WINTER 2008
VOLUME 17, ISSUE 1

RESEARCH AND TECHNOLOGY REVIEW

"CONGESTION AHEAD"

by Hualiang Teng, Ph.D.

There are many entertainment facilities in Las Vegas that organize major events (e.g., conventions) which tend to cause short term surges in traffic and result in queues that often become hazardous. Sometimes motorists are not prepared for rapid reduction of operating speeds and consequently, the probability of crashes occurring increases in these situations. These situations pose even greater dangers during non-peak periods. Drivers in these non-peak periods may not be from the local areas and thus may not be as familiar with traffic and roadways as the drivers in peak periods. Additionally, local drivers may not expect congestion during off-peak hours.

To prevent crashes in this situation, an effective approach is to install queue detectors at the potential locations and alert the upstream motorists of the queues using technologies such as variable message signs. With the messages displayed on the variable message signs, motorists will be warned so they can take due precautions. By doing so, the number of crashes in this situation can be reduced.

Such a system was developed and tested by Hualiang Teng of University of Nevada at Las Vegas through a research project funded by the Nevada Department of Transportation.

The queue detection system consists of video detectors placed at locations where queues usually back up from downstream congestion, wireless communications that transmit the detected traffic conditions, and a variable message loaded upstream of the unforeseen congestion.

Field tests were conducted for two football games at Sam Boyd and the Professional Bull Rider (PBR) tour at Thomas & Mack. For the football games, the test location was chosen at Russell Exit on South Bound I-515; while for PBR, the test location was chosen on Tropicana Avenue close to Las Vegas Boulevard. Video cameras were placed before and after the variable message signs that displayed messages such as "drive safely" and "congestion ahead". From the cameras, queue length and vehicle speeds were derived both manually and using software. To effectively evaluate the impacts of the messages, these criteria were derived for the distinct time periods when motorists can and cannot see congestion downstream during which the message was shown as "congestion ahead".

In addition, these criteria were also derived for the time period when there was no congestion formed due to the special events during which the message was displayed as "drive safely". The data indicate that the warning message "congestion ahead" makes statistically significant impact on the behavior of motorists in reducing speeds or making better use of existing lanes. As a result, the research recommends the application of such systems at identified locations at special events to detect congestion for preventing accidents.

Inside this Issue:

SELF-CONSOLIDATING CONCRETE: A NEW TREND IN THE CONCRETE INDUSTRY

by Nader Ghafoori, Ph.D.

Self-consolidating concrete was first developed in the late 1980's in Japan and quickly spread into the European countries and most recently to the United States. This type of concrete is not a new construction material, but rather an extension of existing concrete technology.

Fresh self-consolidating concrete has a low viscosity (resistance to movement), but stable, matrix that moves under its own weight into demanding form configurations and heavily-reinforced sections without vibration. Unlike conventional concrete, self-consolidating concrete requires specific rheological characteristics to obtain proper consolidation without vibration. There are several standardized and non-standardized tests that have been developed to characterize the performance of fresh self-consolidating concrete.

Flow ability and dynamic segregation test

For the most part, these tests are performed to find self-consolidating concrete passing ability (potential blockage at reinforcement), flow ability (unconfined workability), filling ability (confined workability), and resistance to segregation (stability) during transport, placement, and after placement.

Popularity of self-consolidating concrete stems from its multiple benefits in both cast-in- place and pre-cast applications. Examples of such benefits include: placement without vibration, placement in a highly congested formwork, self-leveling and less screeding, higher quality surface finishing, faster construction scheduling and less labor efforts, and reduction in construction noise and in-place cost.

Self-consolidating concrete is typically proportioned with a relatively higher cementitious materials content, smaller aggregate size and controlled gradation, and higher fine-to-coarse aggregate ratio when compared to those of the vibratory-placed concrete. The use of pozzolanic/cementitious materials such as fly ash, silica fume, and slag is highly encouraged.

Other mineral fillers and additives may also be used to improve flow ability. The fluidity is provided by high-range water reducing superplasticizers. The resistance to segregation is achieved through an appropriate quantity of viscosity modifying admixture. In design of self-consolidating concrete, the following items should be considered:

•Avoid static and dynamic segregations by setting an appropriate limit on slump flow,

•Set limit on cementitious materials content to control excessive shrinkage and creep,

•Avoid low water-to-cementitious materials ratio to contain authogenous shrinkage, and

•Account for extra formwork pressure consistent with the rate of placement.

