



**HCS-3™ is now available.** (see page eight)

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The *McTrans* Center experienced another busy and productive year during 1997-1998. Our team continued to focus on the completion of a number of substantial software development projects. The most noteworthy accomplishment during this period was the recently released Version 3.1 of the Highway Capacity Software (HCS-3). Our software development group worked tirelessly to build each HCS module from the ground up, implementing the procedures of the 1997 Update to the Highway Capacity Manual (HCM) in a Windows 95/98/NT interface. The upgrade of this program from release 2 to 3 was a major undertaking for *McTrans* and was funded exclusively by distribution fees. We are pleased with the results and hope that our users will be too. With the release of this new version, all HCS-2 registered users were automatically notified.

*McTrans* also continued the expansion of its product offering with the addition of 23 new software and technical resource products. We now offer our members over 475 transportation-related products. Titles and brief descriptions of the products that were introduced in our newsletters this last year are listed at the end of this report under their respective categories. If you are interested in learning more about any of these products, please feel free to contact Debbie Escalera or Bill Heitman, or visit our website at <http://mctrans.ce.ufl.edu>

Along with the new products, eight existing products received major updates. Many updated products included conversion to Windows 3.1, 95 and NT, and provided the users with an expanded, more comprehensive program with improved utilities. Traffic Software Integrated Systems (TSIS) was updated to Version 4.2 with an increased network size to include more links, nodes and vehicles and to make NETSIM and FRESIM logic more consistent within CORSIM. TRANSYT-7F was updated to release 8.1 in late spring with improvements in the explicit modeling of saturated and spill back conditions, use of horizontal queue, multi-cycle and multi-period

simulation, and in the optimization under congested conditions. We also continued our support of Version 2.1 of the HCS with the release of patches e, f and g.

Finally, during this last year, we hit the road again to meet with our users by exhibiting at the 77th TRB Annual Meeting in Washington and the ITE Annual Meeting in Toronto. We enjoyed talking with our members face to face about our profession, products, future plans and ideas. We look forward to seeing many of you at the 78th TRB Annual Meeting in Washington this coming January. Please come visit our booth.

#### Plans for Next Year

*McTrans* has formulated a challenging plan for the 1998-1999 fiscal year with a substantial change in emphasis. Although it includes further software development work, we are also undertaking a major effort to update and improve our communication and accessibility of information for all of our members and proprietors.

The software development team will continue to maintain and improve the latest version of HCS and complete the testing and release of the Windows 95/NT interface for release 8 of TRANSYT-7F. The interface is planned for release before the end of 1998 and will be automatically sent to all registered users.

To improve our service to our members, we will begin work to provide online membership sign-up, software ordering, and a complete online database to allow retrieval of information for all of our products. This database will allow us to maintain detailed information on each product in a timely manner improving consistency in our newsletters, print and electronic catalogs, and invoicing. These long needed improvements should help us to better maintain our growing product offering and meet the information needs of our members and proprietors alike.

If you have any questions, comments, or recommendations, please call or e-mail us. We greatly appreciate your continuing support and look forward to another rewarding year of service to the transportation profession.

## New Products Announced Last Year

### Highway Engineering Highway Design

- CBEAR - analyzes bearing capacity of shallow foundations
- PIZER EARTH - earthwork cut and fill calculator
- Reinforced Slope Stability - analyzes and designs reinforced & unreinforced soil slopes

### Highway Engineering Hydraulics

- BASINOPT & BASINOPT Simulation Add In - detention basin design programs
- BOSS RiverCAD - AutoCad based river modeling software package
- CAHH DOS Programs - hydrology and hydraulics design programs
- CHANNEL - open channel hydraulics design program
- EPANET Modeling System - water distribution/network modeling package
- RIMS - highway drainage utility
- Surfacewater Modeling System - two dimensional surfacewater modeling package
- River Modeling System - AutoCad based computation of water surface profiles for structures
- Urban Drainage Design Program & Manual - design of storm drainage systems associated with transportation facilities
- Watershed Modeling System - hydrology modeling package for rural and urban catchment basins

### Traffic Engineering Capacity Analysis

- CCG/CALC2 - signalized intersection analysis package
- Traffic Engineering Data Processing
- SpeedPLOT (+) - traffic data collection and analysis program

### Traffic Engineering General Traffic

- Advanced Rural Transportation Compendium - listing of rural technology based projects
- Manual for Uniform Traffic Control Devices - unification standard for road & street control devices
- Traffic Noise Model - predicts noise impacts in the vicinity of highways

### Traffic Engineering Signal Timing & Warrants

- PREPASSR, PRETRANSYT, PRENETSIM - preprocessors for PASSER-II, TRANSYT-7F, & NETSIM/CORSIM

### Traffic Engineering Simulation & Analysis

- SIMTRAFFIC - performs simulation of traffic networks

### Transportation Planning Site Analysis

- TRAFFIX - traffic impact analysis program for analysis of new development, intersections, and LOS
- TRANMAP - tools for performing site traffic impact analysis

# An Overview of the 1997 HCM Update

by Rod Troutbeck and Wayne Kittelson, P.E.

