AN ANALYTICAL STUDY OF THERMAL COMFORT LEVELS
IN CONTEMPORARY RESIDENTIAL UNITS
IN THE COLOMBO METROPOLITAN REGION

A Dissertation presented to the Department of Architecture
University of Moratuwa
for the final examination in M.Sc. (Architecture)

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June 2001
ACKNOWLEDGEMENTS.

This study, with many complexities, and difficulties completed due to the assistance, guidance and encouragement given by all of the following persons, to whom I wish to extend my heartfelt gratitude.

My tutor, Dr. Emmanuel senior lecturer, Dept. of Architecture, for guidance comments and criticism, which encouraged me to do this study.

Dr. L.S.R Perera, Archt. Ranjith Alahakoon, Archt. Archt Prasanna Liyanage and Archt. Dilshan Ossen for valuable comments and unreserved help given to me for the completion of this task.

All my colleagues, for their valuable support in completing this task.

Finally I expressed my deepest gratitude to my Mother for her unlimited love, affection and encouragement to make this success.
This study analyses the thermal comfort variation between urban houses in Colombo Metro Region. Three Basic urban house forms exist in the CMR were selected for the study. Using parametric building energy simulation software, the study analyses the indoor Operative Temperature levels. Five design options are analysed to determine their potential to improve the indoor comfort levels. Further using two sets of climatic records (1995-2000) (1920-1960) study analyses the effect of altered urban climate to the contemporary residential units.
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INTRODUCTION
Introduction.

The traditional houses in Sri Lanka reflect the simple life pattern, attitudes and needs of a community based on agriculture. The houses were very simple structures, made out of easily available materials from their environment. Thick mud walls and thatched roofs, which have very low thermal conductivity, reduced heat gain and this contributed to keeping the indoor air temperature at low level.

In present day situation, the population growth and unplanned urbanization have compelled people to build houses on smaller plots of land and minimum plot size has been reduced up to 150m² (six perches) in the urban situation. (CMRSP, 1998) Considering Colombo district, the average plot size of a residential unit located within the urban areas has reduced to less than 15 perches (DC&S, 1999).

Contrary to the traditional setup where the house was encircled by a large garden, today a parapet wall encircles the entire land and also the garden is mostly pocketed inside the house by way of small courtyards. The thermal comfort has accordingly changed from the traditional house, to that of the modern contemporary house, resulting uncomfortable living environment. Since a large number of qualitative and quantitative requirements have to be fulfilled in designing the house, such as aesthetics, climate has sadly become a secondary factor or almost been disregarded today. This has resulted in an uncomfortable warm indoor environment especially in houses built on small-restricted lands.

In the face of rapid urbanization and urban development the urban climate also has been changed and this has influenced the indoor comfort levels of the buildings. "the altered urban climate has a significant impact on the potential space cooling and indoor thermal comfort of typical residences in CMR"(Emmanuel, 1999).
Need for the study.

Today the common assumption among the Architects is that a correctly oriented, adequately shaded and properly located building that encourages natural air movement within the building will be thermally appropriate in a warm humid climate like that of Sri Lanka, all year round.

But within the present restricted urban situation and in the altered urban climate, application of those basic thermal control strategies become questionable or not practical. Rather than these commonly practiced strategies there are several aspects, which relate to the thermal comfort in a building, such as materials in the building envelope, volume of the space, roof pitch of the building, shape of the building and the floor to ceiling height of a particular space. Existing knowledge of those aspects and thermal comfort of a building is not studied well in contemporary Sri Lankan residential buildings. The knowledge on those aspects among Architects is lacking and also there is a great deal of controversy about those aspects and thermal comfort, for example, volume and thermal comfort of a particular space. The need to understand these aspects therefore is very important and is the primary intention of the study. By this study, its analysis of the above mentioned aspects and the thermal comfort of a building will help the Architects and students to understand the gray areas and will help to find some design strategies.

Intention and scope of study.

In this study it is intended to examine ways of improving the thermal comfort level in contemporary urban houses in the Colombo Metropolitan Region (CMR) and to explore the variation of comfort levels between common urban house forms. This is a critical study because; contemporary Sri Lankan urban residential units are generally thermally uncomfortable. It is also intended to make this study as an entry to further in-depth research in this field. The study will be limited to houses located within the Colombo area because when considering contemporary Sri Lankan urban situation Colombo is known as the best example.
All case studies for this study were taken from designed houses, which are located in urban restricted situations, where the average plot size is 8-10 perches. Since there are several parameters to compare and since it should be done providing equal conditions computer simulation technique will be used for the study to analyze the thermal environment. The level of comfort is going to be measured in Operative temperature and Predicted Mean Vote (PMV, ISO 7730) index, which was developed by Danish scientist named P.O Fanger. Further this study is not going to be a conclusive study because, more scientific research has to be done before arriving at a firm recommendation.

**Methodology.**

When considering existing house types in Sri Lanka, several house typologies made by various scholars could be identified. But most of these typologies are based on Sociological and Economical aspects. Therefore for the purpose of this study, author will make a typology of existing Sri Lankan urban houses based on generic forms of houses, which have thermal variations on one another. This could be identified as,

1. Rectangular shaped house form,
2. “L” shaped house form,
3. “U” shaped house form,
4. “T” shaped house form,
5. Center courtyard type house form,
6. Irregular shaped house form,

which has average floor area of 1500-2000 sqft. 6-10 perch will be taken as the average plot size for each house type. Further this will classify into categories based on which facade touched or faced with the boundary wall of the plot. Based on this typology, selected houses will be modelled on a computer using parametric building energy simulation program called DEROB, which is capable of analyzing simulated environments thermally.
The study will be carried out in three parts. In the first instance it explores the thermal comfort variation between the selected basic house forms. The second part explores the possibility of improving the comfort levels by changing the Roof pitch, materials in the building envelope, effects of parapet walls and floor to ceiling height of the building. Different simulated environments will be created for each house type by changing above parameters. Comparing the results for thermal comfort levels of each simulated environment, the analysis will be carried out. Finally the study will explore the influence of the urban climate of CMR by using unchanged climatic records of Colombo. All calculations will be done for climatic period of hottest pre-monsoon April.