Research Digest

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Research Digest

Item 1

Texas Metropolitan Mobility Plan: Breaking the Gridlock

NCTCOG

MS 8103 • 2006

The Texas Metropolitan Mobility Plan (TMMP) addresses a statewide initiative to quantify long-range needs within the larger metropolitan areas of the state and to develop a shorter-range prioritized listing of projects aimed at improving mobility, reducing traffic congestion, and mitigating air quality impacts. This Plan will serve as a comprehensive, multimodal blueprint for transportation systems and services within the Dallas-Fort Worth (DFW) Metropolitan Area. Unlike the region's long-range Metropolitan Transportation Plan (Mobility 2025, 2005 Amendment), it is not constrained by anticipated revenues. The TMMP focuses on the magnitude of unmet transportation needs for the region and provides decision-makers with a better feel for the quantity of additional funding needed.

The 2006 TMMP continues the work that was begun in 2004, and will culminate with the development of a final report which will be transmitted to the Texas Transportation Commission and will serve as a platform for future funding discussions statewide.

Full-text PDF of this report is available for free download from

http://www.nctcog.org/trans/mtp/tmmp/TMMP_Report_2006_000.pdf

Item 2

Strengthening Texas Environmental Stewardship in Transportation

ENVIRONMENTAL DEFENSE

MS 8104 • 2006

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http://library.ctr.utexas.edu/pdf02/transportation_stewardship 9_06.pdf

Item 3

Improved Load Rating of Reinforced Concrete Slab Bridges

NEW MEXICO STATE UNIVERSITY

NM05STR-02 • 2007

In New Mexico, many reinforced concrete slab (RCS) bridges provide service on interstates I-10, I-25, and I-40. An accurate strength evaluation of interstate bridges is essential to avoid unnecessary load restrictions. The AASHTO load rating factor for this type of bredge largely depends on the live-load moment per foot of slab width. As a result, the main objective of this study was to determine a more accurate value for the equivalent strip width (using higher level evaluation techniques including diagnostic load testing and finite element analysis) for use in the AASHTO rating.

A continuous, RCS bridge located in Las Cruces, New Mexico was evaluated in this study. An AASHTO load rating analysis based on the Load and Resistance Factor Rating (LRFR) approach was first performed using code-prescribed equations for the equivalent strip width to determine the live-load effects. A diagnostic test was then conducted to measure the strain response at selected points in the positive and negative moment regions of an exterior and interior span. The measured response showed that the slab stiffness fit within cracked and gross section behavior. Furthermore, bending moments from finite element analysis agreed reasonably well with those derived from the experimental strain data (using the average of the cracked and gross section modulus).

Using refined analysis, it was shown that the equivalent strip widths for positive moment were 26.1%, and 22.1% greater than those calculated by the AASHTO approximate method for the exterior and interior spans, respectively. Furthermore, the refined widths for negative moment were greater than AASHTO by 13.1% for the exterior span and 11.1% for the interior span. This increase in the equivalent strip width reduced the live-load effects, which proportionally increased the rating factors. Accordingly, the inventory and operating rating factors for the bridge increased from 0.84 to 0.93 and 1.08 to 1.20, respectively. The factors increased by just 11% (rather than over 20%) since the rating was controlled by negative moment.

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http://www.nmshtd.state.nm.us/upload/images/Research/reports07/ImprovedLoadRatingOfReinforcedConcreteSlabBridges.pdf

Item 4

Live Stop-Controlled Intersection Data Collection

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR2 • 2007

This report describes an experimental investigation performed at live intersections to gather infrastrucute-based naturalistic driver approach behavior data. This data was collected and analyzed with the goal of understanding how drivers approach intersections under various speeds and environmental conditions. Six stop-controlled intersection approaches across five intersections in the New River Valley, Virginia area were selected for data collection. The sites were selected based on the intersection characteristics and crash statistics. Data was collected from each site for at least two months resulting in over sixteen total months of data.

