection that is more detailed and testing to determine the cause and general extent of deterioration. Depending on these findings, further investigation and testing may be required to identify specific boundaries of deterioration or potential deterioration. The information gathered during the investigations is used to provide understanding of the mechanisms that cause deterioration, the severity and extent of defects, and the implications for repair or other rehabilitation strategies [Jeppsson, J,2003].

Schneider [1994], suggests that the key issue when assessing an existing structure is safety, and the options available for the assessing engineer are shown in Figure 1. A large responsibility is placed on the assessing engineer. In Bridge Slab-Expert, Shahhossaini designed expert system to identify causes and distresses in bridge concrete slabs in Persian Gulf region. It can predict realistically the condition and status of concrete bridge decks, including the determination of remaining service life [Shahhosseini, V. 2006]. Rajabi developed expert system for assessment of deterioration of concrete cap piles in a commercial port in south of Iran. These computer programs are considered as a decision-making tool and to be comprehensive computerized expert systems that give recommendations on concrete structures in Persian Gulf region [Rajabi, H. 2007].

The proposed program ((ISFCDFRCC).) asks series of questions about the concerned problem and gives appropriate advice based on its store of knowledge. The knowledge uses to make up of either rules or experience information about the behavior of column that it of a particular subject domain. Such systems can be designed for specific hardware and software configurations.

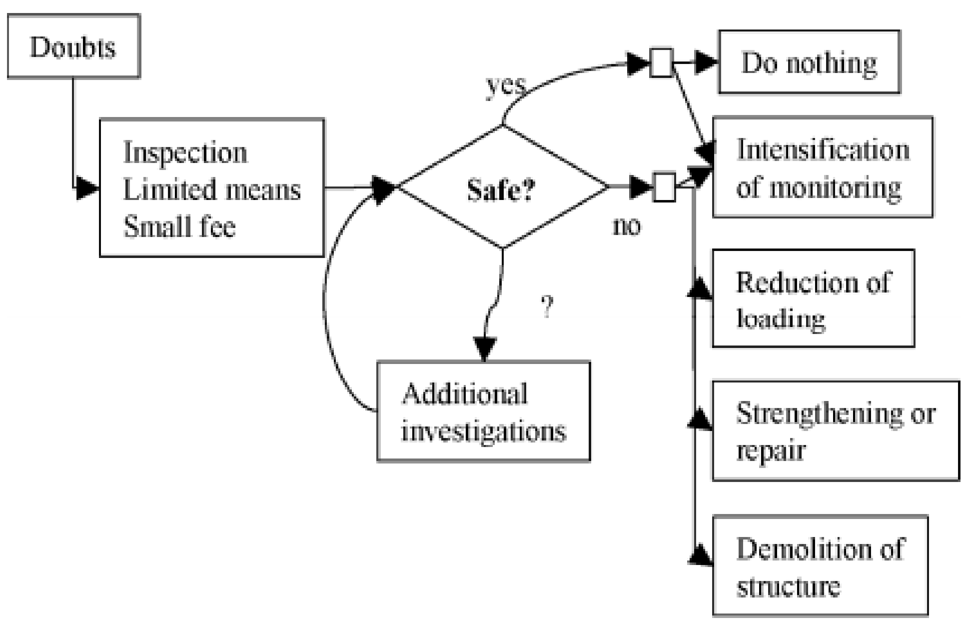

Figure 1: The key question for assessing engineering

INSPECTION OF CRACK

Cracks can be categorized as vertical, horizontal, shear or compound crack. A vertical crack is linear type and parallel to the central line of the column. A horizontal crack is also linear type but orthogonal to the central line. A shear crack is diagonal to the central line, and a complex crack is combination of all of the other cracks. The proposition is 54% vertical and 27% horizontal therefore; the proposed system targets the inspection of vertical, horizontal and shear crack [.Jung, L., Kim, J.-G., and et..1996].

IDENTIFICATION OF PROBLEM

General, in this study there are three results for diagnosis:

1. Simple crack damage, which achieved by the following criteria:
   - There is no spalling and deflection or underside of arch at the R.C column.
   - The cracks type is hair crack.
   - The strength without any reduction
2. Moderate crack damage, which achieved by the following criteria:
   - There is spalling without any corrosion in steel.
   - The cracks width is near to 0.13 mm.
   - The small reduction in strength.
3. Severe crack Damage, which achieved by the following criteria:
   - There is spalling and deflection or underside of arch with corrosion in steel.
   - The width of crack is more 0.35 mm
   - The strength is more reduction.

INVESTIGATION OF REINFORCED COLUMN

Any investigation can conveniently be split into two stages:

Stage 1

An initial survey to identify the cause of the problems.

