

**STUDY ON TRIP GENERATION CHARACTERISTICS
OF NEW APARTMENT BUILDINGS
IN THE COLOMBO CITY**

H. A. Yasantha Pradeep Perera

(189292N)

Degree of Master of Science in Transportation

Department of Civil Engineering

University of Moratuwa

Sri Lanka

December 2022

**STUDY ON TRIP GENERATION
CHARACTERISTICS OF NEW APARTMENT
BUILDINGS IN THE COLOMBO CITY**

H. A. Yasantha Pradeep Perera

(189292N)

Thesis/Dissertation submitted in partial fulfillment of the requirements for
the degree Master of Science in Transportation

Department of Civil Engineering

University of Moratuwa
Sri Lanka

December 2022

DECLARATION OF THE CANDIDATE AND SUPERVISOR

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or 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.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date:

The above candidate has carried out research for the Masters Dissertation under my supervision.

Name of the supervisor:

Signature of the supervisor:

Date:

Abstract

Colombo city as the economic hub of Sri Lanka is attracting more and more people day by day and most of them wanted to settle nearby Colombo city. Therefore, many high-rise apartment buildings have been constructed and many more projects are planned in and around Colombo.

Currently, an apartment building can be classified as low, middle or high-income based on the prize of the unit and the facilities provided for the housing unit. The impact of traffic generated by each category varies with the frequency, time and mode of vehicle travel. In general, generalizing the travel patterns of apartment buildings is quite difficult as it has highly distributed traffic flow throughout the day. There are many land use activities that can affect the flow of neighbourhood traffic, but this research is limited to study the impact on traffic flow by residential developments in operational phases.

The impact of different types of apartment buildings on traffic flow and trip generation rates is very important and useful in making decisions. However, when consider the Sri Lankan context there is no comprehensive study to measure those details. As per the existing practice, the parking demand of the apartment building is estimated based on the unit floor area and no standards have been developed to estimate the trip generation of different type of apartments. Therefore, this study aims to study the trip generation rates for each apartment type and the most suitable parking requirements for different apartment types.

During this study, apartments were selected under three main categories as Low, middle and high income category based on the available facilities and unit price. For this study, 15 apartments as 5 from each category spread over the Colombo Municipal Council area, were selected. The number of occupied housing units, vehicle ownership rate, number of visitors and visitor's vehicle composition were collected by an on-site observation survey, while traffic counts and vehicle composition were collected by a traffic survey. Satisfaction level of the unit owner on the parking facilities provided was collected via questionnaire survey.

Trip generation rate per apartment unit and mode of the vehicle were analyzed individually and compared with each apartment type. Correlation analysis was conducted to study the relationship between trip generations against average unit floor area, average number of bedrooms in occupied units and unit price were analyzed to identify suitable parameter to determine parking requirement of a housing unit. A unit owner's perception was analyzed to check visitor's parking requirements.

During the analysis, it was found that middle income apartments have reported overall highest trip share percentage in morning and evening peak while high income and low income apartments are taking 2nd & 3rd place respectively. Low income apartments have reported high trip share in the day time while high income reported lowest trip share Middle income apartment has the highest per unit trip generation rate. When consider the vehicle composition, car has reported the highest percentage in each apartment category with the highest percentage in the middle income category.

The only unit floor area was found as a suitable criteria for determining traffic generation or parking requirement of an apartment unit, but the average unit price and number of bedrooms per unit are found not significant. Visitor's parking space requirement for cars is between five to ten percent of the total parking requirements while less than five percent is enough for motorcycles and three wheels

Keywords: *Trip generation, Parking requirement*

ACKNOWLEDGEMENTS

I would like to offer my acknowledgement for a number of individuals who support me in the completion of this study by giving their support by different means.

First of all, I would like to thank my principal supervisor Prof. Saman Bandara Senior Professor, Department of Civil Engineering, University of Moratuwa and Co-supervisor Dr. Loshaka Perera, Senior Lecturer, Department of Civil Engineering, University of Moratuwa for the guidance and supervision had given me up to completion of this study.

Also, I wish to offer my gratitude for Dr. Amila Jayasinghe, Senior Lecturer, Department of Town and County Planning, University of Moratuwa for the assistance given me.

The support given by all the academic and non-academic staff of the Department of Civil Engineering in the completion of this study should also acknowledge here.

I would like to thank officers in the Colombo Municipal Council & Urban Development Authority who helped me in secondary data collection process, and apartment developers & premise managers who helped me in the primary data collection process, and unit owners in the apartments who participated in the questionnaire survey.

Further, I want to thank my batch (2019) mates of the M.Sc. in Transportation in Department of Civil Engineering for sharing of thoughts and encourage given me in this study.

Finally, I am happy to acknowledge my heartfelt gratitude for my family; wife, children, farther, and mother for the encouragement given to me in the completion of this study.