A data acquisition system was devised and implemented to obtain the first intersection data set with fidelity sufficient for developing intersection collision avoidance threat assessment algorithms. An explorative analysis of driver stopping behavior and vehicle trajectories was also performed. Results indicate that an intersection collision system for stop-controlled intersections is feasible. Avenues for future research and potential uses of this new database are highlighted.

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http://www.virginiadot.org/vtrc/main/online_reports/pdf/08-cr2.pdf

Item 5

Optimal Placement of Point Detectors on Virginia's Freeways: Case Studies of Northern Virginia and Richmond

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR3 • 2008

In Virginia, point detectors in the Northern Virginia and Hampton Roads regions are placed at approximately 1/2 mile spacing. This density is a product of early requirements for incident detection that have proven ineffective and perhaps unnecessary. There are other important uses of the data that likely have different requirements for detector placement than the original incident detection focus. For example, there is a desire to derive travel time estimates from the point detector data for the purpose of performance monitoring. To do this, the detectors are to be placed so as to effectively sample the conditions on a freeway. Unfortunately, little guidance exists on how to place detectors for effective sampling.

The purpose of this research project was to develop a decision support methodology to identify the optimal locations of a finite set of point detectors on a freeway corridor in order to minimize the error in travel time estimation, within the constrains of available capital and maintenance funding. Case studies of freeway sections in three regions were conducted to demonstrate the utility of the newly developed tool. While there are potentially other important uses of the data collected by freeway point detectors, the recommendations in this report deal specificaly with the issue of travel time estimation.

The investigators found that the placement of detectors for the dvelopment of accurate travel time estimates will vary by location based on specific conditions. Arbitrary, evenly spaced detectors do not necessarily result in accurate travel time estimates, With carefully placed detectors that are well maintained, travel time estimates can be derived with an acceptable level of accuracy from point dtection, under incident-free travel conditions. The methods developed in this research effort including the GPS data collection and the mathematical tool are effective in determining preferred detector locations when the objective is to minimize travel time estimate error. There is evidence that VDOT can reduce the number of detectors that are currently maintained by TMCs and can deploy far fewer than the 1/2 mile spacing guidelines, resulting in significant cost savings in both capital and operations and maintenance costs. Using the results of the Northern Virginia case study on I-66 EB where there are 20 detector stations currently deployed, the tool identified minimum travel time errors when data are assumed to be coming from 11 of those stations, a reduction of 45%. Data from VDOT's Traffic Monitoring System place the ongoing cost of a detector station at approximately $10,500. That results in an annual savings of $94,500 for this 11-mile roadway segment alone.

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Item 6

Bridge Deck Service Life Prediction And Costs

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR4 • 2007

The service life of Virginia's concrete bridge decks is generally controlled by chloride-induced corrosion of the reinforcing steel as a result of the application of winter maintenance deicing salts. A chloride corrosion model accounting for the variable input parameters using Monte Carlo resampling was developed. The model was validated using condition surveys from 10 Virginia bridge decks built with bare steel.

The influence of changes in the construction specifications of w/c = 0.47 and 0.45 and w/cm = 0.45 and a cover depth increase from 2 to 2.75 inches was determined. Decks built under the specifications of w/cm = 0.45 (using slag or fly ash) and a 2.75 inch cover depth have a maintenance free service life of greater than 100 years, regardless of the type of reinforcing steel. Galvanized, MMFX-2, and stainless steel, in order of increasing reliability of a service life greater than 100 years, will provide a redundant corrosion protection system.

Life cycle cost analyses were conducted for polymer concrete and portland cement based overlays as maintenance activities. The most economical alternative is dependent on individual structure conditions.

The study developed a model and computer software that can be used to determine the time to first repair and rehabilitation of individual bridge decks taking into account the time for corrosion initiation, time from initiation to cracking, and time for corrosion damage to propagate to a state requiring repair.

