SCHOOL OF
CIVIL ENGINEERING

INDIANA
DEPARTMENT OF TRANSPORTATION

JOINT HIGHWAY RESEARCH PROJECT

JHRP-90/14

Executive Summary

AN ELECTRONIC SURVEILLANCE AND CONTROL SYSTEM FOR TRAFFIC MANAGEMENT ON THE BORMAN EXPRESSWAY

Michael J. Cassidy
Kumares C. Sinha

PURDUE UNIVERSITY

JOINT HIGHWAY RESEARCH PROJECT

JHRP-90/14

Executive Summary

AN ELECTRONIC SURVEILLANCE AND CONTROL SYSTEM FOR TRAFFIC MANAGEMENT ON THE BORMAN EXPRESSWAY

Michael J. Cassidy
Kumares C. Sinha

An Electronic Surveillance and Control System
for Traffic Management on the Borman Expressway
PART I

Final Report

TO: Harold L. Michael, Director
Joint Highway Research Project

November 12, 1990

Project: C-36-75A

FROM: Michael J. Cassidy, Asst. Professor
Joint Highway Research Project

File: 8-9-1

Attached is the Executive Summary for the study titled "An Electronic Surveillance and Control System for Traffic Management on the Borman Expressway, PART I." The document summarizes appropriate technologies and traffic management strategies for the proposed Borman Expressway freeway traffic management system. The research for this document was conducted by Professor Kumares C. Sinha and myself.

Respectfully submitted,

M. J. Cassidy
Assistant Professor

cc: A.G. Altschaeffl
D. Andrewski
P.L. Bourdeau
M.D. Bowman
M.D. Cassidy
J.L. Chameau
L.M. Chang
S. Diamond
W.L. Dolch
A.R. Fendrick
J.D. Fricker
D.W. Halpin
G.L. Henneke
K.R. Hoover
R.H. Lee
G.A. Leonards
C.W. Letts
C.W. Lovell
R.H. Lowry
D.W. Lucas
B.G. McCullouch
J.F. McLaughlin
H.L. Michael
B.K. Partridge
J.A. Ramirez
G.J. Rorbakken
C.F. Scholer
G.B. Shoener
K.C. Sinha
D.L. Tolbert
C.A. Venable
T.D. White
L.E. Wood
J.R. Wright
R.F. Wukasch

An Electronic Surveillance and Control System for Traffic Management on the Borman Expressway

by

Michael J. Cassidy
&
Kumares C. Sinha

Joint Highway Research Project

Project No. C-36-75A

File No. 8-9-1

Prepared for an Investigation

Conducted by

Joint Highway Research Project
Purdue University

in cooperation with the

Indiana Department of Transportation

Purdue University
West Lafayette, Indiana
47906

12 November 1990

INTRODUCTION

The Borman Expressway (I80/94) in northwest Indiana has the highest average daily traffic volume of any roadway in the state. The expressway, which links Gary, Indiana to Chicago, Illinois, serves an average of over 140,000 vehicles each day. Overall volumes on the Borman remain fairly constant throughout the day. Moreover, a high proportion of trucks (approximately 30%) operate in the traffic stream.

The Indiana Department of Transportation (INDOT) has determined that an automated surveillance and control system is to be implemented on the Borman Expressway. The installation of such a freeway traffic management system will significantly reduce incident-induced operational problems which now occur regularly on the expressway. Such a system will also mitigate recurring congestion problems likely to occur in the future.

This summary details technology options and traffic management strategies which appear most promising for application on the Borman Expressway. In this sense, the document summarizes a preliminary study for the overall project. Findings from this preliminary study should provide definite direction for the design and implementation of the Borman Expressway surveillance and control system.

BACKGROUND

The proposed surveillance and control system is to be installed in a 12-mile section of the Borman Expressway. The "study site" extends from the I65 interchange to the Illinois/Indiana state boundary. Figure 1 illustrates the study area. The expressway currently experiences operational problems resulting from accidents, vehicle stalls and other incidents. The freeway traffic management system ultimately selected must have the capability to mitigate operating problems through the timely detection and removal of expressway incidents. Moreover, the freeway traffic management system must include control strategies for managing (and minimizing) congestion resulting from incidents.

