Research Digest

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Research Digest

Item 1

Transit Friendly Parking Structure Guidelines: Planning, Design, and Stewardship

NJ DOT

FHWA-NJ-2007-002 • 2007

Parking is a critical concern in our auto-dominated society and has a significant impact on our landscape. Transit facilities, which often include parking, are challenged by many parking related issues. The research problem that Transit Friendly Parking Structure Guidelines seeks to solve is to identify best practices for developing structured parking in downtowns that focus on transit.

The multi-year grant's methodology involved a multidisciplinary effort that utilized faculty and staff of NJIT's Departments of Architecture, Infrastructure Planning, Civil and Transportation Engineering, assisted by Rutgers's Voorhees Transportation Policy Institute and the Urban Land Institute. Grant activities included two graduate design studios, one at Rutgers and one at NJIT, focusing student teams on different aspects of the problem. In addition, several symposia were held at which experts in the field commented on the process. Two related studies, the Urban Land Institute Advisory Panel and Parking Matters furthered the investigation of the subject. Work began in September of 2004 and concludes with the final acceptance of this report in June of 2007.

Transit Friendly Parking Structure Guidelines has three objectives: The first is to present current practice through a comprehensive, multi-disciplinary literature review; through consultation with experts at both the agency and professional levels; and by examining and documenting parking facilities in the field. The second is to offer conceptual designs of facilities at four locations in New Jersey and analyze their feasibility. From this experience, design guidelines and management standards, the third objective, were developed that utilize state-of-the-art practice, specifically tailored to conditions around New Jersey's transit facilities. These were imparted to NJ Transit staff and their consultants through symposia, this report, and a series of presentations. It should be noted that these parameters are finely tuned for the particular application in transit focused downtowns, even though some best practices are gleaned from places that do not fit this description. These guidelines and standards are organized according to three inter-related subject areas: planning, design and stewardship.

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http://www.state.nj.us/transportation/refdata/research/reports/FHWA-NJ-2007-002.pdf

Item 2

Lower Rio Grande Valley Development Council / Hidalgo County MPO Access Management Plan

HIDALGO COUNTY METROPOLITAN PLANNING ORGANIZATION

MS 8109b • 2005

This study was commissioned by the Hidalgo County Metropolitan Planning Organization (HCMPO). The HCMPO is a federally funded program that works with Hidalgo County communities and the Texas Department of Transportation (TxDOT) to plan for the county's future transportation needs.

Since 1998, the Hidalgo County Metropolitan Planning Organization (HCMPO) has included an access management element within the Master Transportation Plan (MTP) Project Selection Criteria. However, this element has not promoted the use of access management techniques in project applications.

On September 25, 2003 the Texas Department of Transportation, Transportation Commission, adopted new rules on access management. These rules direct TxDOT to apply access management on all state owned roads. The rules and subsequent access management manual represent an opportunity for metropolitan and local agencies to practice access management along roadways within their jurisdictions.

Therefore, in April 2004 the HCMPO contracted with Kimley-Horn to study how access management can be applied to local transportation projects. The adjacent chart explains the process used during this study. Below each of these tasks are introduced.

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http://library.ctr.utexas.edu/pdf/8109b.pdf

Item 3

Evaluation of Stabilization of Sulfate Soils in Texas

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 4240-01-1 • 2008

This implementation project was developed to provide technical support to the Texas Department of Transportation (TXDOT) in developing subgrade soil mixture designs in high sulfate soils and to monitor the performance of projects constructed following the guidelines established in Project 4240. Secondly, the researchers were to assess equipment needs of the TxDOT districts, train laboratory personnel in mix design procedures in high sulfate soils, and provide educational materials for TxDOT to train additional personnel.

Mix designs of high sulfate soils for two projects, in the Austin and Laredo Districts, are reported as technical support to districts. The construction and subsequent reevaluation of the project in Eagle Pass is reported to give TxDOT a record of the construction process used in the high sulfate soil on the Second Street project and shows how the project has performed since construction. Evaluation of the 3-D swell procedure shows the test to be repeatable if the density and water source are tightly controlled. A review of the equipment needed for adequate testing of the high sulfate subgrade soils showed that all required equipment can be obtained at minimal cost to TxDOT.