Stage 2

An extension of the stage 1 survey, perhaps using a limited number of techniques to identify the extent of the defects revealed by stage 1.

KNOWLEDGE ANALYSIS

The analysis process to the acquired knowledge has been done continuously together with acquisition process. The Figure 1 shows the main menu for (ISFCDFRCC) application. The process of the diagnosis of the damages is applied as a menu-driven and question-and-answer, the process is composed of all steps as abstracted in the data flow diagram in the Figure 2.

KNOWLEDGE REPRESENTATION

In this study, rules are used because they are the most common forms of statement in representing the knowledge. Each rule consists of one or more conditions, which, if satisfied, gives rise to one or more actions [Peter, Pak Fong Chan1997].

A rule can be expressed in the general form:

- IF (condition)
- THEN (conclusion or action)

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Such rules are sometimes called "Production Rules" since they produce a result.

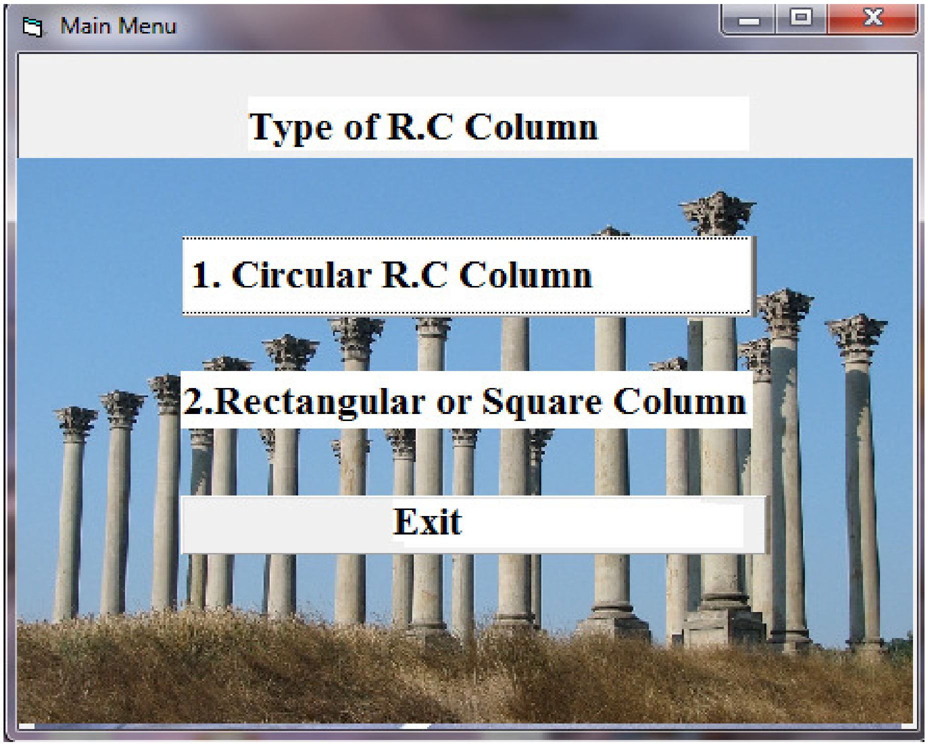

Figure 2.ISDCFC Main Interface Window

Example

IF the type of damages in the column is "cracking" AND the cracks appear on all the sides AND the cracks are "longitudinal" AND the cracks "follow the pattern of the reinforcement" THEN CAUSES. This flowchart starts with the main menu that includes the main types of column to be identified. For every type of these damages there are several choices and questions from which the type of the happened damage is specified. This method begins from the conditions or events until reaching the goals.

RESULTS OF THE SYSTEM

The user interacts with the system through a user interface that simplifies communication and hides much of the complexity, such as the internal structure of the rule base. Knowledge system interfaces employ a variety of user styles, including question-and-answer, menu-driven, or graphics interfaces. The final decision on the interface type is a compromise between user needs and the requirements of the knowledge base and inference system. The heart of the expert system is the knowledge base, which contains the knowledge of a particular application domain. In a rule-based expert system this knowledge is presented in the form of if – then - rules. The knowledge base contains both general knowledge as well as case-specific information. The knowledge of the (ISFCDFRCC) knowledge system is represented as tree of rules contain all questions that user may be ask it to lead to the solution. The constructed tree is the space of a problem of the (ISFCDFRCC) knowledge system. The inference engine applies the knowledge to the solution of actual problems. It is essentially an interpreter for the knowledge base. In the production system, the inference engine performs the recognize-act control cycle. The procedures that implement the control cycle are separate from the production rules themselves.

