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5.9   VOLUME 9 - MODEL OF TIME AND FUEL CONSUMPTION (MTC)

5.9.1   Structure of Volume 9

         CHAPTER 1 - Introduction

         CHAPTER 2 - Logic and Basic Conceptions of the MTC

         CHAPTER 3 - Equations Used in the MTC Program

         CHAPTER 4 - MTC Limitations and Outlook

         CHAPTER 5 - Applications and Examples

5.9.2   *Summary of Volume 9*

The Model of Time and Fuel Consumption (MTC) is presented with all the information and elements needed for immediate utilization by the nation's highway transportation planners.

Chapter 1 explains the purpose of the Model and presents to the reader interested in evaluating the potentialities and limitations of the MTC the necessity of familiarizing himself with the tests on which the Model is based. Although this requires examination of other ICR Research publications, this Chapter contains figures and schematic drawings which, in a simplified manner, indicate how these tests were utilized and associated in the elaboration of the MTC.

Chapter 2 contains the primary objective of the document, a detailed description of the fundamental concepts and the logic of the MTC. Chapter 3 presents the speed and fuel consumption equations utilized in the MTC, together with the tests which gave rise to these equations and the respective mnemonics utilized in the MTC program. Chapter 4 demonstrates the major limitations of the present version of the Model, and suggests how to correct or by-pass them in the near future.

MTC application possibilities are analyzed in the final chapter. It initially evaluates the MTC as a model for independent use in forecasting the speed and fuel consumption of vehicles on specific road segments, whose geometric and road surface characteristics are already known, at the project scale level. This is followed by a discussion of the applications of the MTC as an auxiliary model for generating equations for forecasting speed and consumption, through the utilization of more aggregate road description and geometry variables.

Working Document No. 18 (bound separately in a limited edition) contains the *MTC User's Manual*. It supplies conventional instructions on roads, and diverse Model application examples, along with a number of explanations on certain aspects of the MTC program. These clarifications are aimed at avoiding most of the doubts which can occur to those who, for the first time, prepare and codify the entries of the MTC program.

Working Document No. 18 also presents the MTC *Programmer's Manual*, with additional information on the MTC, including the definition of all program variables and a complete flow-chart and program listing.

5.10 VOLUME 10 - MODEL FOR SIMULATING TRAFFIC (MST)

5.10.1 Structure of Volume 10

CHAPTER 1 - Introduction

CHAPTER 2 - Concepts Inherent to Traffic Simulation

CHAPTER 3 - Generation of Free-Speed Profile

CHAPTER 4 - Vehicle-Travel Simulation

CHAPTER 5 - Operation of the Model

CHAPTER 6 - Calibration and Validation of the Model

CHAPTER 7 - Applications of the Model

CHAPTER 8 - Summary, Conclusions and Recommendations

APPENDIX - MST Computer Output

5.10.2   Summary of Volume 10

The Model for Simulating Traffic (MST) is one of the products of the Research on the Interrelationships Between Costs of Highway Construction, Maintenance and Utilization (PICR). The Model simulates traffic flow on two-lane highway sections of any vertical and horizontal alignment complexity. This makes it possible to evaluate the impact of transportation policies and strategies, such as construction of a third (climbing) lane, construction of a highway intersection, or the introduction of new transportation technologies, such as that represented by the multitrailer ("road train"). The MST also makes it possible to compute travel times, operating speeds, fuel consumption and other data that can be used by the transportation planner in analyzing the effects of transportation policies and strategies.

The major purpose of the Model is to specify the relationships between both operating speed and fuel consumption, on one hand, and highway geometry, type of surface and roughness, on the other. This relationship may also be used in the Highway Planning Model, now being prepared by GEIPOT for the Ministry of Transportation, which seeks to define the relationships between the three components of highway transportation costs: highway construction, maintenance and utilization.

This document presents the second version of the MST, which is both more efficient and more complete than the first one. A third version of the MST, describing input data in greater detail, is expected to be completed soon.

The MST User's Manual is also available (bound separately in a limited number of copies). This manual presents complete instructions for the codification of the input data and Model parameters, together with four examples of applications (present situation of the highway, introduction of a third lane, introduction of a transversal highway with a STOP sign, and the effect on traffic of the application of new technologies or vehicles, such as the multitrailer).

Finally, the Programmer's Manual (bound separately in a limited number of copies) furnishes the complete MST flow chart and the listing of the computer program.

5.11   VOLUME 11 - FUNDAMENTAL EQUATIONS

5.11.1   Structure of Volume 11

CHAPTER 1 - Introduction

CHAPTER 2 - Parameters and Statistical Models

CHAPTER 3 - Program

CHAPTER 4 - Concept and Subjective Scales of the Main
                      Variable

CHAPTER 5 - Examples of Application

APPENDIX I - Definition of Variables

5.11.2   Summary of Volume 11

The Research on the Interrelationships Between the Costs of Highway Construction, Maintenance and Utilization (PICR) is a continuation of efforts made throughout the world to obtain parameters and statistical equations designed to estimate the rate of deterioration of a given road surface and the operating costs of the vehicles that travel on the road.

