1998

Driving performance on an expressway under fog conditions and its improvement use of a fog warning system

Graham James Brisbane
University of Wollongong

DRIVING PERFORMANCE ON AN EXPRESSWAY UNDER FOG CONDITIONS AND ITS IMPROVEMENT BY USE OF A FOG WARNING SYSTEM

A Research Thesis Submitted To

The Department Of Civil, Mining And Environmental Engineering Of

The University Of Wollongong

By Graham James Beattie Brisbane

For The Degree Of Doctor Of Philosophy

February 1998

Acknowledgements

There are many people without whose support I would not have been able to complete this work. The list is lengthy and not able to be reproduced in full. However I would like to acknowledge and pay special thanks to the following:

My supervisors Associate Professor Denis Montgomery, Associate Professor Robin Chowdhury and in earlier days, Dr Yasmin Ashaari, without whose encouragement and advice there would have been no papers, no thesis and no Doctorate.

My family who have put up with the many tantrums and excuses to avoid work that occur often in a seven year period.

The Road and Traffic Authority for their support in both time and money and allowing personal research to be carried out on the project.

Andrew Vasiliou for his knowledge and commitment to the project.

Professor Ken Russell and Professor David Griffiths for their invaluable assistance in providing statistical support.

Neil Lamb for his encouragement and support in providing resources and time through work to ensure the project's completion.

Gareth Brisbane for his not inconsiderable support in statistics and computers without which the project would probably have taken another year.

THESIS ABSTRACT

DRIVING PERFORMANCE ON AN EXPRESSWAY UNDER FOG CONDITIONS AND ITS IMPROVEMENT BY USE OF A FOG WARNING SYSTEM

A Research Thesis Submitted To The University Of Wollongong By

Graham James Beattie Brisbane

Problem

Driving in any situation where the available sight distance is less than that appropriate for the travel speed of the vehicle will naturally present a problem when a hazard occurs. A motorist is often forced to take some emergency action to avoid a potential accident.

In most situations on the road there are many visual cues to give motorists an indication of an appropriate travel speed as well as conferring a perception of the speed actually being travelled. These may take the form of longitudinal lines on the road, warning signs or the general roadside landscaping.

However, in fog these cues cease to be visible and motorists commonly drive at speeds well in excess of the available stopping distance, frequently unaware they are doing so having lost the cues that help create the perception of speed. This problem is obviously

accentuated on higher speed roads such as divided carriageways where the only cues are to tell drivers they are on a high speed road and no apparent threats are available to prompt a lowering of speed.

To address this there have been many attempts to provide Driver Aid Systems to warn motorists of the hazards they face. One such system was provided on the Waterfall - Bulli section of the F6 in 1974. However the continued occurrences of multiple vehicle accidents culminating in a 66 vehicle event in 1986 suggested that the system may no longer be as effective as was originally intended. (No research was ever undertaken to assess whether the system actually met its objectives although this was unlikely, given the nature of the fog in the Bulli Tops area, the way the system operated and the fact a number of features of the original proposal were never actually installed).

Proposed Solution

Rather than simply replace a system which was no longer maintainable or visible in bad fog conditions with a similar system, a research project was proposed to examine changes in technology which had become available since the 70s and to determine whether these could be used to develop a workable system.

The new solution proposed a dynamic, site independent system which could monitor both the fog and the motorists and provide real-time advice to the motorist if vehicle speed was inappropriate to the conditions.

Research

Before developing a new system based purely on the theory, a trial site was selected and research undertaken to assess the effectiveness of the arrangement outlined.

Over a three year period studies were undertaken on the characteristics of vehicles when travelling in various fog visibilities ranging from 250 m to under 50 m.

The research was undertaken in three discrete stages:

April - December, 1992, - characteristics of vehicles unaffected by any sign display

January - April, 1993, - evaluation of the 1974 sign system modified to provide some limited dynamic information

May, 1993 - December, 1994, - evaluation of an improved sign arrangement with full dynamic information provided on fog and speed where appropriate.

The results showed that an independent dynamic sign display could be used which would be effective in modifying vehicle speed characteristics, particularly at times when the speeds were highest without the use of such a sign.

Outcome

As a result of the results of this research project, the RTA proceeded with the design and construction of a new Driver Aid System for the F6 Waterfall-Bulli Freeway. The work involved a $3.5m contract with Telstra and was commissioned in 1996.

A number a factors in the design were directly attributable to the findings of the research including:

- the use of dynamic independent sites
- incorporation into each site of fog detection equipment, speed detection and warning signs capable of displaying appropriate warning messages for individual motorists relative to the situation
- location of the appropriate areas for the system to be located
- use of flashing warning lights in association with each sign display

Papers Published

The following papers on this research have been published at various major Conferences:

BRISBANE G.J.B. (1992) *Driver Behaviour During Periods of Restricted Visibility.* 16th ARRB Conference, Perth, Australia. November, 1992. Proceedings Part 4, pps 313-329.

BRISBANE G.J.B. (1993) *Driver Response to Fog Conditions: An Intelligent Approach.* Pacific Rim Transtech Conference, American Society of Civil Engineers, Seattle, USA. July 1993. Proceedings Volume 1, pps 347-353.

LEVERENZ A.J & BRISBANE G.J.B. (1993) *'Proposed Fog Detection and Speed Advisory System.'* 26th International Symposium Automotive Technology and Automation (ISATA), Aachen, Germany. September, 1993. Proceedings from Dedicated Conference on Advanced Transport Telematics/Intelligent Vehicle Highway Systems - Towards Development And Implementation. Pps nk.

BRISBANE G.J.B. (1994) *Speed modification - Intelligent signs for the future?.* Proceedings 17th ARRB Conference, Gold Coast, Australia. August 1994. Proceedings Part 5, pps 149-163.

BRISBANE G.J.B. (1996) *Driving in Fog - Putting Research into Practice.* Proceedings 18th ARRB Conference, Christchurch, New Zealand. September 1996. Proceedings Volume 5, pps 283-298.

DRIVING PERFORMANCE ON AN EXPRESSWAY UNDER FOG CONDITIONS AND ITS IMPROVEMENT BY USE OF A FOG WARNING SYSTEM

A CASE STUDY OF THE F6 SOUTHERN EXPRESSWAY AT BULLI TOPS.

CONTENTS

BIBLIOGRAPHY

APPENDICES

LIST OF FIGURES

APPENDICES

LIST OF TABLES

APPENDICES