TABLE OF CONTENTS

DECLARATION OF THE CANDIDATE AND SUPERVISOR	ii
Abstract.....	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS.....	v
LIST OF FIGURES	vii
LIST OF TABLES.....	viii
LIST OF ABBRIVIATIONS	ix
LIST OF APPENDICES	x
CHAPTER ONE	1
1. INTRODUCTION	1
1.1. Background.....	1
1.2. Problem Statement.....	1
1.3. Objectives of the study.....	3
1.4. Scope and Limitations.....	3
1.5. Study Approach	3
CHAPTER TWO	4
2. LITERATURE REVIEW	4
2.1 Apartments.....	4
2.2 Traffic Flow	5
2.3 Parking requirement standards.....	7
2.3. Data Collection Methods	12
2.4. Analytical methods	12
CHAPTER THREE	13
3. RESEARCH METHODOLOGY.....	13
3.1. Introduction to Study Area.....	13
3.2. Method of study	14
3.3. Selecting of samples for Case Study.....	14
3.4. Selected Apartments for survey	15
3.5. Location of the selected apartments.....	16
3.6. Method of data collection	17
3.7. Method of analysis.....	18

CHAPTER FOUR.....	20
4. DATA COLLECTION	20
4.1. Secondary data	20
4.2. Traffic count data	21
4.3. Interview of premises managers and security officers.....	26
4.4. Interview of unit owners	27
4.5. Interview of developers.....	29
CHAPTER FIVE	31
5. ANALYSIS AND FINDING.....	31
5.1. Trip generation patterns Vs Apartment types	31
5.2. Trip generation Vs apartment's characters	35
5.3. Vehicle composition	39
5.4. Vehicle ownership Vs apartment character.....	41
5.5. Visitor's Vehicle composition	45
5.6. Summary of analysis between trip generation and apartment character	47
5.7. Unit owner's satisfaction levels	48
5.8. Parking space requirement for visitors.....	50
CHAPTER SIX.....	52
6. RECOMMENDATION AND CONCLUSIONS.....	52
REFERENCES	55

LIST OF FIGURES

Figure 1-1 Study approach	3
Figure 3-1: Location of Colombo Municipal Council Area	13
Figure 3-2: Method of study.....	14
Figure 3-3: Location of the selected apartments.....	16
Figure 5-1: Trip Generation Pattern in High Income Apartments	31
Figure 5-2: Trip Generation Pattern in Middle Income Apartments	32
Figure 5-3: Trip Generation Pattern in Low Income Apartments.....	33
Figure 5-4: Trip Generation Pattern in All type Apartments	34
Figure 5-5: Average all trip rate per day per occupied unit Vs Average number of bed rooms per occupied unit in each apartment types.....	35
Figure 5-6: Average all trip rate per day per occupied unit Vs Average Unit Floor Area in each apartment types	36
Figure 5-7: Average all trip rates per day per occupied unit Vs Unit price in each apartment types	37
Figure 5-8: Average all trip rate per day Vs number of occupied housing units in each apartment types	38
Figure 5-9: Trip generation per occupied unit Vs apartment type	39
Figure 5-10: Vehicle composition in all apartments.....	40
Figure 5-11: Number of owned vehicles per unit Vs Average Number of bed rooms per unit in each apartment types	41
Figure 5-12: Number of owned vehicles per unit Vs Average Unit Floor Area in each apartment types	42
Figure 5-13: Number of owned vehicles per unit Vs Unit price in each apartment types	43
Figure 5-14: Number of owned vehicles Vs number of occupied housing units in each apartment types	44
Figure 5-15: Visitor's trip generation per occupied unit Vs apartment type	45
Figure 5-16: Visitor's vehicle composition in all apartments.....	46

LIST OF TABLES

Table 2-1 Apartment categorization	4
Table 2-2: Parking standards for residential buildings in Sri Lanka	8
Table 2-3: Parking Standard for parking space	9
Table 2-4: Parking standards for driveway.....	9
Table 2-5: Minimum number of assessable space for differently able peoples	10
Table 2-6: Parking standards for residential buildings in other countries	11
Table 3-1: Selected apartments for survey	15
Table 4-1: Detail of all selected apartments	20
Table 4-2: Total vehicle count for period of week in all selected high income apartments	21
Table 4-3: Average vehicle count per day in all selected high income apartments	21
Table 4-4: Total vehicle count for period of week in all selected middle income apartments	22
Table 4-5: Average vehicle count per day in all selected middle income apartments	23
Table 4-6: Total vehicle count for period of week in all selected low income apartments	23
Table 4-7: Average vehicle count per day in all selected low income apartments	24
Table 4-8: Total vehicle count for period of week in each apartment	24
Table 4-9: Average vehicle count per day in each apartment.....	25
Table 4-10: Average visitors vehicle counts per day in each apartment	26
Table 4-11: Interview of premises managers and security officers	26
Table 4-12: Unit owner's satisfaction levels	27
Table 4-13: Visitor's parking requirement	28
Table 4-14: Average unit price in each apartment category	29
Table 4-15: Average unit floor area in each apartment category.....	29
Table 4-16: Facilities allocated for each type apartment units	30
Table 5-1: Correlation analysis (Bivariate) between trip generation and apartment characters	47
Table 5-2: Unit Owner's satisfaction level	48
Table 5-3: Parking space requirement for visitors.....	50

LIST OF ABBRIVIATIONS

CMC	Colombo Municipal Council
CCDP	City of Colombo Development Plan
HI	High Income
IHT	Institution of Highways and Transportation
ITE	Institute of Transportation Engineers
LI	Low Income
MC	Municipal Council
MI	Middle Income
TIA	Traffic Impact Assessment
UDA	Urban Development Authority
USA	United State of America

LIST OF APPENDICES

Appendix A: Traffic Count Survey sheet	57
Appendix B: Interview survey sheet for apartment unit owners	58
Appendix C: Interview survey sheet for premises manager	59
Appendix D: Interview survey sheet for developers	60
Appendix E: Traffic survey result in high income apartments	61
Appendix F: Traffic survey result in middle income apartments	62
Appendix G: Traffic survey result in low income apartments.....	63