RESEARCH BULLETIN

NDOT Research

Comparative Evaluation of Simulation Software for Traffic Operations

To facilitate analysis and simulation of traffic conditions on roadway and freeway sections and networks, the Nevada Department of Transportation (NDOT) contracted out a research project to the University of Nevada at Las Vegas. The objective of this research project was to perform a comparative review and evaluation of traffic simulation software with the purpose of identifying their suitability for use on NDOT-sponsored projects. After an extensive literature review of available

software, three microscopic traffic simulation programs, VISSIM, TSIS-CORSIM, and SIMTRAFFIC, were selected for detailed evaluation. The evaluation involved an analysis of the capabilities and performance of the software in simulating freeway traffic as well as arterial street traffic conditions. The freeway segment simulated was US 95 between the "Rainbow Curve" (i.e., the Summerlin-Rainbow onramps/offramps) and the "Spaghetti Bowl" (i.e. the US 95-I-15 Interchange) in Las Vegas. The key freeway traffic conditions simulated included basic freeway operations, ramp metering, high-occupancy vehicle (HOV) operations, and incident conditions.

To evaluate performance on arterial streets, a section of Martin Luther King (MLK) Blvd. in Las Vegas, consisting of four signalized intersections between the intersections of Washington/MLK and Carey/MLK, was simulated. Included in the simulation were regular transit bus operations. The ability to simulate other special conditions such as roundabouts, and midblock pedestrian crossing were also explored.

TSIS-CORSIM is the most developed and probably the most popular traffic simulation software. It has pre-defined parameters

for most of the special traffic operational conditions, such as HOV lane operations, ramp-metering, incident conditions, and transit operations. TSIS-CORSIM produces a single output file that includes all the key measures-of-effectiveness (MOEs) by link, time interval and network-wide. The MOEs include average link travel times, speeds, average vehicle delays, queue lengths, and aggregate measures such as vehicle-miles and vehicle hours of travel, and vehicle emissions. Using CORSIM, the freeway simulations, including the special conditions for HOV lane operations, ramp-metering with/without HOV by-pass, and incident conditions produced acceptable results.

VISSIM is a fairly new software program that is still undergoing frequent upgrades. It is potentially very powerful, allowing the user a lot more flexibility in network coding, input data and simulation of special situations. Its main advantages over CORSIM is its ability to model special situations such as roundabouts, mid-block pedestrian crossing situations, and highway

interaction with light-rail transit systems. It can also produce 3D animations of the traffic simulation at different "viewing" angles. However, VISSM is not suitable for simulating certain operations such as HOV lanes, demand-responsive ramp-metering and incidents. These features are not explicitly pre-defined in the program, and certain coding "tricks" have to be used to simulate these conditions. This may result in inaccurate representation of the actual field conditions. With respect to arterial streets, coding of intersections in VISSM is more complex than CORSIM. The user has to define all the right-of-way priorities such as right-turning traffic yielding to pedestrians, and left-turn traffic yielding to opposing traffic. It makes the coding process more cumbersome and causes special problems in simulating saturated traffic conditions.

VISSIM produces several output files with different MOEs. However, it does not produce system-wide aggregate MOEs, such as vehicle-miles and vehicle-hours of travel.

SIMTRAFFIC, which can only be used to simulate arterial street networks, is the most user-friendly of the three software, in terms of the user interface. The software works with the window-based macroscopic optimizing model SYNCHRO and this pair of software can be used to quickly evaluate different optimal traffic and arterial network situations. However, compared to CORSIM and VISSIM, it is very limited in simulating special traffic conditions such as transit operations and incidents.**?**

Testing Epoxy Overlay Systems for Bridge Decks

Installed in August, 2002, two thin epoxy overlay products, T-48 from Transpo Industries, Inc. and Poly-Carb Mark 163 Flexogrid, are being tested as waterproofing systems for bridge decks on US 395 at the Mill Street Interchange in Reno. These two products are designed to provide a thin (3/8" thick) overlay for complete waterproofing as well as a non-skid surface to withstand continuous heavy traffic and extreme changes in weather conditions.

The Bridge Division, in conjunction with Research and Materials, is monitoring the project and testing concrete strength and skid numbers. The performance of these two products will be evaluated based on the following criteria: 1) Its ability to adhere after a three year period, (adhesive failure must be in the concrete as measured by a standard pull-off test); 2) The skid number must be above 55 after 3 years; and 3) The deck surface must be crack free after 3 years.