**This feature summarizes the major changes contained within the 1997 update and provides an in-progress review of further work that ultimately will result in a completely revised manual.**

(Reprinted by permission from *ITE Journal*, July 1998.

The 1997 update of the Transportation Research Board's Special Report 209 (the Highway Capacity Manual or HCM) represents a significant advancement in the methods by which capacity and level of service (LOS) are estimated for highway facilities. This feature summarizes the major changes contained within the 1997 update and provides an in-progress review of further work that ultimately will result in a completely revised HCM (dubbed the HCM2000).

The decision to produce a 1997 update to the HCM did not come easily, considering that the 1994 update is still fairly recent and that a completely new edition of the HCM is scheduled for publication in the year 2000. It would have been much simpler for TRB's Committee on Highway Capacity and Quality of Service to skip this 1997 update, waiting until the scheduled year 2000 publication of an entirely new HCM to introduce several significantly improved analysis methods. Ultimately, however, the committee was swayed by the belief that it is important to put the best possible analysis tools into the hands of practitioners as quickly as possible, and this became the fundamental reason for publication of the 1997 update.

The 1997 update provides improved analytic procedures for the following basic facility types:

- Basic freeway segments (Chapter 3): improved method for estimating free flow speed; updated estimates of the ideal capacity of a basic freeway segment; inclusion of a speed-flow curve for free-flow speeds of 75 mph;
- Weaving areas (Chapter 4): level-of-service estimates based on density;
- Signalized intersections (Chapter 9): improved procedure for evaluating the effect of an actuated signal; improved equation for estimating lane group delay; revised LOS definitions; improved method to account for lane utilization effects; minor enhancements to the permitted left-turn model; additional guidance on the use of the central business district (CBD) factor;

- Unsignalized intersections (Chapter 10): improved and expanded method for evaluating two-way stop-controlled (TWSC) intersections; improved and expanded method for evaluating all-way stop-controlled (AWSC) intersections; guidance for estimating the capacity of a single-lane modern roundabout;
- Arterials (Chapter 11): a new arterial class for high-speed arterial facilities; method to account for the effect of upstream intersections on downstream delay; consistency with all changes and updates made to the signalized intersections analysis method; and
- Metric Analysis Reference Guide: specific guidance to HCM users on how to convert from English (U.S. customary) units to metric units in conjunction with a highway capacity analysis; converted tables, figures, formulas and worksheets for each chapter of the HCM; general rules for metric conversion and expression, and presentation of example problems illustrating the conversion process.

The new chapters continue to use U.S. customary units in order to maintain consistency with the remaining chapters of the HCM, which are not being updated. However, a Metric Analysis Reference Guide also is provided, and this document details the conversions necessary to conduct a metric analysis. The need for the Metric Analysis Reference Guide will disappear in the year 2000, when the HCM2000 will be published entirely in metric units.

### Basic Freeway Segments

This chapter of the 1997 update reflects the results of the recently completed National Cooperative Highway Research Program National Cooperative Highway Research Program (NCHRP) Project 3-45.1

Significant changes have been made in the methods used to estimate both capacity and LOS. The most significant of these changes include:

- Free-flow speed is estimated through an improved algorithm which accounts for the effects of various freeway design characteristics, including lane width, shoulder width, number of freeway lanes and interchange density (Figure 1);
- The ideal capacity of a basic freeway segment is found to be a function of free-flow speed. It is estimated to range between 2,250 pas-

senger cars per hour per lane (pcphpl) and 2,400 pcphpl, and to occur at densities ranging from 43.6 pc/miles (mi)/lane (ln) to 46.0 pc/mi/ln; and

- A speed-flow curve has been included for free-flow speeds of 75 miles per hour (mph). The need for this curve became apparent when the federally mandated speed limits were removed, but unfortunately these mandates were not eliminated until after the data collection phase of NCHRP 3-45 was completed. Therefore, this curve was developed through extrapolation.

the sensitivity of the analysis to such factors as the location and type of detectors as well as the specific controller settings. As a result, the accuracy of the delay and capacity estimates are improved substantially for intersections controlled by actuated signals. The method also can be used to optimize the controller settings, though the development of timing plans in this manner would be an iterative process; and

- Improved delay equation. The delay equation contained in the 1994 HCM update had associated with it

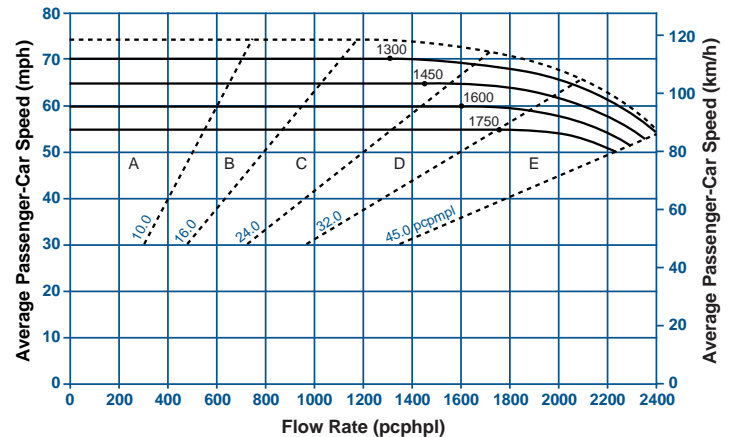


Figure 1. The speed flow relationships and LOS criteria have been modified in the 1997 HCM update.