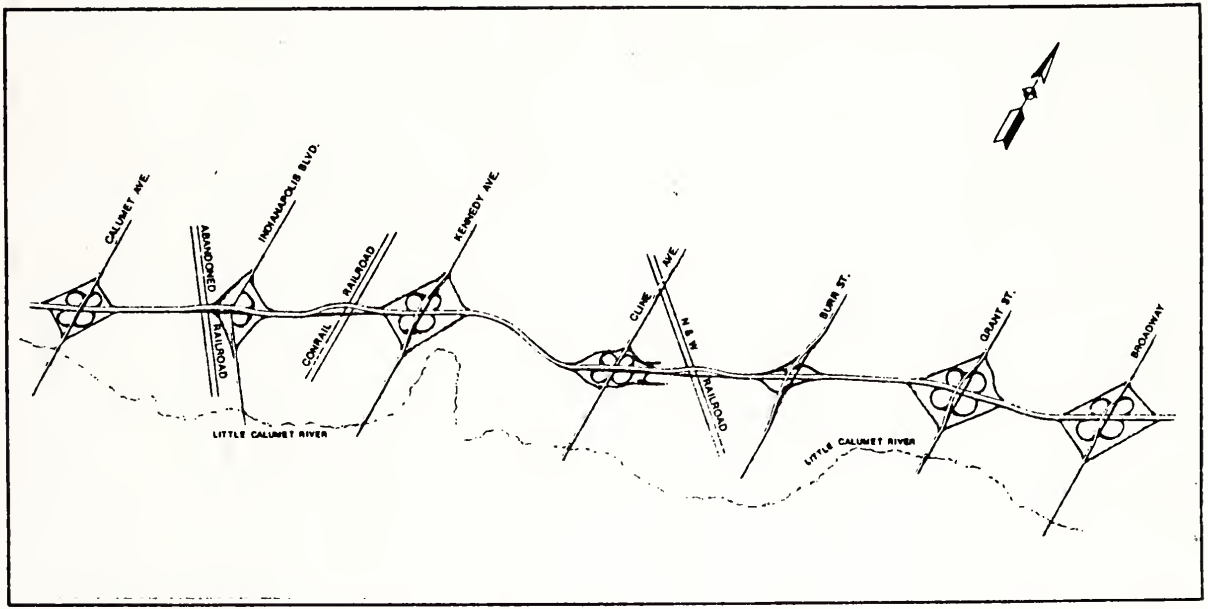

Figure 1
Study Site

A wealth of technologies associated with freeway traffic surveillance and control currently exists. A number of U.S. metropolitan areas have implemented such technologies. A considerable amount of research related to surveillance and control technologies is being conducted at universities and research centers. And finally, a number of manufacturers and vendors currently offer advanced technology equipment for freeway traffic management. Thus, one of the primary objectives of this study is to synthesize available information so as to select technologies most appropriate for application in Indiana.

Toward this end, the tasks associated with this work included 1) a thorough literature review to identify completed and ongoing research in the area of freeway surveillance and control and 2) a study of operating conditions within the corridor and 3) meetings and discussions with researchers and professional personnel who have experience in the design and implementation of freeway traffic management systems.

The objective of the overall project is to use advanced technologies for monitoring and managing traffic operations on the Borman. The system ultimately proposed must be implemented in the near future and must function in a "real world" environment. Thus, all elements of the surveillance and control system must be implementable and should not rely upon technologies which currently require significant additional development. This study has therefore sought to identify technology advancements which have proven to be effective and appropriate.

Researchers involved in this study subscribe to the belief that the appropriate design and implementation of a surveillance and control system on the Borman Expressway produces benefits which are two-fold. The first, and most obvious benefit, is improved operation on the expressway itself. Beyond this, however, the system chosen will serve as a pilot study for systems implemented at other locations in the future. In coming years, such systems may be called upon to monitor and control recurring congestion as well as incident-induced operating problems. The Borman

surveillance and control system must therefore have the ability to "expand" and change. Moreover, advancements in technology could dictate the need for modifications or adjustments in the proposed system. The system should be capable of incorporating future technologies for the purpose of evaluation and testing. This, of course, means that the Borman surveillance system must be comprehensive. A comprehensive system facilitates maximum operating efficiency, and also provides the capabilities to measure and evaluate the impacts of implemented technologies.

