Procedures for Diagnosis and Assessment of Concrete Buildings

Wen-Gang Hua

B.Sc. (Eng.) (P. R. China)

Thesis Submitted For The Degree of

Doctor of Philosophy

In

The Faculty of Engineering (Civil)

The University of Adelaide

Australia

Contents

Summary

Given the enormous stock of existing concrete structures in Australia, the maintenance, rehabilitation and treatment of ageing structures (especially those potentially defective) is of national importance. Due to the lack of previous research in this field, there is an urgent need to develop systematic methodologies that can be used in the treatment of structural defects.

In this thesis, an attempt has been made to establish a practically useful process for dealing with existing concrete buildings based on sound theories and techniques. Three key procedures, i.e. diagnosis, condition evaluation and decision-making, are proposed, and relevant methods for implementing these procedures are described.

The proposed method for diagnosis is an *hypothesis-and-test* procedure through which the most likely explanations of the observed anomalies in structural behaviour can be identified. An hypothesis is a set of explanations that fully covers the observed pattern of anomalies, and a test is any information-gathering activity. To take account of the uncertainties involved, an informal probabilistic reasoning procedure is used to rank all possible hypotheses. The most likely hypothesis is the one which has the highest subjective probability. The diagnostic method can be continued until an hypothesis is identified which has an acceptably high level of probability.

Condition evaluation, as defined in this thesis, consists of procedures for the assessment of structural adequacy regarding safety, serviceability and durability. Both experience and structural reliability theory are used in the assessment procedure.

The decision-making procedure is used to plan appropriate corrective work for the structure. Based on the framework of probabilistic decision theory, the best action is selected from a set of alternatives according to the preferences

of the owner of the structure, in regard to factors such as structural safety, serviceability, durability and incurred costs. The proposed method forms a multi-stage process in which the engineer can also decide on whether to gather more data or to take action at any stage, using the results obtained from diagnosis and condition evaluation.

By integrating systematically the iterative procedures of diagnosis, assessment and decision-making, a comprehensive process is developed for dealing with existing concrete structures, which allows the engineer to decide rationally on what to do about a given structure in a well-structured manner. Two examples are used to show how the proposed process is practically useful.