### Weaving Areas

Density has replaced speed in the 1997 update as the measure of LOS for weaving areas. Since density also is used as the LOS measure for basic freeway segments, this change will provide more consistency in the analysis of freeway systems. The technical analysis procedure for weaving areas remains unchanged in the 1997 update. It should be noted, however, that a research project is underway to update and extend the weaving area analysis procedures. It is expected that the results of this research project will be incorporated into the HCM2000.

### Signalized Intersections

The 1997 HCM update includes several significant changes to the procedure for evaluating signalized intersections. These include:

- Improved procedure for evaluating the effect of actuated signals. A new procedure has been developed that allows timing plans to be estimated using actual controller data and signal design characteristics. This substantially enhances

several known weaknesses. Using the 1994 version of the equation, traffic engineers were unable to: a) discriminate between fixed time and actuated control operation; b) evaluate oversaturated intersections or variable-length analysis periods; c) evaluate intersections using variable demand profiles on the intersection approaches; d) consider the filtering and metering effects of upstream signals; and e) fully consider the effects of progression on delay.

Each of these known weaknesses in the procedures has been either remedied or significantly improved in the 1997 HCM update. The delay equation now includes a third term that specifically accounts for the effects of oversaturation. It also includes a parameter that allows the traffic engineer to adjust the analysis so as to reflect varying durations of congestion. New parameters are provided that allow the traffic engineer to account for coordinated operation and the effects of upstream signals. Finally,

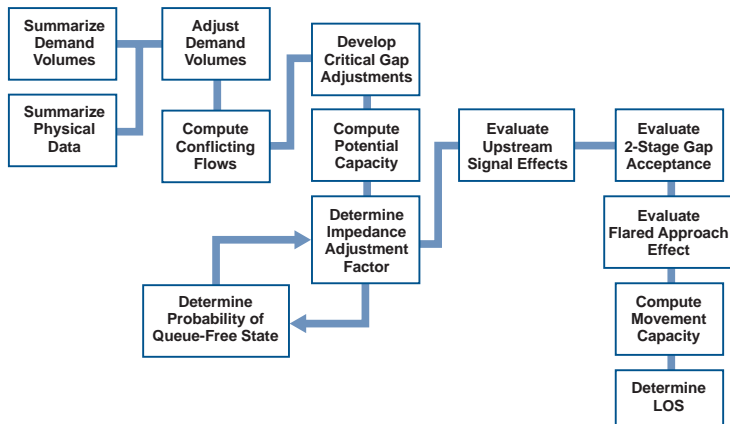


Figure 2. The new TWSC intersection analysis method accounts for several additional geometric and operational elements.

guidance is given on how to collect data in oversaturated conditions.

- Revised definition for level-of-service. The LOS for a signalized intersection is now defined in terms of “control delay.” Control delay is always higher than the stopped delay that was used as the primary determinant of LOS in the 1994 update because it includes stopped delay plus all of the acceleration/deceleration delay that is caused by the signalized intersection. It is fairly easy to estimate control delay from field measurements, and the 1997 update includes directions on how this can be done. Because the 1994 HCM implicitly assumed a direct relationship between stopped delay and control delay, this revision will have no significant effect on the LOS designations resulting from application of either the 1994 update or the 1997 update.
- Improved method to account for lane utilization effects. Prior to the 1997 update, lane utilization effects were taken into account through a volume adjustment process wherein the lane group volume was multiplied by a factor (usually 1.05 or 1.10) to account for imbalanced lane distribution. This had the effect of creating phantom vehicles that were subsequently carried through the remainder of the capacity and LOS analysis as if they were real vehicles. The 1997 update corrects this problem by moving the adjustment process from the demand side (in the volume adjustment module) to the supply side (in the saturation flow rate adjustment module).

- Minor enhancements to the permitted left-turn model. Enhancing the accuracy of the permitted left-turn model continues to be one of the more challenging aspects of the signalized intersection analysis procedure. The reasons that the task is so challenging are at least twofold: 1) permitted left turns occur in an environment of many variables and many interactions; and 2) the operation of permitted left turns depends heavily on driver behavior and judgment, neither of which is consistent or easily quantifiable, the 1997 update makes some enhance-

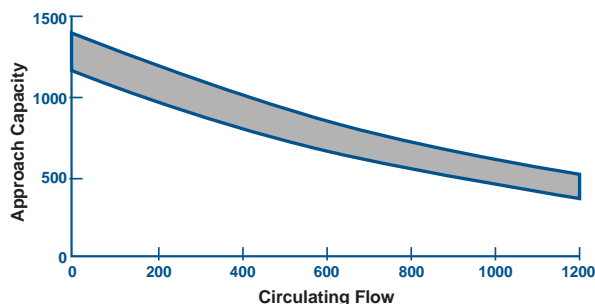


Figure 3. The 1997 HCM provides an estimated range within which the capacity of a single-lane modern roundabout can be expected.