In this (ISFCDFRCC) knowledge system we considered the Expert System Lifecycle. The procedure of the execution is begun with menu-driven to select the type of the simple R.C tunnel lining such as box, circulars tunnel. After this step there are a submenu used to select the type of the damage occur in the simple R.C column. The next step represents the scenario and dialog between the (ISFCDFRCC) knowledge system and the user. The scenario is done by the question-and-answer, where the expert system asks and the user answer until reach to the goal of the diagnosis.

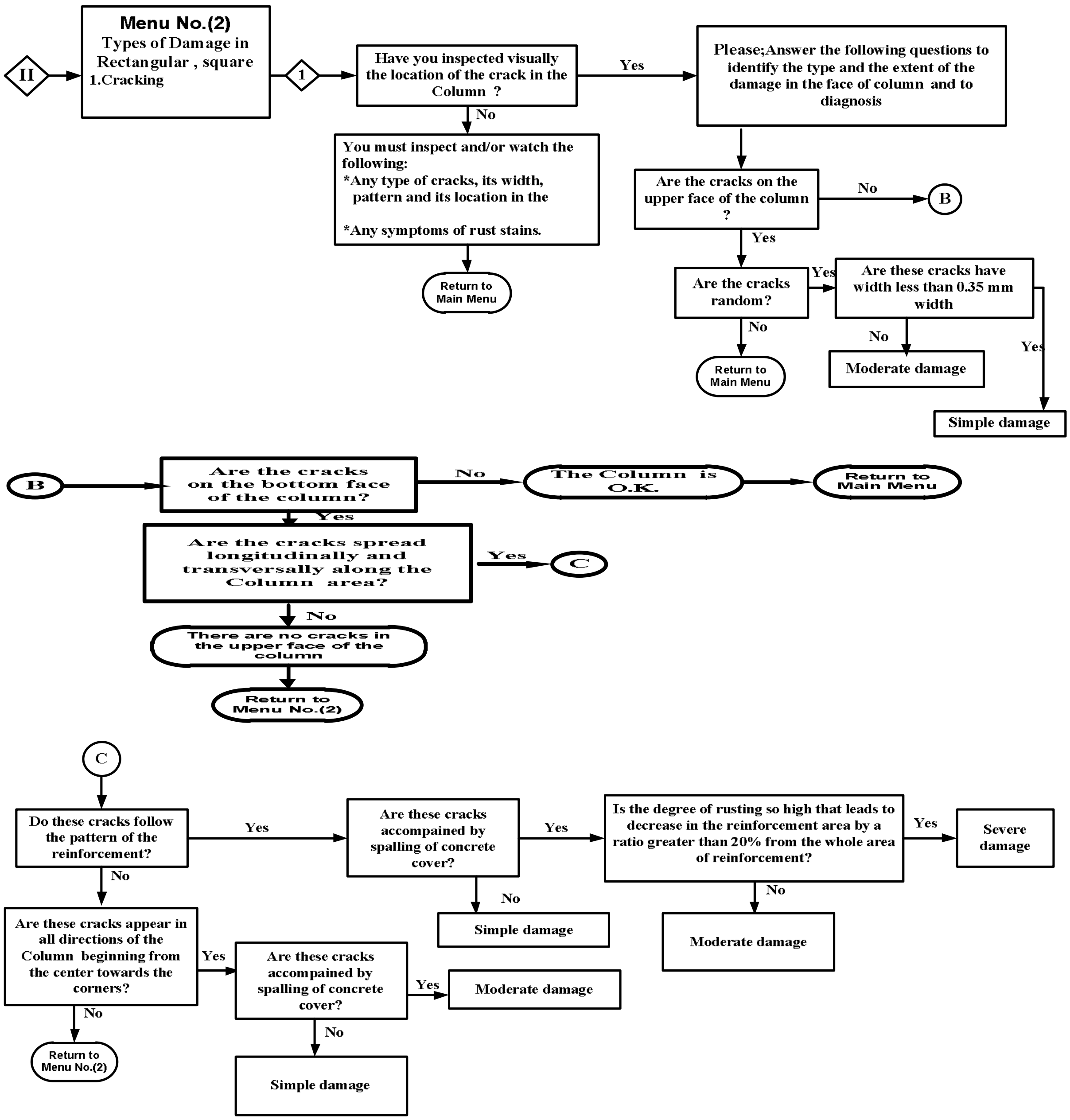

Figure 3.The Flow Chart Described the DCDRCTL Mechanism. (*continued*)

