Continued From Previous Page

cap is used. This detail allows for easier assembly of the connection in the highly congested bent cap region. Cyclic experimental testing of the precast girder, cast-in-place sub-structure bridge system is the next phase of the project. The variables will include the placement and magnitude of post-tensioning; splice type and amount of cast-in-place concrete.

You think you have a hard time working under pressure

Library Corner

Coming soon to a computer on your desk:

The NDOT research Library!

Heidi Wood, Research Librarian, is in the process of putting the entire Nevada Department of Transportation Research Library online.

Soon more information and instruction on how to access the library online will be provided. But for now,

Questions or comments, please call Heidi, ext. 7895, Research Library, Room 115, NDOT Headquarters

Nevada Department of Transportation
1263 S. Stewart Street
Carson City, NV 89712

First-Class
U.S. Postage
PAID
Carson City, NV
Permit No. 15

RESEARCH AND TECHNOLOGY REVIEW
Summer 2006
Published by the Nevada Department of Transportation, Research Division

Volume 15 **Number 2**

The 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 evaluation and other pertinent research topics.

The Nevada Department of Transportation
1263 S. Stewart Street
Carson City, Nevada 89712

Governor, Kenny C. Guinn
Jeff Fontaine, P.E., Director

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.

Editor, Roma Clewell

RESEARCH AND TECHNOLOGY REVIEW
Summer 2006
Published by the Nevada Department of Transportation, Research Division

Research Bulletin

DOT RESEARCH IN PROGRESS

Winter Maintenance Improvements in Nevada - Phase I

Efficient, fast snow removal is important in different regions of Nevada, which frequently experience substantial snowfall every winter. Snowplow operations must respond more quickly and more effectively with the ever-increasing public demand for clear and dry roads. This was particularly true of the last two snow seasons, especially the winter of 2005 with near record snowfall in the northern part of the state.

The major challenge is the need for high-speed plowing on the heavily traveled, multilane freeways and other major rural and urban roads. There is a need to improve safety of the motoring public by removing snow and ice from the road and depositing materials that improve traction.

Snowplows operate in the worst traffic conditions, i.e. completely covered roads, very low tire traction, visual whiteout, blowing snow, headlight glare, obscured windows, and objects hidden by snow. In addition, mountainous terrain in many areas of Nevada poses a special risk to snow plow operators especially at night.

Efficiency, snowplow operators' safety, and the safety of motorists and passengers on Nevada roadways are all major concerns. The selection of winter maintenance equipment suitable for the Nevada conditions is critically important as well.

Snow Covered Lights

Studies reporting on the visibility problem during snow plowing operations show that glare caused by back-scattered light reflected from falling snow and fog affects forward visibility of snowplow operators.

The snow blowing over the top of the moldboards (splash) also creates hazards for both plow operators and drivers following the snowplow. Another serious problem appears as the snow is entrained in the wake of the snowplow (snow cloud), which reduces visibility for following motorists. This is summarized in Table 1.

New Research Continued on Next Page

In This Issue

New Research Continued From Previous Page

Glare	=	back scattered light reflected from falling snow	reduction of visibility for snow plow operators
Splash	=	snow blowing over the top of moldboards	
Cloud Snow	=	snow entrained in the wake of snow plow	reduction of visibility for drivers following snowplows

Table-1 Visibility Hazards

The Nevada Department of Transportation (NDOT) is sponsoring a new study through University of Nevada, Reno (UNR), with Cahit Evrensel, Yanyao Jiang and Kwang Kim as principal investigators.

The main goal of the study is to recommend ways to improve the visibility for the snowplow operator and the visibility of the snowplows by the motoring public.

The three major types of visibility improvements are identified in terms of 1) Optical; 2) Mechanical; and 3) Electronic means:

1) Optical means of improving visibility: The research team has initiated a survey of 25 northern state Department of Transportations to identify different techniques used to improve visibility during snow plow operations. One of the main sections of the survey is concentrated on lighting. A preliminary result of this work in progress is the preference toward LED lights, especially for improving the visibility of the snowplow truck for the drivers following it.