- ments to this model in the following ways: a) a method is provided to estimate the proportion of left turns in the left lane on multilane approaches; and b) adjustments have been made at the boundary conditions of several equations (specifically, at zero or very low flow conditions).
- Additional guidance on the use of the CBD factor. The CBD factor can have a significant effect on the overall capacity and LOS of a

signalized intersection. Therefore, it is important for traffic engineers to understand why and under what conditions it should be applied. The 1997 update is much more explicit about the purpose and application of this factor.

### Unsignalized Intersections

The 1997 update both modifies and extends the analysis procedures for unsignalized intersections, which are now defined to include TWSC, AWSC and modern roundabout intersections. The chapter primarily results from work completed under NCHRP Project 3-46.2

**TWSC intersections.** The analysis method continues to rely on gap acceptance theory. The chapter includes significant methodological modifications and extensions, resulting in substantially improved accuracy and applicability (Figure 2). The most significant changes include the following:

- New defaults for critical gap and follow-up times based on actual observations through the United States;
- A method for adjusting the critical gap and follow-up times to account for variations in approach grade, vehicle mix and intersection geometry;
- Modified equations for estimating the conflicting volumes for each minor movement;

update has been replaced with a theoretically based procedure. This procedure follows an approach proposed earlier by Richardson.<sup>3</sup> More specifically, it estimates capacity as a probabilistically weighted function of the various “environments” or “states” that a driver might encounter on the approach being analyzed.

The method for estimating control delay at an AWSC intersection also has been modified so that it is now consistent with the theoretical basis used for TWSC intersections. **Modern roundabouts.** The 1997 update also includes some information on the analysis of modern roundabouts. This new section has been included because of the emerging interest throughout the United States in the application and evaluation of modern roundabouts. The information contained in the 1997 update is necessarily quite limited because there is, as yet, very little U.S. data upon which to base the development and/or validation of an analysis method. Instead, the 1997 update looks to methods currently being used in other countries, and uses these to establish lower- and upper-bound estimates of the capacity that can be expected for a single-lane roundabout in the United States (Figure 3). No estimates of delay or LOS are given because of the degree of uncertainty that exists with the currently limited database.

### Arterials

The 1997 update of the chapter on urban and suburban arterials is primarily focused toward assuring consistency with the changes previously discussed for signalized and unsignalized intersections. Thus, many of the changes contained in this chapter mirror the changes described earlier. Beyond this, however, are two changes that are specific to this chapter:

- A new arterial class has been established for high speed arterial facilities. With this change, there are now four arterial class alternatives; and
- The delay equation has been modified to take into account the effect of upstream intersections. This change is in addition to those described earlier for signalized intersection analysis.

### Metric Analysis Reference Guide

The 1997 HCM update is published in English (U.S. customary) units in order to remain consistent with those chapters of the HCM that were not updated. The HCM2000 will be pub-

- Capacity adjustments to account for the effects of pedestrians, upstream traffic signals, wide medians and/or two-way left-turn lanes and flared minor street approaches; and
  - A modified equation for estimating control delay; and corresponding changes in the control delay thresholds for defining LOS.
- AWSC intersections.** The regression-based analysis method used to analyze AWSC intersections in the 1994

## New Tools for Highway Development and Management: HDM-4

By Neil Robertson, PIARC HDM-4 Project Coordinator

lished entirely in metric units, but in the meantime many HCM users may still need to conduct their analyses in metric units. To meet this need, a document accompanies the 1997 update entitled, *Metric Analysis Reference Guide*. This document is designed to guide users of the HCM through the process of converting from U.S. customary to metric units in conjunction with a highway capacity analysis. It includes converted tables, figures, formulas and worksheets for every chapter of the HCM, as well as example problems illustrating the conversion process.

The Metric Analysis Reference Guide also includes basic rules governing the conversion to and expression of metric units. In general, a hard conversion is used wherever possible to maintain consistency with the American Association of State Highway and Transportation Officials' Guide to Metric Conversion. Even so, there are some situations where soft conversion is more appropriate, such as empirically derived formulas and observed speed values.

### The HCM2000

A complete update of the HCM will occur in the year 2000. Currently referred to as the HCM2000, this new document will be entirely metric. It will be expanded considerably from the current HCM to meet the needs of a growing and more diverse user base. Key features of the HCM2000 are expected to include the following:

- Updated and/or extended analysis procedures for weaving areas, freeway systems, two-lane highways, pedestrians and transit;
- A new method for evaluating the operational characteristics of closely spaced signalized intersections in interchange ramp terminal areas;
- A comprehensive set of planning applications for the analytical techniques contained in the HCM, including default values and input estimation techniques; and
- Techniques for planning-level analysis of corridors and subareas.

The format of the HCM2000 also will be modified to make it more readable and useful. This will include a different page layout incorporating wide margins and marginalia (for example, thumbnail sketches and summary notes). Example problem sets also will be updated and extended.

In addition to the paper version of HCM2000 described above, there also will be a multimedia version on CD-ROM which takes advantage of hyper-text linkages, sound, still photography and video clips to elaborate on the analysis techniques that are presented.