In recent years, several European and American organizations have collected and used information on self-consolidating concrete to develop guidelines. A number of DOT's have also taken an active role in developing self-consolidating concrete specifications and quality control/assurance manuals.

Funded by NDOT, a research project on self-consolidating concrete is being conducted at the University of Nevada, Las Vegas (UNLV).

J-Ring passing ability test

The investigation is divided into three major phases. In the first phase, a document detailing standard specifications and test methods is developed. For the second phase of the study, the optimum dosage requirements of four different admixture sources and their effects on fresh and hardened properties of three distinct groups

Self-Consolidating Concrete, cont., page 3:

of self-consolidating concretes are investigated. The third phase of the investigation deals with the influence of seven different temperatures (ranging from 31º F to 109º F), nine hauling times (ranging from 10 to 90 minutes), combined hauling time and temperature, and pumping on performance of fresh self-consolidating concrete matrices.

The UNLV project and other similar studies being conducted in the United States and abroad are providing valuable information on the behavior of self-consolidating concrete. Without a doubt, the high level of interest from the construction industry assures the use of self-consolidating concrete will intensify at a rapid rate in the coming years. With more awareness about performance of this material and better communication and planning among producers, contractors and owners, self-consolidating concrete will soon find its way as the concrete of choice. Along the way, more resources should be dedicated to the education (understanding of the technology and required skills) and marketing of self-consolidating concrete.

National Transportation Week

is scheduled for May 11-17, 2008

http://www.ntweek.org/

Check it out!

"We will continue to modernize transportation and, during National Transportation Week, we honor the professionals who help to keep our transportation systems secure, efficient, reliable and safe."

Mary E. Peters, U.S. Secretary of Transportation

PRODUCT EVALUATION COMMITTEE ACTIVITIES

by Jason Van Havel

Establish New QPL Categories from Materials: The Product Evaluation Committee (PEC) is adding three curing compounds and a fly ash category, to the Qualified Products List (QPL). The acceptance criteria for curing compounds will match the current specifications in the Standard Specifications. All of the fly ash will be Type F. The QPL categories reference numbers will match the numbers from the Standard Specifications.

Boston Big Dig Epoxy Anchoring Panel Failures: The epoxy, anchoring the bolts that held the ceiling panels, failed because of creep. The epoxy that was used, along with other epoxies that are not susceptible to creep, are on the NDOT QPL. There does not appear to be any differentiation between products susceptible to creep and not susceptible to creep within the listings on the QPL. Depending on how the epoxy anchoring system will be used, NDOT may need to more clearly identify the epoxy to use. NDOT may need to change the acceptance criteria for epoxy anchoring systems, or designate the creep characteristics of each product on the QPL. After discussing a couple options to address the potential problem, Research and Bridge divisions will follow up with a meeting to address the situation further.

Potassium Acetate on Galena Creek Bridge: Current plans are to have a potassium acetate deicing system on the Galena Creek Bridge. Two research studies that are currently underway regarding the potential reactivity of potassium acetate and concrete were distributed. The Federal Aviation Administration (FAA) had noticed accelerated degradation to airport concrete runways that used potassium acetate as deicers. While it seems clear that the potential safety benefits for the deicing system are substantial, it also might create substantial risk to the concrete deck and concrete structure of the bridge. The PEC talked about mitigating issues. The Materials Division outlined their study of this topic in the past that seemed to imply that the aggregate was the problem. The aggregates here in Nevada are different, so this should be less of an issue. Further, the Materials Division outlined how NDOT will use low permeability and high performance concrete. These applications should mitigate most of these issues. When potassium acetate was selected for the deicer on the Galena Creek Bridge, magnesium chloride was not an acceptable alternative. Now, magnesium chloride is a useable alternative, and is currently being used by NDOT. It was pointed out that potassium acetate was used on the I-35 bridge in Minnesota because it would not react with steel; however, it did react with the zinc coating. Unless the FAA studies produce new information, the PEC decided to take no further action at this time.

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LIBRARY CORNER
by Heidi Wood

The winter months are a great time to visit the NDOT Research Library. The general public, as well as NDOT employees, are welcome to the library. We have a large selection of magazines, journals, and even study material. The Research Library is located in room 115, in the main NDOT Headquarters building. Stop by whenever you can, and I'll be happy to show you around. For those of you in other areas, remember; I send any book, anywhere in Nevada! So just send me a request of what you may need, and I'll put it in the mail to you!

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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 "clearinghouse" 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 Heidi Wood
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