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http://tti.tamu.edu/documents/5-4240-01-1.pdf

Item 4

Evaluation of Traffic Control Devices: Fourth-Year Activities

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 4701-4 • 2008

This project was established to provide a means of conducting limited scope evaluations of numerous traffic control device issues. During the fourth year of the project, researchers completed assessments of five issues: developing an automated process for identifying the start and end of no-passing zones, developing guidelines for the use of pedestrian countdown signals, evaluating the performance of lead-free yellow thermoplastic pavement markings, developing improved guidelines for accessibility issues associated with traffic signalization, and continuing development of the Work Zone Impacts Handbook. The automated no-passing zone activity developed a prototype method of using Global Positioning System (GPS) coordinates to identify the start and end of no-passing zones based on vertical alignment. The activity on pedestrian countdown signals synthesized available information to develop some initial guidelines. The signal accessibility and work zone impacts' activities are producing separate documents that address those issues.

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Item 5

Feasibility Study for Development of Marine Exposure Site: Technical Report

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 5266-1 • 2008

Durability is a serious issue for managers of the U.S. transportation infrastructure. Work remains to be done to improve the service life, life-cycle durability, and both direct and indirect life-cycle cost of reinforced concrete, steel, and other structural materials in all environments throughout the state of Texas. For this project, researchers performed a feasibility study for the development of a marine exposure test site on the Texas gulf coast. The goals of the site are to increase the service life, reduce the capital and maintenance costs, and improve the quality, performance, and safety of transportation infrastructure in Texas through real-exposure research, experimentation, and testing of construction materials and processes.

A literature survey reviews economic studies of durability problems and associated costs, including the costs nationwide and in Texas of deterioration, degradation, and corrosion, and the tangible benefits of improved durability. The project researchers visited and evaluated existing exposure test sites in the U.S. to identify site requirements and the critical success factors for a Texas marine exposure test site. A quantitative cost-benefit analysis was performed considering costs and future benefits in the short-term and long-term. The results demonstrate that the development of a Texas marine test site would be economically feasible and cost-beneficial to Texas.

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Item 6

Risk-Based Framework Using Geographic Information Systems to Identify Transportation Corridors Vulnerable to Development

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-CR8 • 2008

The Virginia Department of Transportation (VDOT) is increasingly involved with the with the land development process in evolving transportation corridors. This process includes consideration of real estate interests, rezoning and permitting approvals, site plans, public utilities, right of way, access management, and the transportation facilities themselves. Localities may compete with one another for economic development and withhold plans for developing corridors or may simply be unaware of development intentions. It is therefore important that VDOT transportation planners anticipate and proactively address future development along corridors to avoid surprise, regret, and belated action.

With many thousands of miles of undeveloped corridors across the Commonwealth, VDOT must prioritize the corridors and corridor sections most in need of immediate attention. This study developed a comprehensive approach using geographic information systems (GIS) to identify and prioritize the needs for protection strategies in countywide corridors. Over eighty GIS data layers sourced from VDOT, Fauquier County, and others were evaluated to determine appropriate factors for the analysis, Layers not available to other counties were ruled out. Layers were selected by adopting principles of risk management, asking experts about the flaws and consequences in corridor protection. Four indicator factors including lateral distance from corridors, proximity to intersection of corridors, proximity to population centers, and proximity to employment centers were used in the analysis to identify parcels with a high likelihood of development. Two constraint factors including protected parcels and economically developed parcels were used to identify very low likelihoods of development and eliminate parcels from the analysis.

Several corridor sections were identified as candidates for further study of protection strategies including early right-of-way acquisition and access management. The density of curb cuts and the average parcel values and development likelihoods were plotted against the centerline mile to suggest the opportunities and costs of risk management. The methodology aims to generate maximum insight by using a manageable number of GIS layers and is repeatable in other cities, counties, and regions of Virginia by using currently available data. The suggested training material for the GIS analysis is (1) the PowerPoint presentation initially developed for the steering committee, and (2) the sample GIS layers and associated files that were used for the Fauquier County case study. Both are available for download at www.virginia.edu/crmes/corridorprotection. The results (relative prioritization of corridor sections) are not dependent on assumptions or steps that may differ from analyst to analyst. In the future, a web- or spreadsheet-based implementation of the layer combination process could be developed for use in presentations and public meetings. The results will help VDOT make the business case for corridor protection, for example, considering cost-effectiveness, return on investment, multiple objectives and stakeholders, and/or cost-benefit ratio. The results (maps of priorities) should highlight the features that confirm and reject the intuition of the planner and analyst. Numerous examples of such insights gained in discussion of the results with Fauquier County planning staff and the steering committee are included in this report.