SUMMARY OF FINDINGS

Based on findings from this study, it is recommended that the proposed freeway management system consist of three components. Each of these components could be implemented sequentially. The duration of time between the implementation of each component would depend on the assessed need and/or urgency. The recommended elements comprising each of the three components are briefly summarized below:

Component 1: Traffic Surveillance

Traffic surveillance systems will provide real-time incident detection capability. The system should consist of 1) inductive loop detectors, 2) closed circuit television (CCTV), 3) additional milepost signs to provide location information to motorists "phoning-in" (i.e. reporting) congestion problems and 4) motorist service patrols. Through rapid detection, the surveillance system will greatly reduce delays and safety hazards resulting from incident-induced congestion. The system will also provide comprehensive information on freeway performance.

Component 2: Motorist Information

The motorist information system should provide highway users with information on incidents and other roadway problems by means of 1) changeable message signs (CMS), 2) highway advisory radio (HAR) and 3) traffic bulletins issued by local radio stations and

other commercial media. The motorist information system should alert drivers to downstream traffic hazards. Under incident conditions, the system should provide motorists with opportunities to select alternate routes, thereby minimizing individual delays and reducing overall congestion in the corridor. The traffic surveillance system (component 1) will provide real-time roadway information required by the motorist information system.

Component 3: Traffic Management

Traffic management systems will serve to minimize traffic congestion resulting from incidents. Motorist service patrols serve a dual role of detecting **and** removing expressway incidents. To more effectively deal with incident occurrences, communication links with other agencies (e.g. local DOTs, police, fire) will be implemented and emergency response strategies will be developed. In the future, ramp metering may be implemented to maintain acceptable expressway performance under incident conditions (or future recurring congestion). Ramp metering can also encourage alternate routing so as to create more balanced use of available corridor capacity. To accommodate route diversion, self-adaptive arterial signal systems should eventually be implemented.

The operation and coordination of these expressway systems will be controlled from a Traffic Operations Center (TOC). The TOC should be equipped with computing and communications equipment, T.V. monitors for the CCTV system, real-time traffic operations display maps and links to state police, local transportation agencies and the media. The TOC could also function as a visitor and information center for the public.

Ultimately, the TOC may centrally supervise the operation of all freeway traffic management systems in the state. Due to the proximity of the Borman Expressway, the TOC would likely be located in or near INDOT's LaPorte District. However, the option may also exist to initially manage the Borman Expressway surveillance system via the Illinois Department of Transportation (IDOT) Traffic

Systems Center in Oak Park, Illinois.

CONCLUSIONS

As the work described in this summary represents a feasibility study, considerably more work remains prior to implementation of the final freeway management system. For example, each system element recommended in this report serves a vital role in the overall surveillance and control scheme. Yet, one could argue that not all elements are of equal importance. Thus, each technology and strategy which is to be implemented in the overall system must first be agreed upon by the Borman Expressway Technical Advisory Committee. And clearly, the complexities associated with freeway corridor management dictate that a number of further studies and design refinements be undertaken.

Significant complexities are associated with each element of the overall Borman system. The operating experiences of existing freeway traffic management systems suggest that a "generic" surveillance and control system should not be "blindly" applied to any given corridor. Design of each system element must be done with careful study. Final designs should be a function of 1) desired objectives of the overall system and the individual system element and 2) the operating environment in the corridor.

Much of the design work could be performed by consultants - with supervision by INDOT and Purdue staff. In some instances, designs of each system element should be done sequentially - recognizing that information resulting from the installation of one element might be used to better design subsequent elements. Moreover, a sequential design process would likely promote more careful consideration of individual surveillance and control elements.

The recommended technologies and management strategies described in this summary will produce an effective surveillance and control system for the Borman Expressway. Such a system would facilitate improved traffic operation and highway safety under incident conditions as well as serve to mitigate recurring

congestion problems likely to occur in the future.

COVER DESIGN BY ALDO GIORGINI