ASSIGNMENT OF URBAN TRIPS TO VARIOUS PUBLIC TRANSPORT MODES

by

HASSAN SAAD AHMED
B.Sc. in Civil Eng.,
University of Khartoum
March/67

Supervised by :
Prof. Dr. M. El Hawary,
Prof. of Transportation
Planning & Railway Eng.,
Faculty of Engineering,
Cairo University

Co-Supervisor :
Dr. M.K. Radwan,
Assoc. Prof. of
Railway Engineering,
Faculty of Engineering,
Ain Shams University

A Thesis
submitted in partial fulfilment
of the requirements for the Degree

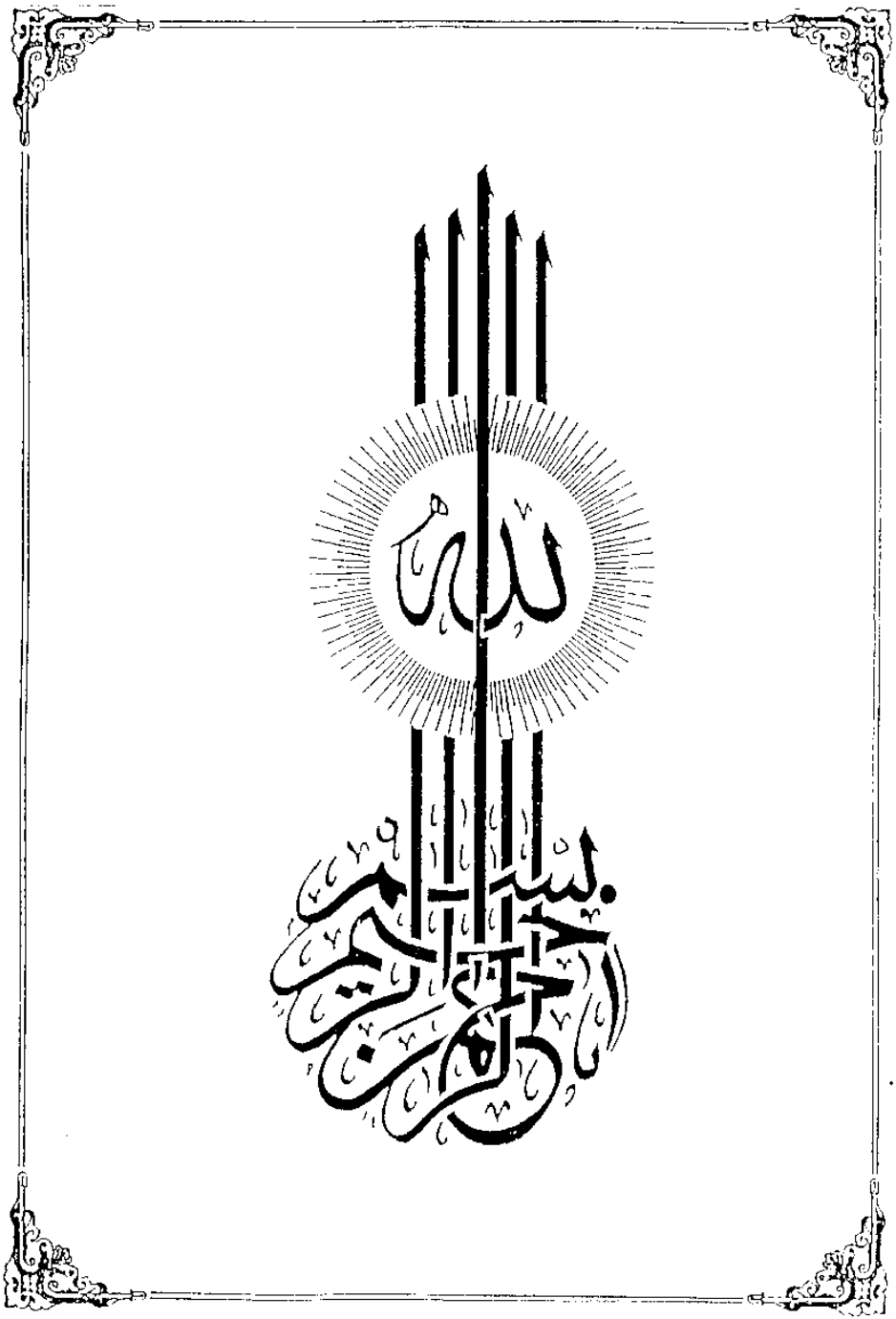
رسالة

Master of Science
in
Civil Engineering

Faculty of Engineering
Ain Shams University

1973

TABLE OF CONTENTS



LIST OF FIGURES

ACKNOWLEDGEMENTS

The author is deeply indebted to his supervisor, Prof. M. El Hawary, for having offered valuable suggestions and great help with regard both to the contents and the style of this thesis. His advice, vast experience and knowledge largely contributed to the successful conclusion of this work.

Thanks are also due to Dr.M.K. Radwan for having participated in the supervision of this thesis.

The author expresses his gratitude to all staff members of Cairo Transport Authority, Egyptian Railways and Ministry of Transport for their great help in the collection of data. He also owes special thanks to Sudan Railways officials and the staff of the Cultural Attaché Office (Sudan Embassy, Cairo) for their continuous encouragement during the course of this work.