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http://www.virginiadot.org/vtrc/main/online_reports/pdf/08-cr8.pdf

Item 7

Exploratory Investigation of High-Performance Fiber-Reinforced Cementitious Composites for Crack Control

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)
VTRC 08-R12 • 2008

This study evaluated high-performance fiber-reinforced cementitious composites (HPFRCC), which are mortar mixtures with synthetic and steel fibers. The feasibility of using HPFRCC technology for transportation applications by the Virginia Department of Transportation, such as link-slabs that can replace joints on decks and in thin overlays for reduced permeability, was explored.

HPFRCC has high ductility, is though, and can exhibit strain-hardening that leads to multiple microcracks at large deformations. Such tight cracks prevent the transport of aggressive solutions and improve durability. In this study, mortar batches with high amounts of fly ash were prepared that had satisfactory compressive and flexural strengths, low permeability, and high ductility and toughness. The mixtures with special synthetic fibers exhibited strain-hardening with multiple microcracks. Shrinkage values were high but are not expected to cause distress because of the high tensile strain capacity. Mortar mixtures with fibers did not contain an air-entraining admixture; however, their resistance to cycles of freezing and thawing is expected to be satisfactory. The results obtained in a laboratory environment indicate that using HPFRCC in link (closure) slabs and thin overlays is possible.

The study recommends that field applications be conducted to determine the full potential of this system in the field.

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Item 8

Network Level Pavement Evaluation of Virginia's Interstate System Using the Falling Weight Deflectometer

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R18 • 2008

The Virginia Department of Transportation (VDOT) currently uses the results of automated surface distress surveys to assist in developing pavement maintenance strategies for its interstate and primary roadways. Totaling nearly 27,000 lane-miles, these roadways consist of flexible, rigid, and composite (flexible over rigid) pavements. These video-based surface distress data consist of quantities of distress that are visible in the pavement surface; however, no information regarding the actual structural capacity of the pavement system on a network level is currently available.

This study describes the processes and presents the results of a network-level survey conducted on Virginia's interstate system using the falling weight deflectometer (FWD). The data obtained from this study can be used by pavement engineers to determine the structural capacity of the interstate network and to develop condition forecasting tools to assist with determining future structural conditions. Similar network surveys have been performed by the Kansas, Texas, New Jersey, Indiana, and Oklahoma departments of transportation.

Although it is not yet possible to assign a monetary benefit to the results of this study as these data were not previously available, their benefits to VDOT's Asset Management Division are expected to be great. The use of these data can result in more cost-effective decisions regarding pavement rehabilitation. In a study comparing pavement rehabilitation designs based on visually observable distresses versus pavement rehabilitation designs based on structural capacity using the FWD for sections of interstate pavement in New Jersey, the authors estimated that only 27% of the designs based on visually observable distresses agreed with those based on structural data; 41% of the rehabilitation treatments were underdesigned, and 32% were overdesigned.

The current study recommends that VDOT continue network-level structural evaluation of the interstate system using the FWD and perform similar testing on the primary network.

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Item 9

Performance of a Skewed Semi-Integral Bridge: Volume I: Field Monitoring

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R20 • 2008

This project was developed to enhance the Virginia Department of Transportation's (VDOT) in-house expertise in the design of integral bridges and to provide a resource for consultants performing design work for VDOT. It involved extensive field monitoring of a highly skewed semi-integral (integral backwall) structure. The main purpose was to provide feedback regarding some of the assumptions behind the recently adopted set of integral bridge design guidelines, ultimately leading to reduced construction and maintenance expenses for VDOT.