### Summary

The 1997 update of the HCM represents a significant advancement in the methods available to practitioners for evaluating basic freeway segments, signalized and unsignalized intersections and urban arterials. Used in conjunction with the Metric Analysis Reference Guide, this update will enhance the quality and accuracy of operational analyses that will be performed through the end of this century. The publication of a new HCM in the year 2000 will continue this trend and will be a significant step toward meeting the transportation profession's growing need for system-wide evaluation tools.

### References

- 1 Schoen, J., A. May, W. Reilly and T. Urbanik. *Speed-Flow Relationships for Basic Freeway Segments*, Final Report. NCHRP 3-45 (May 1995).
- 2 Kyte, M., Z. Tian, Z. Hameedmansoor, W. Kittelson, M. Vandehey, B. Robinson, W. Brilon, L. Bondzio, N. Wu and R. Troutbeck. *Capacity and Level of Service at Unsignalized Intersections*, Final Report. NCHRP 3-46 (April 1996).
- 3 Richardson, A. *A Delay Model for Multiway Stop-Sign Intersections*, Transportation Research Record 1112. Transportation Research Board (TRB), Washington, D.C., USA, 1987.

**Rod Troutbeck** is the head of the Civil Engineering Department at the Queensland University of Technology in Brisbane, Queensland, Australia. He is the chair of the Subcommittee on Unsignalized Intersections; a member of the User Liaison and Interpretations Subcommittee of the TRB's Committee on Highway Capacity and Quality of Service; and a member of ITE.

**Wayne Kittelson, P.E.**, is chair of the User Liaison and Interpretations Subcommittee of the TRB's Committee on Highway Capacity and Quality of Service. He is a principal at Kittelson and Associates and a member of ITE.

The **Highway Design and Maintenance Standards Model** (HDM-III), developed by the World Bank, has been used for over two decades to conduct technical and economic appraisals of road investment projects, and to analyse standards and strategies for road network maintenance and improvements. *McTrans* distributes the HDM-III software and documentation.

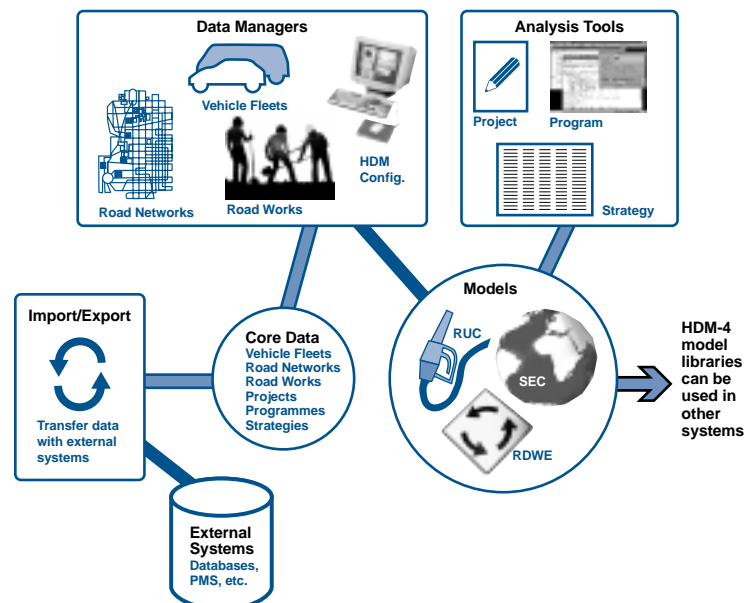
The **International Study of Highway Development and Management** (ISO-HDM) has extended the scope of the HDM-III model to provide a harmonised systems approach to road management, with adaptable and user-friendly software tools. The new **Highway Development and Management (HDM-4) System** is the result of the study.

ISOHDM was set up in August 1993 by four main sponsors; the UK Department for International Development (DFID), the World Bank (IBRD), the Asian Development Bank (ADB) and the Swedish National Road Administration (SNRA). Significant financial and other contributions were made by a number of organisations and individuals including the Finnish National Road Administration (Finnra), the US Federal Highway Administration (FHWA), the governments of Malaysia, France, South Africa, Japan and Australia, and the Federation of Inter-American Cement Manufacturers (FICEM).

Coordination of the project has been conducted by the University of Birmingham (UK) during the



### HDM-4 System Architecture



## New Tools: HDM-4 continued

development phase, and will be conducted by the Permanent International Association of Road Congresses (PIARC) during the implementation phase.

### The HDM-4 Approach

#### Management Functions

The new HDM-4 provides a powerful system for:

- road management
- programming road works
- estimating funding requirements
- budget allocations
- predicting road network performance
- project appraisal
- policy impact studies
- a wide range of special applications

The scope of the new HDM-4 has been broadened considerably beyond traditional project appraisals, to provide a powerful system for the analysis of road management and investment alternatives. The new HDM-4 is intended to cater for the wide ranging needs of road agencies, international funding institutions, consultants and research organisations through separate application tools developed to perform the following management functions:

- strategic planning
- roadwork programming
- project preparation
- research and policy studies

#### Strategic Planning

This function can be performed using the HDM-4 Strategy Analysis application. It involves an analysis of the road system as a whole, to prepare long term strategic planning estimates of expenditure for road development and maintenance under various budgetary and economic scenarios. The physical road system is usually characterised by representative lengths of road, or percentages of the network, in various categories defined by parameters such as road class or hierarchy, traffic flow/capacity, pavement and physical condition. The main outputs are estimates of medium to long term budget requirements for the entire road system together with forecasts of pavement performance and road user effects. The results of the planning exercise are of most interest to senior policy makers in the road sector, both political and professional.

