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Research Bulletin

FY2006 Research Problem Statement Solicitation Completed

The FY 2006 solicitation for research problem statements has been completed. Compared to 13 statements we received last year, the 50 research problem statements we received this year was a great success. They were submitted by NDOT employees, the University of Nevada at Reno (UNR), the University of Nevada at Las Vegas (UNLV), the Desert Research Institute (DRI) and consulting firms. The problem statement topics covered a variety of areas including Materials, Construction, Traffic/Safety, Structures, Maintenance, Environment, Planning, Landscaping, and Human Resources.

The successful completion of this year's solicitation is attributed to the staunch support and leadership of NDOT top management, particularly our Deputy Director, Susan Martinovich. It is also ascribed to the support and participation of NDOT division heads and managers. We are particularly grateful to the following people who submitted statements: Dennis Coyle, Thor Dyson, Reed Gibby, Denise Inda, Tracy Larkin-Thomason, Russ Law, Mike Lawson, Susan Luescher, Joe Martinez, Heidi Mireles, Michael Murphy, Rick Nelson, Chuck Reider, Sandi Stanio, Dave Titzel, Kathleen Weaver, and Dean Weitzel from NDOT; George Bebis, Cahit Evrensel, Yanyao Jiang, Kwang Kim, Selva Raja, Raj Siddharthan, M. Saiidi Saiidi, David Sanders, and Zong Tian from UNR; Nader Ghafoori, Mohamed Kaseko, Barbara Luke, Srinivas Pulugurtha, Shashi Nambisan, and Harry Teng from UNLV; Vic Etyemeezian and John Hallett from DRI; and also Jason Puccinelli from Nichols Consulting Engineers.

Based on the established process and criteria, the problem statements have been prioritized by the Research Advisory Committee. Requests for proposals have also been issued for the selected problem statements. The approved research projects will start at the beginning of fiscal year 2006 on October 1, 2005.

In This Issue

PERFORMANCE, DESIGN, AND DETAILING OF TWO-WAY COLUMN HINGES

Two-way hinges are commonly used in bridge columns to eliminate column moment transfer to the foundation. Figures 1 and 2 show two examples of two-way hinges in Reno and Las Vegas. Currently the shear capacity of two-way hinges is determined using the shear friction method (SFM). When subjected to lateral forces such as earthquake load, hinges are under a combination of axial load and shear, as well as moment. The shear transfer mechanism is different from that assumed in the standard shear-friction theory. However, SFM is used because very limited studies are available and no rational code provisions for two-way hinge design exist.

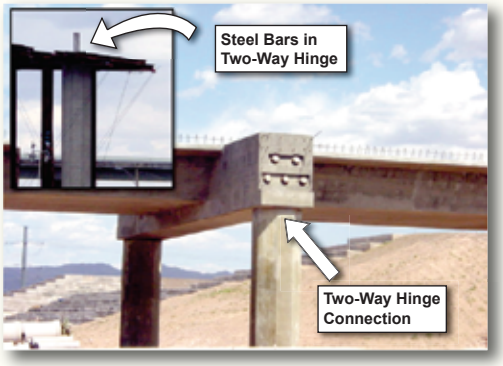

Figure 1 - Two-way hinges at column top in I-515/I-215 Interchange in Las Vegas

Under a current research project funded by NDOT, a preliminary hinge design method was developed, refined, and finalized based on shake-table tests of large-scale column models. A rational mechanism was used as the basis of the proposed method (Fig. 3). To verify and identify critical parameters, five 1/3-scale reinforced concrete bridge column specimens with two-way hinge details were tested (Fig. 4). The main objective of the tests was to investigate the performance of two-way hinges subjected to combined vertical and lateral loads, including seismic forces, and use the results to develop a comprehensive and reliable design method for practical application. Several major parameters that may affect the hinge and column performance were included in tests, such as the level of axial load, column aspect ratio, column and hinge/steel ratio, and the size of hinges.

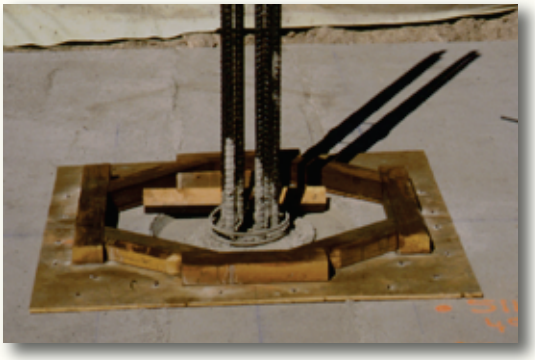

Figure 2 - Two-way hinges at the base US-395 bridges in Reno

The test results provided useful information based on which preliminary design method was evaluated and modified. The data showed that regardless of the level of axial load, size of the hinge, hinge/steel ratio, and the column aspect ratio, the shear capacity of two-way hinges was much lower than the shear-friction theory estimates. A procedure for two-way hinge design including a rational method to determine the shear capacity of the hinge was proposed and evaluated using the test data. A representative design example was used to demonstrate the application of the proposed method (Fig. 5). The study also included a method to estimate hinge rotation during extreme seismic events and to aid designers in calculating a safe hinge gap.