The project was focused on the long-term monitoring of a skewed semi-integral bridge located on Route 18 over Blues Springs Run in Alleghany County, Virginia. This report presents the results and analysis of field data acquired from various sensors between October 19, 2006 (shortly after the bridge was completed), and March 24, 2008. The results to date indicate satisfactory field performance, with a need for further monitoring.

The main reason for constructing jointless bridges is to eliminate recurring maintenance costs associated with deteriorated bearings and spalled beam ends, commonly encountered with conventional structures. It is estimated that these maintenance expenses amount to approximately $366,000 per year in Virginia. In the past 7 years, integral bridges constituted between 10% and 30% of the total bridges constructed by VDOT, with 24% reached in 2007. VDOT is committed to the design of jointless bridges where practicable, within a clearly defined set of constraints based on the current state of the practice. It may be possible to consider a greater percentage of bridges for integral design through a better understanding of the field behavior.

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Item 10

Evaluation of Using Higher Percentages of Recycled Asphalt Pavement in Asphalt Mixes in Virginia

VIRGINIA TRANSPORTATION RESEARCH COUNCIL (VTRC)

VTRC 08-R22 • 2008

In 2007, the Virginia Department of Transportation (VDOT) decided to allow higher percentages of recycled asphalt pavement (RAP), i.e., more than 20 percent, in hot-mix asphalt with no change in binder grade. Because of this increase, one section of the contract provisions in certain plant-mix overlay schedules around the state had to be rewritten to raise the limit on the proportion of recycled material to 30 percent from the customary 20 percent. The allowance of the higher RAP percentages should result in a lower cost of asphalt mix per ton, especially given the recent rising cost of asphalt cement and virgin aggregates.

The purpose of this study was to estimate the effect of increased RAP percentages on performance and relative mixture cost on specific VDOT paving projects in 2007. Projects using more than 20 percent were conducted in three VDOT districts. In addition, several value engineering proposals for using increased percentages of RAP submitted by contractors were accepted and carried out in another district. Six contractors produced a total of 129,277 tons of mix containing 21 to 30 percent RAP from seven asphalt plants in four VDOT districts. Mix containing less than 30 percent RAP was also sampled and tested for comparison purposes.

Laboratory tests performed on samples collected during production revealed no significant difference between the higher RAP mixes and the control mixes for fatigue, rutting, and susceptibility to moisture. Binder was recovered from asphalt mix sampled during construction and graded to determine the effect of adding higher percentages of RAP.

There were no construction problems attributed to the use of the mix
with the higher RAP percentage. Only slight price adjustments were applied to 2 of the 10 high-RAP projects, and these adjustments were not due to the higher RAP percentage.

Analysis of bid data found that the inclusion of contract specifications that allowed the higher RAP percentages had a small, statistically insignificant impact on the bid prices for surface mix items. However, value engineering proposals received for jobs that were not advertised with the high-RAP specification showed that the use of over 20 percent RAP could reduce costs in at least some cases.

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Item 11

Quieter Pavements Survey

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WS DOT)
WA-RD 688.1 • 2008

This study looked at the performance of quieter pavements in use in the United States of America and Europe with specific emphasis on those states that are using open-graded mixes for both friction or porous courses on an ongoing basis. All States were contacted and 34 states responded with information on their use of open-graded mixes and stone matrix asphalt (SMA) mixes. Eleven states were able to provide an estimate of the range and average service life of their open-graded mixes and three states provided information on the service life of their SMA mixes. Specifications for open-graded mixes and SMA mixes were compiled from 20 states and compared to Washington State's open-graded friction course mix and the open-graded mix used on recent test sections built by the Washington State Department of Transportation.
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http://www.wsdot.wa.gov/research/reports/fullreports/688.1.pdf