#### Roadwork Programming

This function can be performed using the HDM-4 Program Analysis application. It involves the preparation, under budget constraints, of multi-year road works and

### Register your interest in HDM-4!

More information about HDM-4 and the ISOHDM project can be found at the following web sites:

- **HDM-4 Overview:** <http://www.bham.ac.uk/publications/civeng/hdm-4/index>
- **Recent newsletters:** <http://www.bham.ac.uk/publications/civeng/hdm-4/news/hdm4janhttp://www.bham.ac.uk/publications/civeng/hdm-4/news/hdm4may>
- **ISOHDM project and documents:** <http://www.bham.ac.uk/isohtm>
- **Various HDM-4 reports and other information:** <http://www.roadsource.com/hdm>

If you would like to register your interest in using HDM-4, and to be kept informed of future activities, obtain an interest registration form from the RoadSource site (<http://www.roadsource.com/hdm>), the PIARC site (<http://www.piarc.lcpc.fr>), or directly from the HDM-4 Coordinator, Neil Robertson at the PIARC headquarters (contact details below). The interest registration includes some questions that will enable us to better plan the implementation activities.

**Contact Details** The HDM-4 Project Coordinator, Neil Robertson, may be contacted as follows.

World Road Association (PIARC)  
La Grande Arche, Paroi Nord (niv 8)  
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Tel: +(33) 1 47 96 81 21 or direct line: +(33) 1 41 02 05 84

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expenditure programs in which candidate road sections likely to require maintenance, improvement, or new construction are identified in a tactical planning exercise. The programming activity produces estimates of expenditure required in the short to medium term, under defined budget heads, for different types of road works. Budgets are typically constrained, and a key aspect of programming is to prioritise works to find the optimal set of road works.

Typical applications are the preparation of a budget for an annual or rolling multi-year work program for a road network, or sub-network. Managerial-level professionals within a road agency normally undertake programming activities.

#### Project Preparation

This function can be performed using the HDM-4 Project Analysis application, and replaces the function performed by HDM-III.

Project preparation is concerned with the evaluation of one or more road projects or investment options. Road sections with user-specified treatments are analysed over a specified life cycle. Project analysis can be used to estimate the economic or engineering viability of road investment projects by performing life cycle analysis of pavement performance, maintenance and/or improvement effects together with estimates of road user costs. The main outputs include:

- annual predictions of pavement performance
- pavement maintenance and road improvement effects
- road user costs and benefits
- estimates of environmental effects

- standard economic indicators; NPV, EIRR, BCR, etc.

Typical projects include pavement maintenance and rehabilitation, road widening or geometric improvements, new construction, and so on.

#### Research and Policy Studies

HDM-4 can be used to conduct a number of road sector policy studies including:

- Funding policies for competing needs, e.g. feeder versus main roads
- Road user charges for setting up Road Funds
- Impacts of road transport policy changes on energy consumption
- Impact of axle load limits
- Pavement maintenance and rehabilitation standards

#### System Architecture

The HDM-4 technology is designed to be modular to allow it to be integrated with present and future road management systems. The technology has been developed at three levels:

- The knowledge and algorithms embodied in the modelling of technical and economic performance of road infrastructure;
- The program modules which deliver the models in explicit terms;
- The HDM-4 software, including the modelling modules, which provides the investment analysis and works programming functions.

The system architecture, shown in the diagram below, consists of

- a database – manages the input data and analysis results;

- data managers – software that provides the user interface, and controls data flows;
- models – software modules that reflect the modelling algorithms;
- analysis tools – software that controls the system applications.

These modules can interface with, or in some cases be integrated into, existing road agency information systems.

#### Implementing HDM-4

The first version of the HDM-4 software is currently going through a beta testing phase and software refinement, together with finalisation of documentation, which is expected to continue until the end of 1998. Following that, the software will go to its first global release.

The software will not be released as public domain or shareware, but will be available through electronic and hard copy distribution channels on a user-pays basis, to provide funds for user services and continuing research and development. Implementation activities will include:

- sales and distribution of software
- sales and distribution of manuals
- regional training and support services
- train the trainer services
- maintenance and upgrades of software
- information dissemination activities
- research and development.

