

1. INTRODUCTION

1.1 Background

Most low to medium rise buildings in Sri Lanka are reinforced concrete(RC) structures. Versatility and simplicity of reinforced concrete has led to its preference over other construction materials. But the design of reinforced concrete structural elements is a somewhat tedious process compared to other types of materials. RC design involves not only selecting element dimensions, but calculating reinforcement requirement and detailing also.

At the initial stage of a reinforced concrete building structure, it is necessary to have a proper understanding of the structure that is going to be constructed in order to conduct cost estimation and decide on foundations, reinforcement, etc. Often it is necessary to estimate structural member sizes fairly accurately at the outset. One of the problems faced by the RC designer is how to estimate member dimensions reasonably at the beginning whereas theoretical procedures are time consuming and in some instances practical considerations may take precedence over other aspects in deciding element dimensions. Usually for the estimation of member dimensions, theoretical knowledge alone is not sufficient as there are some practical issues to be addressed too. Therefore frequently, expert advice is sought at the initial stage to decide on element dimensions.

Artificial Neural Networks (ANN) is an artificial intelligence technique which can be seen as similar to that of a human brain. ANN excels in recognizing patterns among data which are difficult to represent algorithmically. Therefore a properly trained ANN can easily solve problems which are difficult by conventional methods. ANN is widely used in applications related to structural engineering design, where experience based knowledge plays a major role.

Structural drawings of buildings contain lot of information. Once a project is completed these drawings are rarely used. Design experience relevant to the project

is confined only to the designers involved. Therefore it is appropriate to look into previous design data and attempt to recognize useful information such as element sizes which can be adapted to future buildings of similar nature. Moreover it is better to have some simple guidelines for element sizing appropriate for Sri Lanka specially for practicing Engineers. Availability of well trained ANN models will be an added advantage for such instances.

1.2 Objectives

- To propose suitable dimensions for Reinforced Concrete elements in low to medium rise buildings based on Sri Lankan design data from past buildings
- To explore the potential of using Sri Lankan design data from past buildings in Artificial Neural Network models

1.3 Scope and Limitations of Study

For this research, design data of Reinforced Concrete members in twenty one low to medium rise buildings (from two to thirteen storeys) in Sri Lanka were considered. Only buildings belonging to either residential or office category only are considered.



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Main structural members considered are one-way and two-way slabs, staircases, beams, columns and pad footings. Design data such as loads, spans, tributary areas, number of storeys, concrete grade, etc are extracted from architectural / structural drawings. Graphical representations of member sizes against design parameters are also made.

This study focused on uniformly loaded continuous slab panels and staircases. Only uniformly loaded beams of width 225mm are considered. Mild exposure condition is considered for superstructure elements while severe exposure is considered for footings. Structural members cast with grade 25 concrete is considered except for columns for which grade 30 also included.

In neural networks analysis only backpropagation networks having one middle layer are used. For each member type four ANN models (with varying target error levels

and middle layer nodes) are taken into account. Results of ANN are compared with results of linear Multiple Regression (MR) models.

1.4 Outline of the Thesis

This thesis begins with a discussion of the practice of reinforced concrete design in Sri Lanka and problems encountered by the designers. The ability of Artificial Neural Networks models to solve problems of similar nature is discussed too. In the literature review, existing guidelines and literature for estimating structural element sizes is explored. Furthermore findings related to use of ANN models for member sizing and their limitations and applicability to local conditions are discussed.

The characteristics of data collection and graphical and ANN analysis procedures adopted are described in the methodology. Results of the analysis, including identified relationships are given in the latter part, where the factors that have contributed to such results are also discussed.

Finally the member sizes decided by analysing the data were compared with the values derived from the guidelines given in the Manual for the design of reinforced concrete building structures (1985) - published by the Institution of Structural Engineers, which is the most widely used document for reinforced concrete member sizing in Sri Lanka.



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