ABBREVIATIONS

TM	:	Tramway (Old Type)
K5(10)	:	Articulated Tramway (Type K5), speed 10 Km/hr.
K5(18)	:	Articulated Tramway (Type K5), speed 18 Km/hr.
TR	:	Trolley-bus
U.G.	:	Underground train
MRT	:	Rapid transit train
BN	:	Bus (Type Nasr)
IK(100)	:	Bus (Type Ikarus), Capacity/Vehicle 100 passengers.
IK(150)	:	Articulated Bus (Type Ikarus), Capacity per Vehicle 150 Passengers.
CRF	:	CapitalRecovery Factor.
KWH	:	Kilowatt Hour.
Psr/hr	:	Passengers per hour.
Cost/pL Km	:	Cost per Place Kilometre
V	:	Volume of Traffic (psr/hr)
L	:	Length of line
L.E.	:	Egyptian Pounds.
M/Ms	:	Milliemes

INTRODUCTION

Transportation in general is one of the most important factors in civilization and progress. "Earlier cultures were narrowly limited in area, and if, like the empire of Alexander, they grew large, they soon fell to pieces from the difficulty of communication between the parts."* The modern system is dependent on rapidity in persons' movement, transport of goods, and transmission of messages. So, the transportation problem takes much time, needs more effort, and requires a lot of consideration in both developing and developed countries. However, the transport of passengers problem is most acute in urban areas. It is because of today's way of living which is characterized by the increase in rate of trips per person. This is reflected in traffic congestion resulting from the rapid increase of urban population and vehicle ownership. At the same time, in most communities, there is a limit to the financial and physical resources available for capital investment in new works and modernization of urban transport infrastructures.

Hence, the urban transportation planning process becomes increasingly important, especially in developing countries.

---

* Lehfeldt, R.A., Descriptive Economics. Oxford University Press, reprinted 1946.

[illegible] future travel demand, and obtaining optimum solutions to the problem of satisfying this transport demand. Operation Research techniques are followed to construct and solve these models giving dependable answers.

One phase of the urban transportation planning process is the modal split (that is the determination of the relative usage or assignment of trips by transport modes). The two modes generally considered are the public transit means and the private means. However, in developing countries the urban trips by public transit represent a very high and dominating percentage of the total number of trips in an urban area. This percentage in Cairo, for example, is almost 87.8% of the total urban trips.* Therefore, it is of great significance, for developing countries, to split passengers' trips by the different modes of public transport (e.g. trams, tolley-buses, buses, metro, and the underground).

The main objective of this thesis is to adopt a tool for the assignment of passengers' trips in an urban area to the available modes of public transport with as less burden on the national economy as possible. This may be termed as controlled or directed modal split analysis. In other words, this thesis tries to plan for splitting the urban trips in a developing country where transport is under the government control and responsibility.

---

* Appendix 7 of [1]

CHAPTER II

1) Introductory

With the increase in population of urban areas the need for efficient mass transportation means becomes more important. Hence arises the problem of choosing the most suitable type of carrier among the different modes of transport. The cost of transport provides the criterion for the division of function between the different modes of urban transportation. However, this term "cost of transport" can have different meanings. It can refer to the cost of providing a transport service from the standpoint of the supplier. In this sense costs provide a basis for the evaluation of the economy of a project, for deciding the fare policy, or for decision-making, concerning the choice of the suitable modes and facilities by planning. Again different costs are required for these different objectives. On the other hand, "cost of transport" can be looked at from the point of view of the consumer or user of transport, and it refers to money paid and quality of service received by the user.

In this chapter cost analysis is discussed and calculations are carried out to provide "cost of transport" for planning purposes. The criterion for planning,

[illegible] is that : "Trips of passengers between origin and destination must be assigned to different modes of transport in such a way that every traffic is carried by the mode, which in providing the required facilities, incurs the least annual cost."

The indicator for the utilization of the mobile transport facilities (i.e. the degree to which the carrying capacity is effectively employed) is taken the same for all modes of transport coming into play in the transport region. Also in case of passenger traffic, a more complete measure of the amount of service performed, which takes account of both number of passengers carried and distance they cover is the "PASSENGER-KILOMETRE". However, when speaking of the producer cost for planning purposes it is preferable to refer costs to "PLACE-KILOMETRE", i.e. the amount of money incurred to provide a space for a potential passenger for a distance of one kilometre. This unit of cost was adopted in the analysis to avoid the varying capacity conditions of the carriers. In the second place it helps in giving a unified system for the construction of cost matrices for the different modes of transport.

The "cost of transport" matrix is a matrix with

[illegible] a place for a potential passenger for specified distances using different modes of transport. These cost matrices, as can be seen in Chapter III, are essentially significant when a strategy of (minimizing) the total cost of transport in an urban area is the objective, i.e. transport optimization is required.

However, it must be mentioned here that, specific cost determination is complicated by the inherent difficulties of cost allocation and by the fact that the accounting systems of the carriers are not designed for planning purposes.

2) Components of the Annual Cost [2],[3],[4].

The two main components of transport cost are capital and operation costs.

2-1) Capital Costs :

These are the costs of providing the initial plant and equipment and addition to or betterment of these facilities. Such costs can be divided into the following subgroups :

- Investment in route including power transmission systems and roadway buildings.