The objective of the field test is to identify thin epoxy overlay systems that are comparable to the polymer (polyester styrene) concrete waterproofing systems. It is hoped that via the test a specification for epoxy systems, along with a qualified product list, will be developed as an alternative method for bridge deck waterproofing, particularly under some conditions where polymer concrete is not suitable for use. **?**

Photo 1. Thin epoxy overlay systems being tested on US 395 in Reno.

Product Evaluation Committee (PEC) Meeting Recap

APPROVED

Based on information provided by 3M representatives and a request from Traffic Engineering, the PEC approved a field test of wet reflective tape from 3M. It was clear to the PEC that this product is viable and has considerable cost-effectiveness when compared to similar durable striping materials from 3M such as "waffle-tape" or LPM 1200 liquid pavement marking.

3M representatives, Mr. Eric Dornak and Mr. Howard Tolliver, provided a video demonstration of their Stamark™ wet reflective pavement marking tape. This tape is a marking material intended for longitudinal line applications as an overlay marking on concrete and asphalt surfaces in locations where traffic is free rolling with low to moderate encroachment. The tape is reinforced by a structural medium and pre-coated with a pressure sensitive adhesive and utilizes specially designed optics to provide dry and wet reflective performance. Its initial minimum retroflectance values under wet or dry conditions are 750 $(mcd/m^2)/fc$ for white and 540 $(mcd/m^2)/fc$ for yellow tape.

Traffic Engineering reviewed the product literature for the wet reflective pavement marking tape series 820 and recommended a field test of this product to determine its in-service performance. A roadway close to Carson City would be a suitable location for this field test. The product manufacturer will be responsible for all costs associated with the installation of tape except for the traffic control. NDOT forces will provide traffic control during installation.

Although section 732 of NDOT Standard Specifications covers permanent pavement marking film, the vendor requested a field test of their wet reflective tape since this tape's wet characteristics are not addressed by our standards. If a test is successful, implementation would require amendment of our standards to allow the use of wet reflective tape. While field test data may confirm that this is a durable and effective pavement marking product, its relatively high cost may limit its use to specific applications.

Other state DOTs such as West Virginia, Washington, Tennessee and Georgia tested and approved 3M's wet reflective tape; however, most of these approvals are for work zone use.?

Photo 2. Wet reflective tape series 820 installed in Sequatchie County, Tennessee.

APPROVED

The PEC approved the establishment of specifications and an accompanying QPL for Dynamic Message Signs (DMS).

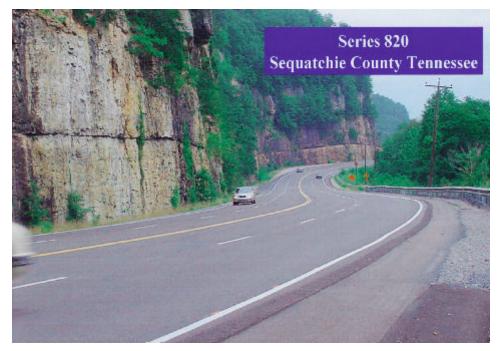DMS function to serve as the interface between a traffic

Photo 3. Dynamic Message Sign helps to inform motorists of road conditions and traction device requirements ahead on westbound I-80 over Donner Pass.

reside with one party - the contractor.

Traffic Engineering and Specifications will develop a specification for dynamic message signs that is National Transportation Communications for ITS Protocol (NTCIP)-compliant. In the future, companies solicited for our qualification process and placement on the QPL must have a successful history in manufacturing DMS and fully comply with our standards.❓

management system and specific roadway equipment that provides information to motorists. The primary purpose of DMS is to convey traffic conditions, weather conditions, and other traveler-advisory and traveler-alert conditions. These signs are capable of displaying various messages ranging from brief, limited messages to fully customized messages. NDOT plans to use these signs as an element of the ITS-based traffic management systems throughout the state, in particular, the Freeway and Arterial System of Transportation (FAST) that is being deployed in Clark County. FAST will focus on the Las Vegas area where a rapid and coordinated response to traffic-related situations is critical. An example of a complex traffic situation may include diversion of high traffic flow around traffic jams which inevitably accompany an accident.

In the past, the Department, through State Purchasing released a qualification-based RFP for manufacturers of DMS. However, this method of procurement and installation for DMS has resulted in major problems.

Conflicts arose when contractors in their zeal to complete a project considered connectivity problems to be the responsibility of the manufacturer. Consequently, Traffic Engineering suggested that the responsibility for both purchase and installation of the DMS should