### CULVERT4

CULVERT4 is using the Caltrans (California DOT) culvert corrosion criteria included in the California Highway Design Manual, dated May 30, 1997, memo to District Designers dated May 26, 1998, and the current California Test Methods 417, 422, 532, and 643. Using Caltrans corrosion criteria for culverts, CULVERT4 (English or Metric units) presents alternative culvert materials thickness acceptable for 50 years of service using site specific test data. The minimum resistivity test data (ohm-cm) and pH of the site soils and/or water are required for all analysis. Water soluble sulfate and chloride concentrations (ppm) are required for aggressive sites when the minimum resistivity is less than 1000 ohm-cm. Culvert materials addressed include Corrugated Steel Pipe, CSP; Corrugated Aluminized Steel Pipe, Type2, CASP; Corrugated Aluminum Pipe, CAP; and Reinforced Concrete Pipe, RCP. Also, recent Caltrans analysis shows that aluminized steel pipe (type 2) performs significantly better than previously suggested. Coating materials addressed include Bituminous Coatings, soil side and water side; Bituminous Coating plus Paved Invert, water side abrasion; Polymerized Asphalt on the inside/outside bottom 90 degrees, water side. Also, CULVERT4 presents new Caltrans pH and SULFATE criteria for structural concrete and RCP. CULVERT4 (#CULVERT4) by Dean M. Coats is available at LOS 6 for \$50.

### Drainage Requirements In Pavements

The windows based microcomputer program DRIP contains all key drainage design elements and provides graphical displays of computations and results. The program:

- performs drainage designs for flexible and rigid pavements and retrofit edge drains;
- calculates the time-to-drain and depth-of-flow in the drainage layer;
- performs separator layer and geotextile designs;
- performs edge drain and geocomposite fin drain designs; and
- converts input and output from SI to English units, or vice versa.

The most important drainage parameter, the coefficient of permeability, is an input (from laboratory tests) with an option that it can be determined from empirical equations if no laboratory or field permeability test results are available for the material. Both a clogging criterion and permeability criterion are used. After determining the material properties of the drainage material, the resultant slope and the resultant length is determined from a trial road geometry. For a given trial thickness, the drainage capacity is determined from the permeability, the slope, the thickness, and the length of the drainage layer. The time-to-drain is determined from these parameters along with the effective porosity of the soil. The steady-state flow criterion is used to ensure that the drainage capacity is greater than the design inflow. The unsteady-state flow criterion (time-to-drain) is applied to ensure rapid removal of infiltrated water and limit the saturation time period. If these two requirements are not satisfied, a new design will be determined by changing the coefficient of the permeability of drainage materials and/or the road and drainage layer geometry, and combining these methods to achieve the optimal practical and economical solution. After completing the drainage layer design, the final state in the design process is to design a system of longitudinal collectors with transverse collectors at critical points to remove the

free water from the drainage layer and transfer it to suitable outlets. The Manning's formula is used to determine the diameter of the pipe for a given lateral inflow, distance between outlets, roughness coefficient, and slope of the pipe. The geocomposite flow equation along with other appropriate design criterion is employed to design geocomposite fin drains.

Proper execution of the DRIP program requires at minimum an Intel 486 processor and the Windows 3.1 operating environment. Due to the graphical nature of the program, a 256-color monitor with 800x600 resolution is recommended.

The User Manual provides the microcomputer operator with instructions on the operation, use and application of the software, examples of typical design calculations, and documentation of the program's technical background with a list of reference documents.

The User Manual contains general information on drainage design methodology, organization of the program, and key components for preparing the input, operating procedures and display of the design results. Example problems walk the user step-by-step through the design process and demonstrate all aspects of DRIP. Default values are provided throughout the system to allow the user to retrieve an example typical value for any parameter.

DRIP (#DRIP) by FHWA is available at LOS 3 for \$40 The User Manual (#DRIP.D) is available for \$10.

### NOSTOP

The popular program NOSTOP for arterial bandwidth optimization has recently been released by Strong Concepts as a new Windows-based program. Like its DOS predecessor, NOSTOP/TEAPAC for Windows performs simplified arterial

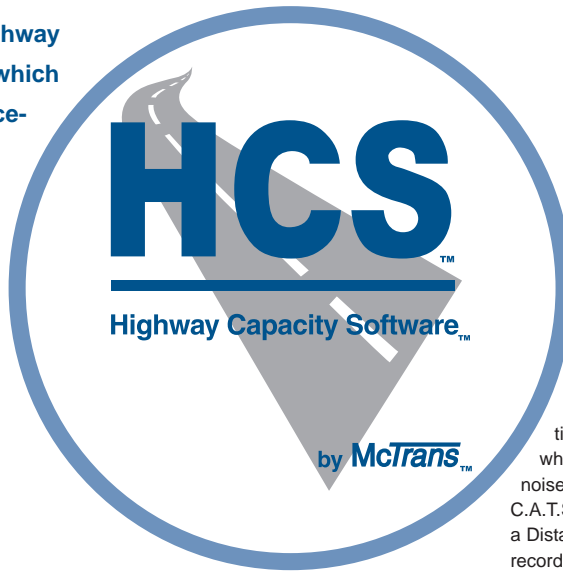
bandwidth optimization of signal timings. With a minimum of input, NOSTOP will first optimize the system cycle length and produce a graph that shows how cycle length impacts progression band efficiency. Then for the best cycle, or one selected by the user, NOSTOP produces a complete detailed timing report showing all of the optimum settings, including a time-space diagram. Additional options include creating a preferential flow direction, searching for optimal progression speeds and exploring lead versus lag opportunities.