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Item 7

Parameters Governing the Corrosion Protection Efficiency of Fusion-Bonded Epoxy Coatings on Reinforcing Steel

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR5 • 2008

The purpose of this study was to investigate various epoxy coating and exposure parameters to determine their efects on the corrosion of reinforcing steel. The parameters investigated were: chloride content at the bar depth, coated bar corroded area, corrosion product color under the coating, epoxy coating adhesion, coating color, coating damage (holidays and holes), coating thickness, TGA, DSC, and EDS analysis and SEM coating cracking investigation.

This study demonstrated that the ECR coating samples extracted from concrete exhibited cracking compared to the new ECR samples in which the coating cracking was limited to only one sample. The coating cracking correlated with the amount of chloride at bar level, residual adhesion of the epoxy to the steel surface, and the percent moisture in the coating. The coating cracking is also related to the change in color of the epoxy and indicates that the epoxy coating degradation in concrete influences the surface condition of the coating.

The DSC results showed that both the extracted epoxy coating samples as well as new samples are not fully cured during the manufacturing process. Additionally, the extracted epoxy coating samples investigated presented significant permanent adhesion loss with little or no epoxy coating residue present on the bar surface, while the EDS analysis showed that once adhesion is lost, corrosion will proceed unimpeded under the coating even in the absence of chlorides.

The parameters that presented a direct correlation with the observed corrosion activity were the number of holidays and the number of damaged areas per unit length of bar. The results also show a distinct loss of quality control in the handling and possibly storage of new coated bars. The new ECR samples had significantly higher damage density than the samples extracted from concrete, while there was no change in the number of holidays and cure condition.

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Item 8

Access Control Design on Highway Interchanges

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR7 • 2008

The adequate spacing and design of access to crossroads in the vicinity of freeway ramps are critical to the safety and traffic operations of both the freeway and the crossroad. The research presented in this report develops a methodology to evaluate the safety impact of different access road spacing standards. The results clearly demonstrate the shortcomings of the AASHTO standards and the benefits of enhancing them. The models developed as part of this research were used to compute the crash rate associated with alternative section spacing. The study demonstrates that the models satisfied the statistical requirements and provide reasonable crash estimates. The results demonstrate an eight-fold decrease in the crash rate when the access road spacing increases from 0 to 300 m. An increase in the minimum spacing from 90 m (300 ft) to 180 m (600 ft) results in a 50 percent reduction in the crash rate. The models were used to develop lookup tables that quantify the impact of access road spacing on the expected number of crashes per unit distance. The tables demonstrate a decrease in the crash rate as the access road spacing increases.

An attempt was made to quantify the safety cost of alternative access road spacing using a weighted average crash cost. The weighted average crash cost was computed considering that 0.6, 34.8, and 64.6 percent of the crashes were fatal, injury, and property damage crashes, respectively. These proportions were generated from the field observed data. The cost of each of these crashes was provided by VDOT as $3,760,000, $48,200, and $6,500 for fatal, injury, and property damage crashes, respectively. This provided an average weighted crash cost of $43,533. This average cost was multiplied by the number of crashes per mile to compute the cost associated with different access spacing scenarios. These costs can assist policy makers in quantifying the trade-offs of different access management regulations.

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Item 9

Use of Manufactured Waste Shingles in a Hot-Mix Asphalt Field Project

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R11 • 2007

The Virginia Department of Transportation (VDOT) is faced with trying to maintain its roads with materials whose cost is increasing at an alarming rate. The significant cost increase for asphalt concrete, which is used to pave a majority of Virginia's roads, is primarily linked to the cost increase for the petroleum products from which asphalt binder is produced. In the 1990s, VDOT developed a special provision to allow contractors, upon request, to use waste shingles in asphalt concrete. These shingles contain approximately 20 percent asphalt, which replaces part of the expensive virgin binder in the mix. In 2006, a contractor requested that the manufactured waste shingles be allowed on an overlay paving project in southeast Virginia.

