Exsys Case Study

Reinforced Concrete Diagnostic System

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Reinforced concrete structures include highway bridges, pavements, retaining walls, piers and seawalls, drainage culverts, reservoirs and buildings. It is imperative that these structures are safely maintained and in good working condition. The diagnosis of deterioration and other problems is of prime importance so that the condition of the structures can be assessed, and remedial actions can be taken before serious situations occur.

The Reinforced Concrete Diagnosis Expert System (RCDES) was built using Exsys® Knowledge Automation Software. By integrating 5 different modules, the RCDES provides situation-specific diagnosis of problems. The RCDES can assist civil engineering trainees, inspection staff, and professional engineers as well as their top management personnel regarding likely problems so that early action can be taken. A significant advantage of incorporating a modular design in the RCDES is having flexibility in updating and adding modules in the future.

Traditionally, human experts or specialists carry out the process of diagnosis. The emphasis of the RCDES is providing a broad view of diagnosis by capturing the knowledge of several human experts and using a modular approach. The use of Exsys tools provided a systematic and efficient capture of the diagnostic processes.

The knowledge automation system provides diagnostic analysis based on the query input and information supplied by the user. It applies expert rules and confidence factors to come up with an aggregate of evidence, which supports the diagnosis of the most likely causes of deterioration and other problems. The system consists of 5 different modules. The main module gives an overall determination and is supported by 4 additional modules focused on specific areas; surface blemishes, exposure requirements, surface cracking and diagnostic testing.

The RCDES was extensively validated through selected test cases as well as case studies and field tests. Real cases were chosen for validating the system against knowledge from expert literature, known results, archival data and documented historic cases. During the process of validation, domain experts including professional civil engineers were also involved in evaluating and providing feedback on the performance of the RCDES. Tough and exceptionally rare cases were also chosen for testing. In order to fully evaluate and validate the system, onsite field tests were carried out and the RCDES results were compared with those of human experts

The RCDES was validated on 80 selected test cases as well as 10 case studies and 3 field tests. It performs satisfactorily with over a 70% success rate on real cases. The system provides significant time and cost savings by identifying structure problems, so repairs can be made before serious damage and potentially catastrophic incidents occur.