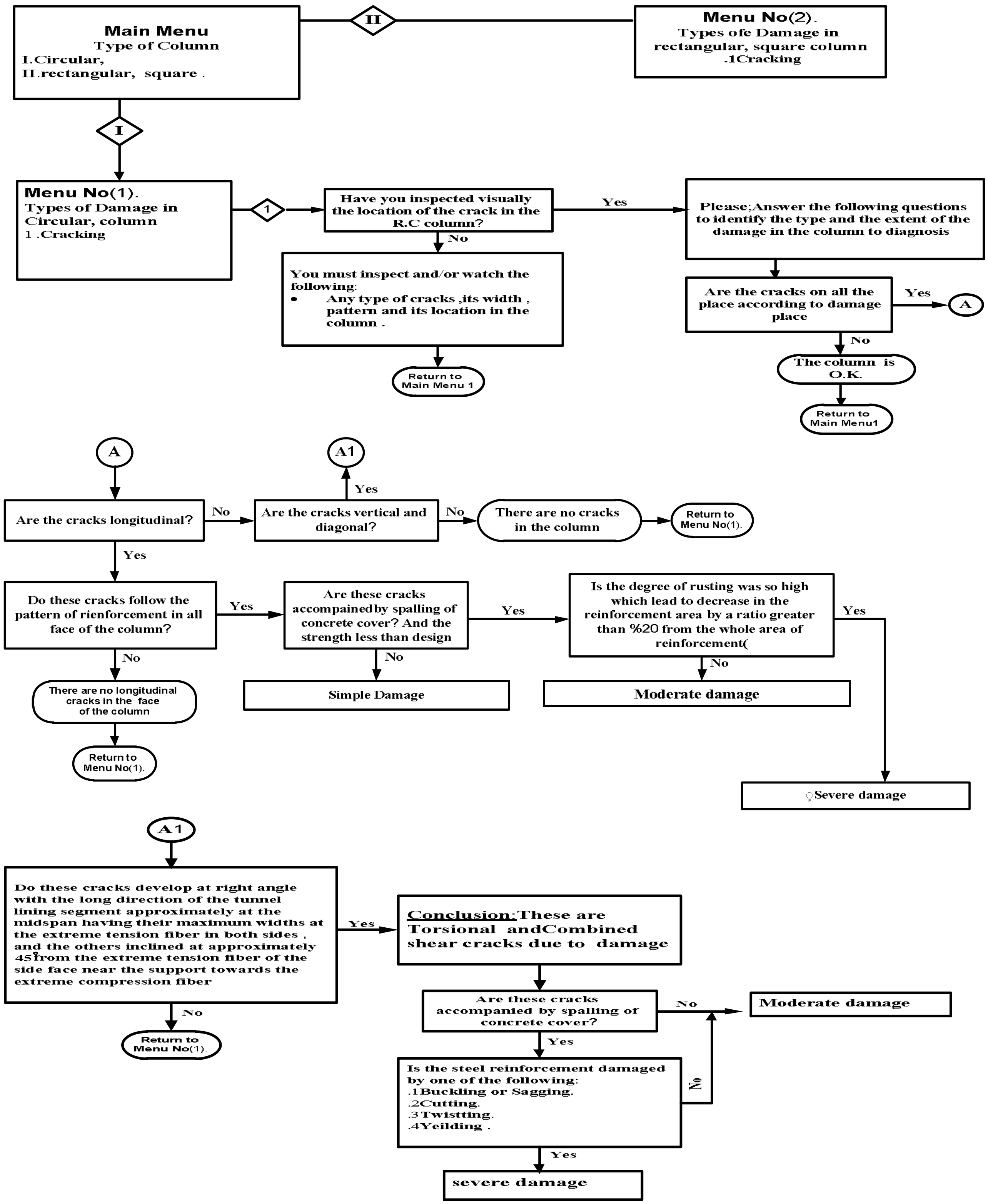

Figure 3.The Flow Chart Described the DCDRCTL Mechanism.

CONCLUSION

From the present theoretical study and depending on its results the following points are concluded:

1. The knowledge system (ISFCDFRCC). Developed in this work is a diagnostic advisory system that can be used as an alternative to the human expert, to give technical decisions in diagnosing crack damages in R.C. column.
2. The presented system was based on close visual inspections and simple measurements, it would pave the way for future research on condition evaluation of existing structures based on detailed investigations, and it may provide substantial assistance to more complicated works.
3. The most difficult stage of KBA system development is knowledge acquisition because the effectiveness, efficiency and reliability of the developed system highly depend on the quality and quantity of its knowledge base.
4. The decision on the type of damage taken by the system, is a multitask process which requires the user to provide the necessary information about the condition of the structural element gathered by both visual as well as technical tests.
5. The using of the (ISFCDFRCC).KBA system is easy, fast and give successful answer for engineer, because we take almost the perhaps damages in consideration.
6. The development of the (ISFCDFRCC) KBA system may be done by updating the knowledge base in the system without changing the inference engine.
7. It is recommended that the importance of each assessment criterion derived in this study should not be used as a fixed value but needs to be amended from time to time and from case to case to better reflect the situation characteristics and the opinion of the experts.

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