NOSTOP is now available for several Windows platforms. The Windows versions have all of the features noted above (found in the DOS version), plus a unique Visual Mode which provides an intuitive, graphical user interface as a true Windows program, like WinSIGNAL94. These versions also provide a fully-indexed on-line user guide and context-sensitive help. Data files are fully interchangeable with the DOS version of NOSTOP. The .WIN versions will run on any of the Windows 3.x or Windows 95/98 platforms; the .W95 versions will run on any of the Windows 95/98 or Windows NT platforms. The 12-intersection version of NOSTOP/TEAPAC Ver 4.30 from Strong Concepts (#TPCNST.1, #TPCNST.1.WIN and #TPCNST.1.W95) is available at LOS 7 from *McTrans* for \$395. The full-size, 25-intersection version of NOSTOP/TEAPAC (#TPCNST.2, #TPCNST.2.WIN and #TPCNST.2.W95) is available at LOS 7 for \$495. Educational versions are available for half-price and demonstration versions are available for \$5 or as free downloads from the WWW (#TPCNST.0, #TPCNST.0.WIN and #TPCNST.0.W95). Registered licensees of DOS versions of NOSTOP may upgrade to a Windows version directly from Strong Concepts.

## Updated Products

### HCS-3™

Release 3 of the Highway Capacity Software, which implements the procedures in the 1997 Update to the Highway Capacity Manual (HCM), is now available in a Windows95/98/NT4 interface.



### C.A.T.S.™

Houston Transportation engineers at the Texas Transportation Institute have refined their versatile software, C.A.T.S. (Computer Aided Transportation Software), to include several improvements over the old version.

The newest improvements to C.A.T.S. include multiple speed profiles on one graph, user-selected speed bins, built-in data file utilities, and selectability of output. Output features include: distance, time, average speed, standard deviation from average speed, user defined speed bins (time and percent time between user defined speeds i.e., 0 mph to 30 mph, 3 mph to 40 mph which can be used as an estimate of level of service) acceleration, acceleration noise, and fuel consumption.

C.A.T.S. was developed by TTI in 1996 to improve data collection methods involving a Distance Measuring Instrument (DMI). Prior to C.A.T.S., this information was recorded with a stopwatch and a notepad, and later with a DMI unit and a notepad. The cumbersome methods were far more costly and less accurate than C.A.T.S., which focuses on quality control of the data. The versatile Windows program can be used for anything from travel time runs and congestion management, to producing speed profiles for roads and synchronizing traffic signals.

C.A.T.S. collects 20-30 times the data as the stopwatch method. Since it is computerized, it easily records information every half-second, or approximately every 100 feet at freeway speeds.

There are two modules in C.A.T.S.: the DOS-based DMI-Read module records data from the probe vehicle and DMI unit and the Windows-based Setup and Analysis module, which allows the user to customize DMI-Read, define function keys, process data collected by DMI-Read, and create yardstick files, which match up with data collected to ensure excellent quality control.

The software possesses a unique file naming system, which avoids overwrites and runs on a 386 CPU (or higher), although the DMI-Analyze module requires a 486 CPU or better.

C.A.T.S. by Texas Transportation Institute (#CATS) is available at LOS 6 for \$150.

### Update Watch

Package	Version	Status	Target	Distribution
HCS	2.1g	Complete	Available	Patch File
HCS-3	3.1	Complete	Available	Registered users may upgrade
TRANSYT-7F	8.1	Complete	Available	Registered users may upgrade
TRANSYT-7F	Win	Under development	Winter	Automatic to registered users



The TSIS web site ([www.fhwa-tsis.com](http://www.fhwa-tsis.com)) now has a discussion group for TSIS users. It is intended for TSIS users to exchange ideas, questions, techniques, etc. Additionally, TSIS developers will monitor the group and participate in discussions.

To read the contents of this list or to post a message, visit the TSIS web site and select the "Support" button. The group is labeled "TSIS Discussion Group (Public)." Follow the directions to get the messages.

This web based group is available through any Internet browser. If you have any questions about it or problems accessing it, please send e-mail to [Brad.Mears@ssc.de.ittind.com](mailto:Brad.Mears@ssc.de.ittind.com).

### U.S.DOT Invests in Internet

The U.S. Department of Transportation (U.S.DOT) is funding a project to share ITS information through the Internet. State and international transport bodies will contribute to the ITS Cooperative Deployment Network (ICDN), which aims to use several linked Web sites to reach state and local transport decision makers. The network will include discussion forums, a newsletter, calendars and links to other ITS Web sites. ICDN information will be integrated into member organizations' homepages, using the member's branding and site layout to present the common information. This will enable the U.S.DOT to easily reach a diverse audience and solicit feedback on its initiatives. The Institute of Transportation Engineers is the prime contractor for the network. Other members include the Federal Highway Administration, ITS America, the Joint ITS Program Office of the U.S.DOT, Transportation Research Board and the International Bridge Tunnel and Turnpike Association. The newsletter is already available at two member Web sites: <http://www.ite.org> and <http://www.its.dot.gov>.

The ICDN's members belong to the 36-member National Associations Working Group, which has been sharing information on ITS developments through meetings every six weeks for three years. (Reprinted from *ITS International* magazine, May/June 1998.)

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