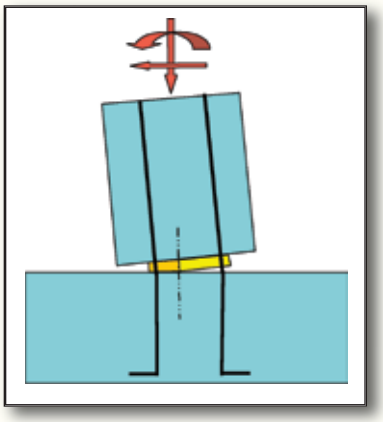

Figure 3 - Mechanism used in the proposed new method

Figure 4 - Shake table test setup and close-up of a hinge after failure

For more information on this project, please contact Dr. M. Saiid Saiidi at the University of Nevada at Reno via email at saiidi@unr.edu

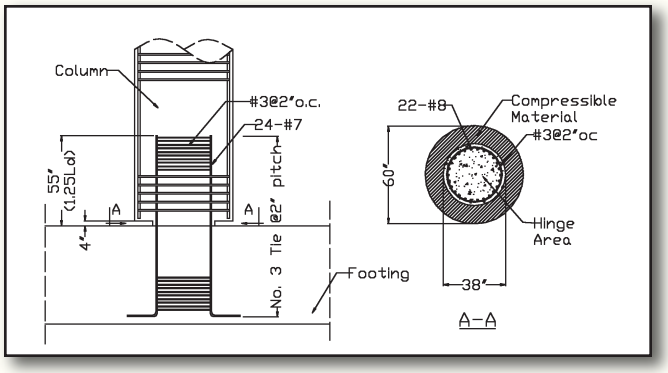

Figure 5 - Design example

Product Evaluation Committee (PEC) Meeting Recap

APPROVED

Field Test of Anti-Graffiti Coatings

At its March 1, 2005 meeting, the PEC approved a field test of permanent anti-graffiti coating systems. On-going efforts in developing acceptance criteria for this product category demonstrated that, in addition to compliance with the specifications and consideration of inventory issues regarding removal products, the department's acceptance criteria for anti-graffiti coatings should include product field-testing. Establishing a test section will enable NDOT to monitor product performance and also to obtain adequate data regarding performance of these products prior to placing qualified products on the QPL.

One of the products proposed for testing is the SEI Graffiti Proofer GPA 100(1) from SEI Chemical, Inc. It is a penetrating, non-sacrificial, non-yellowing and non-glossy graffiti proofing treatment. According to the submitted product literature, the product does not deteriorate from ozone, ultraviolet rays, salt spray, or acid rain. The SEI Graffiti Proofer GPA 100(1) allows for expansion, contraction, and temperature extremes. Also, it allows moisture to escape while not allowing moisture to enter the structure. It is a coating with high slip characteristics, which prevents paint and other discoloring agents from adhering when this product is pre-applied to concrete.

SEI Chemical Inc. representative, Dan Rosenblat, addresses the PEC members at the March meeting.

The Landscape Architect will work with theDistricts' maintenance forces to develop a test protocol (work plan) for the proposed trial installation. The work plan will include the exact location of the test section, description of evaluation criteria, test cycle, test duration, etc. Once the test is completed, the investigators will write a final report and submit it to the committee for consideration and action. All elements of current acceptance criteria (meeting standards, compliance with inventory issues in terms of use of removal products, and successful field testing) must be met before products can be approved for use on NDOT projects.

APPROVED

Change to Acceptance Criteria for Guardrail Off-Set Blocks Made of Recycled Plastic

In the past, evaluation and approval of off-set blocks for W-beam and Tri-beam guardrails were based on vague criteria prescribed under subsection 618.02.01(b) of NDOT Standard Specifications. Recently, the Specification Section developed a position paper that describes the department's acceptance criteria including material, design, and performance requirements for wood, metal, and recycled plastic offset blocks. The current design requirements for offset blocks are shown in sheets R-8.5.1, R-8.4.1, and R-8.4.1.1 of the Standard Plans. The developed acceptance criteria include a requirement that all guardrail offset blocks must conform to AASHTO's "A Guide to Standardized Highway Barrier Hardware" and be tested according to NCHRP 350 test requirements.

Our Design Manual allows use of the plastic offset blocks with either wood or metal posts. Plastic offset blocks are normally dark gray or black, therefore, they do not add or detract from the visual presence of the guardrail system. The proposed requirements for offset blocks made of recycled plastic are as follows: 1) D1.4 - Gravitation Pendulum from Appendix D of NCHRP 350 with an impact equivalent to 35 mph or higher. The results must indicate that the product will maintain its structural

Continued on next page

integrity during initial vehicle impact under service conditions; 2) ASTM D6108 - Comprehensive Properties of Plastic Lumber and Shapes; 3) ASTM G90- Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight; and 4) ASTM D256, Method A- Determining the Izod Pendulum Impact Resistance of Plastics.

All approved recycled plastic offset blocks must meet the new requirements. Products that already have been approved and listed in the QPL must comply with the new requirements to ensure that these products are able to provide adequate performance given prescribed service life and conditions.

The Product Evaluation Committee members at their March meeting.

APPROVED

Change to Acceptance Criteria for Soundwalls

The PEC approved a request from the Bridge Division to change our current requirements listed in the Soundwall Application Package, which is part of the Soundwall System Evaluation Manual. The manual was prepared in 2000 to establish acceptance criteria and methods by which non-traditional soundwall systems will be evaluated by the department. As products have been submitted and evaluated for compliance with established acceptance criteria, the necessary revisions to these criteria have been identified. While several changes are being proposed, specific details of some proposed revisions would be determined in the future.

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Research and Technology Review
Is published quarterly by the NDOT Research Division. Its purpose is to provide the latest information on the NDOT research activities including product evaluation and other pertinent research topics.

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If you have comments or need additional information regarding any of the topics discussed in this issue please contact the Research Division at (775) 888-7223.

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