Item 12

Dynamic Response of Bridges to Near-Fault, Forward Directivity Ground Motions

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WS DOT)
WA-RD 689.1 • 2007

Research over the last decade has shown that pulse-type earthquake ground motions that result from forward-directivity (FD) effects can result in significant damage to structures. Three typical post-1990 Washington State Department of Transportation (WSDOT) monolithic concrete bridges were chosen to investigate their nonlinear response to FD ground motions (FDGMs) and non-FDGMs. Results showed that significant seismic damage may occur if the structural response is in tune with the period of the velocity pulse of the FDGM. This velocity pulse is a result of fault propagation effects in the near-fault, and occurs when the direction of slip and rupture propagation coincide. The period of the velocity pulse is proportional to the magnitude of the earthquake. The severity of the demand is controlled by the ratio of the pulse period to bridge fundamental periods. As a consequence of this, damage in a bridge with moderate periods (T=0.1s to 1.0s) may be more significant in smaller magnitude earthquakes where the pulse period is closer to the fundamental period of the structure. This was the case for both the MDOF and SDOF analyses of all three bridges in this research. The results showed also that the occurrence of high PGA and/or PGV is only one of several conditions that can cause high demand on the bridges.

Of the three bridges considered, all typical concrete overpasses ranging from 50 m to 91 m in length, all generally survived the earthquake motions with only minor damage to their columns. However, column flexural failure was predicted for one model when subjected to two of the forward directivity ground motions.

SDOF bridge models for preliminary analyses were found to yield slightly unconservative base shears and displacements compared to that of the full bridge models under non-FDGM. For FDGM, the results of a simple SDOF bridge model ranged from very conservative to slightly unconservative. Therefore, nonlinear SDOF analyses are specifically not recommended in the case of FDGM since the results were not consistent. A more detailed MDOF model should be used to assess bridge seismic performance so that SSI and the interaction of the longitudinal and transverse responses of the bridges can be included, particularly if a performance based design or assessment of the bridge is required.
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Item 13

Cost Effective Safety Improvements on Two-Lane Rural State Roads in Washington State

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WS DOT)

WA-RD 695.1 • 2008

Two-lane rural highways in Washington State represent approximately 4,900 miles. From 1999 to 2005, 42.8% of the fatal collisions reported on state highways occurred on two-lane rural highways. WSDOT determined that the traditional high collision frequency location approach do not necessarily reflect the safety needs of two-lane rural highways. The research team first conducted as systematic review of the network and then developed a proposed decision-matrix for the selection of countermeasure on two-lane rural highways. A rate-based approach was used to show various trends across different user groups, geometric features, and contexts. It is generally accepted that the context of the two-lane rural highway would influence countermeasure choice. The project tested two contextual surrogates for the identification of particular two-lane rural highways that may exhibit safety characteristics that are different from the rest of the network. First proximity to K13 schools (in half mile increments up to 2 miles) was tested to determine whether it could assist in identifying more developed areas, such as rural town centers. It showed promise and identified areas with lower collision severity but higher collision frequency along with a higher incidence of pedestrian related collisions. Second proximity to urban boundaries (increments up to 2 miles) as means to identify transition areas showed less promise. The decision-matrix summarizes countermeasure effectiveness by collision group and also make reference to the findings from the systematic assessment. The project also included a limited before-after study of centerline rumble strip installations (CLRS). Although results indicate some benefits and possible collision increases, caution is noted in terms of application of these findings because of small sample sizes in the analysis and the fact that roadside characteristics could not be incorporated in the evaluation process. The report recommends the development of safety performance functions that would incorporate these features. These multivariate approaches could further assist the department in the development of system-wide and corridor level approaches for two-lane rural highways.

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Item 14

Effect of Intermediate Diaphragms to Prestressed Concrete Bridge Girders in Over-Height Truck Impacts

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WS DOT)

WA-RD 696.1 • 2008

The objectives of this study are three-fold: (1) develop/validate dynamic numerical finite element models to simulate the prestressed concrete bridge girders with intermediate diaphragms, (2) perform numerical parametric study to evaluate the effect of the critical factors on design of intermediate diaphragms, and (3) provide recommendations and guideline to better design of intermediate diaphragms to impact of over-height trucks. The conducted study aims to shed light on improved impact protection of prestressed concrete bridge girders with intermediate diaphragms and aid the WSDOT in design, analysis, and construction of prestressed concrete bridges.

The findings of this study assist in developing the specific standard of practice (such as, amendments to AASHTO standard specifications, WSDOT standard specifications, policy directives, implementation manuals, or operating procedures) for design of prestressed concrete bridge girders with intermediate diaphragms. More importantly, the proposed recommendations and guideline help the bridge engineers to make better design decision for prestressed concrete bridges.

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