EFFECTIVENESS OF VARIABLE MESSAGE SIGNS IN IMPROVING THE ROAD NETWORK PERFORMANCE THROUGH ROUTE GUIDANCE

By

Eng. Ahmed Kamal Mostafa Ahmed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of The
Requirements for the Degree of
MASTER OF SCIENCE
in
CIVIL ENGINEERING - PUBLIC WORKS

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Title of Thesis:

Effectiveness of Variable Message Signs in Improving the Road Network Through Route Guidance

Key Words:
Variable Message Signs, Route guidance, Performance measures

Summary:

Over the last few decades in Egypt, traffic volumes have been increasing on road networks leading to congestions during peak hours. This could be mainly attributed to the lower efficiency of the road networks in terms of the traffic distribution and the randomness of driver's behavior. In an effort to ease traffic congestions, several methodologies were implemented that involve changing the geometrics of the road network or building new infrastructure. Converting traffic flows at intersections to U-turns to prevent left turns, building new bridges or tunnels, permanent closure of access to roads and rerouting traffic are a few examples of such enhancements. These methods have proven to be temporary as they improve the road network according to the current traffic flow and ignore the future demands of the road network.

Therefore, there is a need to find innovative ways to manage the increasing demand on the road network. This research aims provides a methodology for providing traffic management on congested road networks in Egypt by means of route guidance through the use of Variable Message Signs. Variable Message Signs are portable and easy to apply, and this research has proven its success in reducing travel times and queue lengths, therefore increasing average traveling speeds.

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DEDICATION

The author would like to dedicate this thesis to his family, the rock which held him down through the whole process. My family gave me strength and support needed to complete this research. For my mother, my companion and my friend. She lifted me up when I was down and was always there for me.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Variable Message Signs (VMS) are a means of providing valuable information to roadway users and enhancing the performance of the road network. The likelihood of an accident occurring may also be reduced through the application of VMS by informing drivers of rough weather conditions and reduced visibility. Studying the effect of VMS on driver behavior and its effect on the performance of the road network is very important and can lead to significant improvements in travel times and reduce traffic congestion overall. The main objective of this research was to analyze the effectiveness of the use of VMS as a form of a route guidance tool in improving the efficiency of the road network. This was implemented through a number of case studies to identify the effectiveness of the Variable Message Sins under different incidents and different factors of the message sign itself. As this is a unique traffic guidance method to Egypt and has not been previously applied, the different factors that may affect the effectiveness of the sign to divert drivers had to be studied to fully understand the benefits of implementing VMS in Egypt.

To fulfill the research objective, traffic data was collected from five sites located in Giza Governorate, Egypt. At each location, the driver had the choice of two alternative routes leading to the same destination. The VMS informed the drivers that one of these routes was congested and to use the less congested alternative route to reach the destination. Special considerations were taken according to Egyptian driving behavior; and three different sign types were designed and applied to identify the most effective type of VMS on drivers.

Traffic counts for each route was recorded for twenty minutes without the VMS (normal conditions) and twenty minutes with the VMS applied to obtain the diversion rate of drivers form their original route choice to the alternative less congested route. Travel times for 30 vehicles were also recorded before and after the application of the VMS in order to obtain the average travel time with and without the VMS. Queue lengths were also recorded before and after applying the VMS.

CHAPTER 1. INTRODUCTION

1.1 General Introduction

Variable Message Signs (VMS) have been implemented since 1960 in the United States of America and are largely deployed on freeways, highways and in work zones throughout the world. VMS are traffic control devices used to provide motorist en-route traveler information. They are commonly installed on full-span overhead sign bridges, post-mounted on roadway shoulders, and overhead cantilever structures. The information is most often displayed in real-time and can be controlled either from remote centralized location or locally at the site. Traveler information displayed on VMS may be generated as a result of a planned or unplanned event, which is programmed or scheduled by operations personnel. Variable message signs are commonly used to warn of traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific segment of the network. The VMS may guide vehicles to alternative routes due to congestion, limit travel speed, inform of incidents or traffic conditions (IRC SP 085, May 2010).

Variable Message signs have recently been implemented in Egypt near the downtown Cairo, Egypt to inform motorists of parking vacancy's in the surrounding parking lots. However, VMS has not been applied to give route guidance to travelers. Due to the high congestion in Egypt, VMS have a large potential to improve the performance of the Egyptian road network. The intertwining nature of the road network in Egypt creates multiple routes the road user may choose to take leading to the same destination. This provides a suitable environment for the application of VMS.

The mountable version or portable version of the VMS are used in areas where the permanent VMS are not available. Portable VMS are used in areas where traffic patterns are temporary and the high cost of a permanent VMS is not needed. These areas are usually next to work zones, during the occurrence of a natural disaster, unusual traffic congestions, or traffic management for special events (United States Access Board Current, VMS Technologies and Applications).

The messages displayed on the sign can be programmed locally in the unit's control panel, or units equipped with a cellular modem can be programmed remotely via computer or phone. Trailer-mounted VMS can be equipped with a radar, camera, and other sensing devices as part of a smart work zone deployment.

1.2 Problem Statement and Research Objectives

Determining the effectiveness of the VMS on drivers and its effect in improving the performance of the road network is an important issue for determining the possibility of reducing traffic congestion through new technologies as the VMS. VMS is defined in the VMS Operations Manual, Texas Transportation Institute Texas A&M University System College Station, In Cooperation with New Jersey Department of Transportation Division of Research and Technology and U.S. Department of Transportation Federal Highway Administration, as "programmable traffic control devices that can usually display any combination of characters to present messages to motorists.".