This research explains the rate of pavement deterioration on the basis of such characteristics as highway design, traffic and maintenance practices adopted, while vehicle operating costs are quantified on the basis of the type and volume of the vehicles that make up the traffic flow, the highway design and the level of road maintenance.

Once the parameters and statistical equations are logically organized into a computational model, it becomes possible to simulate, in an integrated manner, for the entire life span of a highway or for a given period of analysis, the quantities of materials and services required for maintaining the road, as well as the parts and services necessary for operating the vehicles (road maintenance cost and vehicle operating cost).

The computational model designed to perform the aforementioned functions, in a dynamic and iterative manner, was termed the Highway Costs Model (MICR), and is presented in Volume 8 of this Report.

However, highway planners and analysts do not always need complete simulations (dynamic and iteractive simulations). For example, sometimes they will desire only to calculate the cost of operating a specific type of vehicle under a given set of highway conditions.

The equations presented herein make it possible to determine the operating costs of vehicles according to the method developed by the ICR Research.

The primary objectives of Volume 11 are: (1) to illustrate the utilization of a series of programs for hand calculators (the *Hewlett-Packard HP-97* is used) and microcomputers (*Basic Language*) and (2) to facilitate a number of cost calculations which would otherwise have to be performed by the MICR. For the most part, this volume was prepared before the equations presented in Volume 5 of this report became

available. Therefore, it should be kept in mind that the equations presented herein are based on 1979 data and correspond to those utiliz-ed by the MICR in December 1981. These data should be updated as new equations are introduced into the MICR or as the need occurs to use those of Volume 5.

5.12   VOLUME 12 - INDEX TO PICR DOCUMENTS

5.12.1   Structure of Volume 12

CHAPTER 1 - Introduction

CHAPTER 2 - List of Documents Produced by PICR

CHAPTER 3 - Bibliography Consulted

CHAPTER 4 - List of Manufacturers

CHAPTER 5 - List of Authors

CHAPTER 6 - Index of Titles

CHAPTER 7 - Subject Index

5.12.2 Summary of Volume 12

The *Index to PICR Documents* permits one to locate the subjects discussed in the Final Report and in the other documents produced by the ICR Research.

The *List of Documents Produced by the PICR* enumerates all the documents produced by the PICR under the format of bibliographical references and are chronologically arranged.

The *Bibliography Consulted* contains the bibliographical references (alphabetically arranged) cited by PICR technicians in their work.

The *List of Manufacturers* is alphabetized according to the name of the manufacturer and includes the company's address. A number refers the reader to the *List of Documents Produced by the PICR* .

The *List of Authors* contains the name of each author, in alphabetical order, followed by a number or numbers which indicate the documents which he or she produced and their location in the *List of Documents Produced by the PICR*.

The *Index of Titles* lists the titles of all documents in alphabetical order, followed by a number or numbers which refer the reader to the *List of Documents Produced by the PICR*.

The *Subject Index* presents, in alphabetical order, "word by word", all the topics discussed in the Final Report and in the other documents produced by PICR.

5.13   WORKING DOCUMENTS

5.13.1   Working Document No. 1

Project Background Documents for the EWG - This volume contains documents submitted by the project's technical team at the first meeting of the Expert Working Group (EWG), to assist in defining the methods and techniques to be followed during data collection.

5.13.2   Working Document No. 2

Summary of Findings - EWG Meeting - This document contains a summary of the conclusions and recommendations which resulted from the meeting between the project team and the EWG.

5.13.3   Working Document No. 3

Appendix to the Project Inception Report - Research Concepts and Procedures - This appendix contains documents that complement the English version of the Inception Report - Concepts and Methodology.

5.13.4   Working Document No. 4

Project Technical Memos 1976 - This is a collection of technical memos produced by the project's technical staff during 1976.

5.13.5   Working Document No. 5

Project Technical Memos 1977 - This is a collection of technical memos produced by the project's technical staff during 1977.

5.13.6   Working Document No. 6

Project Instrumentation Memos - This consists of a description of the measuring instruments used by the PICR.

5.13.7   *Working Document No. 7*

Project Instrumentation - Operational Memos - This is a
series of technical memos with instructions on the operation and main-
tenance of the measuring equipment used by the PICR.

5.13.8   *Working Document No. 8*

User Survey Route Inventory - This document contains a des-
cription of a survey of users' routes, whose cost data served as basis
for the study. Here a schematic presentation of the distribution of
nodes is offered, together with the establishment of the links and
routes.

5.13.9   *Working Document No. 9*

Details of Pavement and Maintenance Sections - Here the
characteristics of the sections included in the Pavement Deterioration
studies are documented.

5.13.10   *Working Document No. 10*

Roughness Measurement Systems - This document describes the
various pieces of equipment used for measuring road surface roughness,
and a first attempt to correlate the measures generated by the various
instruments.

5.13.11   *Working Document No. 11*

Project Technical Memos 1978 and 1979 - This is a collection
of technical memos written during 1978 and 1979.

5.13.12   *Working Document No. 12*

Vehicle Weight Data - This document contains data on vehicle
weight obtained on Brazilian roads. These data were obtained in order
to permit an identification of the loading habit of users.