STRATEGIES FOR ADOPTING NEW TRENDS IN WIND LOAD EVALUATION ON STRUCTURES

by

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Research work supervised

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DECLARATION OF THE CANDIDATE

I declare that this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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DECLARATION OF THE SUPERVISOR

I have supervised and accepted this thesis for the submission of the degree.

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DEDICATION

I would like to dedicate this dissertation to professional Engineers in Sri Lanka, who will make future buildings safer, benefiting the general public of Sri Lanka.

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ABSTRACT

With respect to the other disciplines of Engineering, Wind Engineering is at its premature state in Sri Lanka. The only mandatory document available in Sri Lanka is the design manual, named as “Design buildings for high winds-Sri Lanka”, which generally covers the construction methods and techniques that can be used to improve the wind resistance ability of low-rise buildings. Since Sri Lanka does not possess its own wind loading standards, the common practice is to utilize various international wind loading standards and the most widely used is CP 3 Chapter V Part 2:1972.

As many countries in the world, Sri Lanka also has a trend to construct high-rise building at its city centres, especially in the city of Colombo. In this context, the designers as well as regulating bodies face many problems, such as non-uniformity among wind load calculations, lack of verification for the methods and factors that are given in different standards, when utilize in Sri Lankan context, uncertainty of the achieved risk levels for load combinations with load factors, etc. Therefore, it is worthwhile to produce at least a document, which can guide the practice engineers to properly select and subsidize a utilize standard for design.

CP3 Chapter V-Part 2:1972, AS 1170.2:1989, AS/NZS 1170.2:2002, BS 6399.2:1997 and BS EN 1991-1-4:2005 are the codes and standards that have been used in this particular study. These codes are selected, by considering many factors such as previous practice in Sri Lanka, available data, new technologies, method and factors proposed in the recent times in the wind engineering etc. Wind loads derived from above five standards were applied in two buildings with different heights, which are 48 m and 183 m in height to cover both static and dynamic analysis methods given in wind loading standards. Computational Fluid Dynamic (CFD) Techniques have been used to evaluate the various strategies adopting by different standards such as division – by – parts rule given in British and Euro codes.

From the studies carried out in this research, it can be noted that the two types of wind speed values as defined in wind loading manual can be used to design law rise and high rise buildings within certain accepted risk levels. Further, it is recommended to apply windward and leeward pressures separately to evaluate wind induce forces in structural members of a building. The discrepancies among CP3 Chapter V – Part 2:1972 and other selected standards have been evaluated by the means of structural

forces in columns, beams, concrete shells and base reactions and results are shown as normalised forces with respective to load obtained from CP3 Chapter V – Part 2:1972. The behaviour of the two buildings at serviceability limit condition was evaluated by using both acceleration and drift index values according to selected standards.

Final observations and recommendations would lead practise engineers to select one of these wind loading standards for making a building with more wind resistant capabilities and higher satisfaction in comfort levels to its occupants.

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