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Bridge Deck Asphalt Plug Joint

By Dr. Nader Ghafoori

A bridge joint can be defined as the area between adjacent bridge deck spans or the bridge deck and abutment. The expansion joint is the device used to support the surfacing or provide a running surface across this gap. Bridge deck expansion joints play an important role in the functioning of a bridge structure. They allow for expansion and contraction movements resulting from thermal changes, live loads, physical properties of materials and other external forces.

The general classification for accommodating a large range of bridge movement can be grouped into small (with maximum of 1.8 inches), medium (between 1.8 and 5 inches), and large (with minimum of 5 inches) movements. For each type of movement there are different types of bridge deck joints, some of which can span between small, medium, and large movements. In the category of small movement joints, those most frequently used are the sliding plate joint, poured seal, compression seal, butt joint, and asphalt plug joint (APJ). For the medium movement joints, finger joint, and strip seal are common. In the category of large movement joints, the most common ones are bolt-down panel joint, modular elastomeric seal, inflatable neoprene seal, and reinforced elastomeric joint.

Although water on bridges creates most problems, poor design, inferior materials, and inadequate construction or maintenance have been considered as problems that cause the premature failure of expansion joints. Several factors should be taken into account in designing expansion joints including bridge type, riding quality, skidding resistance, vehicle loads, movement resistance, fatigue, climate condition, waterproofing, and drainage. Inspections for deck joint maintenance are conducted at 2-year intervals. Debris collection in deck joints and leak in sealing are the most common problems leading to their deterioration or failure.

In a recent study it was found that over 25% of the NDOT District III bridges have experienced failure of their newly constructed bridge deck asphalt plug joints. This premature failure has been observed in various bridge types having different characteristics and movement decks. While designed for 5 to 8 years of service, these deck joints need significant maintenance within six (6) months of their installation.

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In an attempt to develop various alternative solutions to the problems associated with asphalt plug joints, an NDOT-sponsored project is conducting an investigation to (1) identify the problems and causes associated with this type of bridge deck movement device, (2) explore the available literature and unpublished information related to the identified problems pertaining to materials, design, construction, drainage, and maintenance, (3) propose a plan for evaluating selected alternative techniques for modification/alteration in design, construction methods, and maintenance strategies, (4) analyze the proposed modifications/alterations in order to recommend the most viable solutions for implementation and further evaluations, (5) develop a laboratory testing program to examine the selected alternative solutions, and (6) propose a field verification system. It is hoped that the findings of this investigation will result in improved bridge deck asphalt plug joint systems used by the Nevada Department of Transportation and other users.

INNOVATIVE SAFETY TECHNOLOGY FOR I-580 FREEWAY

By Roma Clewell

On October 30, 2008, members of the Nevada Department of Transportation (NDOT) Research staff were invited to join the Southwest Bridge and Preservation Working Group on a tour of the I-580 Freeway Extension Project. The extension of I-580 between Carson City and Reno, Nevada, begins at the Bowers Mansion interchange and connects nine (9) miles further at the Parker Ranch Road interchange.

The project has focused on the safety of the traveling public by adding the following innovative techniques to the project:

A taller, **42-inch barrier rail** will be employed along the entire length of the I-580 Freeway Extension corridor as opposed to the standard 32-inch barrier rail typically used. This taller barrier rail will provide an additional level of safety for higher profile passenger and commercial vehicles traveling along the new freeway, provide a measure of wind protection on all of the bridges and aid in mitigating tire noise projecting from the pavement into the surrounding valleys.

Full-width shoulders will provide an area where drivers can pull off of the main roadway and out of traffic in the event of an emergency or if they experience vehicle trouble. Shoulders are provided on both the inside and outside in each direction so that drivers will only have to cross over a maximum of one lane to reach the safety of the shoulder. Full-width shoulders are also useful for emergency vehicle access and snow storage during severe winter storms.

Drainage ditches not only serve the purpose of collecting water and directing it away from the roadway, they also aid in providing rock-fall protection along the highway as it traverses the mountainous terrain. Rock-fall models were run to simulate the length and contours of the slopes above the freeway to help determine the size of ditch required to catch falling rock without it bouncing onto the freeway.

Two emergency turnarounds will be located along the new freeway, spaced equally from the two interchanges, in order to provide enhanced emergency vehicle response times. These locations also provide a safe place for Highway Patrol officers and NDOT maintenance crews to turn around between interchanges during their patrol.

Adequate lighting levels and lighting placement are critical factors in enhancing safety along any roadway. This facility will be lit in all areas where drivers' decisions are made and at interchanges to ensure that on- and off-ramps, signage, and vehicles entering the roadway are visible. Lighting will also be provided at undercrossings and snow-chain installation areas. For the mainline freeway, the roadway will not be continuously lit in this rural area, to match the surrounding area.

Snow fencing will be installed along various areas of the alignment in order to minimize the potential for snowdrifts to build up on the roadway and reduce the impact of blowing snow during high winds. Special fencing designed to route migrating deer under the freeway at natural channels will also be placed along the freeway alignment in areas with known mule deer populations. The fence will be high enough to prevent the deer from jumping over it.

An automated bridge anti-icing system will be installed on some of the bridge decks. The system monitors the atmospheric and pavement conditions then engages small sprinkling devices when icy/snowy conditions exist. These devices will spray an environmentally-safe solution onto the bridge deck to inhibit the formation of ice. These systems have been used in states such as Minnesota and Pennsylvania and have proven successful in minimizing dangerous icy road conditions during winter months.

Dynamic Message Signs (DMS) will be installed to provide drivers with advance warnings of unusual or potentially dangerous conditions. These signs are capable of displaying warnings such as inclement weather or high wind advisories, road and lane closures, and traffic incident advisories. The DMS can also display alternate route suggestions for drivers in the event of road closures or unusual events impeding freeway traffic. Both the anti-icing systems and DMS will be connected with NDOT's District 2 Traffic Operations Center to facilitate 24-7 management and deployment of these safety devices.

Access hatches and staircases were designed throughout several of the bridges to enhance bridge repair and inspections. Another important bridge design is the slanting of surfaces to minimize graffiti access.

The above mentioned features are only a few of the features showcased. It doesn't describe the size of the Galena arched bridge, or discuss the innovative use of cast-in-place culverts. NDOT truly looks to the future in designing for the present.

New Names and Faces in Research

The NDOT Research division has a new staff profile pictured left to right: Roma Clewell, Product Evaluation Coordinator; Heidi Englund, Research Library Assistant III; Tie He, Research Chief; Ken Chambers, Research Coordinator; and Gizachew Zewdu, Research Analyst.

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About NDOT's R&T Review

The NDOT Research Division administers the Department's research, development and technology transfer program and serves as the "clearing-house" for product evaluations.

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 information and other pertinent research topics.

If you have comments or need additional information regarding any of the topics discussed in this issue, please contact the Research Division.

Edited by

Gizachew Zewdu

Research Analyst

LIBRARY CORNER

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Also, look at our webpage on the NDOT Homepage under, "Reports and Publications", for our research publications.

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