The 4.1-mile two-lane section was paved using a surface mix containing 5 percent shingle waste and a surface mix containing 10 percent recycled asphalt pavement for comparison. Density tests were performed on the pavement, and various laboratory tests such as permeability, fatigue, tensile strength ratio, rut, and binder recoveries were performed on samples of mix collected during the construction of the section. Both the field and laboratory test results indicate that the behavior and performance of the two mixes should be similar.

The study recommends that VDOT's Materials Division prepare a permanent special provision to allow the manufactured waste to be used in asphalt. Because of the success of using manufactured waste, tear-off shingle waste resulting from replacing home shingles should also be investigated.

Although manufactured waste shingles are available only in the northeastern part of North Carolina, several Virginia counties near the North Carolina border may be able to realize a cost reduction if shingles are used in the future. There is potential for approximately 50,000 tons of hot-mix plant mix containing waste shingles to be supplied to VDOT's Hampton Roads District per year. It was estimated that as much as $2.69 could be saved for every ton of asphalt that uses the waste shingles.

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Item 10

Safe Travel for Virginia's Non-Motorized Road Users: A Comprehensive Review of Pedestrian and Bicycle Laws in Virginia and the United States.

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R5 • 2007

This study involved conducting a comprehensive review of Virginia's laws regarding the status, rights, and responsibilities of pedestrians and other non-motorized users of Virginia's transportation network and comparing them with the status, rights, and responsibilities of motorists.

The analysis of Virginia's pedestrian-related statutes and their comparison with those of other states and the Uniform Vehicle Code revealed a number of areas where the Code of Virginia is unclear as to the rights and responsibilities of pedestrians and motorists. For example, pedestrians are directed to use crosswalks and intersections only "wherever possible," which is a vague standard. The Code also contains several pedestrian-related provisions where the language is ambiguous, and there are also provisions in the Code that potentially conflict with one another. In addition, the Code is silent in a number of areas that could increase pedestrian safety, such as a due care requirement, a requirement that pedestrians obey the directions of law enforcement officers, and a requirement that pedestrians yield the right of way to emergency vehicles.

Bicycles were used as a proxy for "other non-motorized users" because Virginia laws governing bicyclists frequently govern individuals using electric personal assistive mobility devices, electric power-assisted bicycles, roller skates, skateboards, or mopeds (e.g., ss 46.2-800, 46.2-904, and 46.2-905 of the Code of Virginia). However, Virginia's bicycle laws were updated relatively recently by the General Assembly and were found to be generally clear and in harmony with those in the majority of other states.

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Item 11

Framework for Selection and Evaluation of Bicycle and Pedestrian Safety Projects in Virginia

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R8 • 2008

The Virginia Department of Transportation's (VDOT) Bicycle and Pedestrian Safety (BPS) Program provides funds for implementing short-term, low-cost bicycle and pedestrian safety projects in Virginia. This initiative is administered by evaluating each project application on a case-by-case basis. The current evaluation process does not include a direct linkage between the selection criteria and conditions at the site that might be hazardous to non-motorized travel. This significant limitation has resulted in the desire for a new methodology for project selection and evaluation.

This study developed a four-component framework for administering the BPS Program. In this framework, analysis procedures were identified for each component that can be used for identifying hazardous locations, determining causal factors, establishing performance measures, and determining potential countermeasures. The framework was than applied for selecting an appropriate safety treatment and for prioritizing a set of safety projects requested for funding.

To demonstrate the applicability of the framework, five case studies were conducted at locations in and around Charlottesville, Virginia. The prioritization process was demonstrated using the results of the case studies. The study findings showed that the framework synthesis existing practice into a systematic approach for identifying bicycle and pedestrian hazardous locations and selecting appropriate countermeasures for implementation. The study also established the need for evaluation studies on safety treatments after implementation, as the effectiveness of many bicycle and pedestrian safety countermeasures are not well established.

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