2) Mechanical means of improving visibility: Recent work by the research team identified the snow cloud formation behind the snowplow truck as a major issue. The snow cloud severely degrades the visibility of the drivers following the truck and causes snow buildup on the back of the snowplow truck covering brake, tail, and warning lights, further hindering the visibility of the snowplow truck for the motoring public. Hence, the primary aims of the current study are to minimize the snow buildup on the rear lights and decrease the size of the snow cloud.

To properly address this issue and potentially help with other visibility concerns UNR researchers have initiated Computational Fluid Dynamics modeling of the flow around a snowplow truck and verified the results by comparing with the published data for a simplified model. A typical result of flow trajectory around a generic snowplow truck traveling at 35 mph is shown in Figure 1.

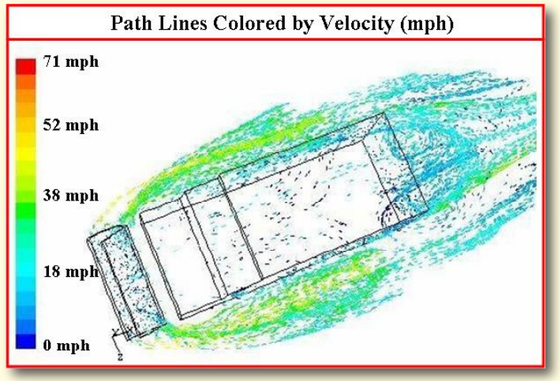

Fig 1. CFD simulation of airflow around a generic snowplow truck traveling at 35mph

As this result of modeling indicates, the recirculation zone is the main cause of snow buildup on the rear section of the truck. An airfoil on the upper back of the snowplow truck is being considered to address the issue. A Computational Fluid Dynamics model of one of the NDOT snowplow trucks is being developed that explores the effectiveness of different airfoil designs. Designs selected based on this computer model, will be recommended to the NDOT for field-testing.

Other major causes of low visibility are falling snow and fog. It is possible to reduce the concentration of falling snow within a certain distance in front of the maintenance vehicle by using a mechanical method. The UNR team is studying the feasibility of using an

New Research Continued on Next Page

New Research Continued From Previous Page

air blower to blow off the falling snow to improve the visibility for the snowplow operators. Experimental testing and numerical modeling will determine the power and the proper nozzle design in order to achieve a cost effective visibility enhancement.

3) Electronic means of improving visibility: Product and literature studies were made in order to discover methods and technologies that could be used to improve road visibility for snowplow operators and thus improve the overall safety of snowplow operations. The UNR research team is considering a collision warning system, which is composed of a radar antenna and a display unit, to detect solid objects in the pathway of the snowplow truck and then provide warnings to the operator through a mixture of lights and sounds. The system can provide snowplow operators with advance warning of obstacles and vehicles in their path during low visibility conditions such as snowstorms. The initial test run of the snowplow with the radar system is currently underway.

Seismic Performance of Integral Connections Between Cast-in-Place Substructures and Precast Concrete Superstructure

Widening of existing bridge structures or new bridge construction in heavily congested areas has become necessary due to increasing traffic demands on Nevada's highway systems. The typical cast-in-place construction method utilizes formwork and falsework over traffic lanes that potentially create unsafe conditions to both the driving public and construction workers. Additional consequences are traffic delays and increased construction time at the job site. To address this concern, NDOT has contracted with the University of Nevada, Reno (UNR) for the services of Dr. David H. Sanders, Associate Professor of Civil Engineering and graduate student Kevin L. Almer. They are investigating construction details using precast girders and cast-in-place substructures. The use of precast girders increases safety by eliminating the need for falsework over the traffic lanes and decreases traffic delays by reducing the construction time at the job site. However, the connection details between the precast components and the cast-in-place components are not well defined due to lack of research and design guidelines.

There, that should be enough rebar

To develop practical construction details, researchers at UNR have surveyed several other state Departments of Transportation for their state of practice and completed the design and analysis of the first two of four test specimens. The initial system of choice uses post-tensioning to splice the girders together creating an integral connection. It allows the bridge to be continuous for dead load, and provides negative moment continuity over the bent cap so no additional joint reinforcement is needed in the deck. In order to completely develop an integral connection, a positive moment connection is required. Mild reinforcement extending from the soffit of the girder and lap-spliced across the bent

Continued on Next Page