M I N I S T R Y O F T R A N S P O R T A T I O N

Road Talk

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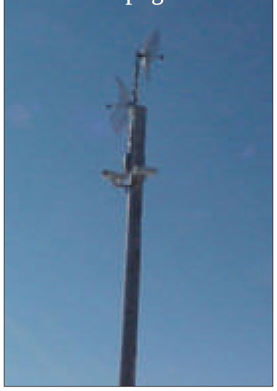

Traffic Camera Trials
See page 5

McKellar Creek Culvert Replacement Project

Problem Solving with Polystyrene

Construction of the new McKellar Creek road structure - a unique matrix containing blocks of expanded-polystyrene fill.

MTO is well known for its ability to design innovative, practical solutions to complex engineering problems. The ministry showcased this ability once again by successfully completing a challenging culvert replacement at McKellar Creek, located on Highway 17 east of Terrace Bay, using large blocks of expanded-polystyrene (EPS) foam confined to a unique matrix system (for those unfamiliar with EPS, think of foam coffee cups!). This system produced an efficient replacement with significant cost savings.

The culvert replacement was tendered in spring 2004, as the creek's existing timber culvert structure was experiencing failure due to age and wood decay. The highway geometry at the site was constrained by soil conditions in rugged terrain, which impeded the safe flow of traffic. Northwestern Region (NWR) was faced with the challenge of replacing the deficient culvert and improving both the grade and alignment of the roadway while operating under several design constraints. The site featured poor soil condition and a weak load-bearing foundation. As a result, no weight could be added to the soil substrate under the roadway, the highway footprint could not be altered, and the toe of slope (the point at which the natural terrain and the highway fill intersect) could not be increased. Environmental factors heavily impacted the project, as construction needed to take place without disrupting the creek's highly sensitive fish habitat. Furthermore, all surplus rock produced during construction had to be hauled off-site due to limited work zone >

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Road Talk

Technology Transfer is a communication process by which information, regarding an improvement in a product or method, is exchanged and implementation into practice is facilitated.

Transportation for Ontario

Ontario

Photo courtesy of Murray Metcalf Photography

The completed roadway following culvert replacement. Top left: The steel cellular wall facing of the matrix system. Top right and bottom: The open footing structure of the completed culvert.

> space and environmental concerns.

In order to compensate for these design constraints, NWR decided to use deep EPS fills confined in an innovative, stage-constructed matrix. The new road structure is a matrix consisting of an EPS core, steel cellular wall facing and elastizell foamcrete filler. These components were tied together with steel stressing rods, and all steel components were double zinc-galvanized to produce added longevity. The structure, which is both lightweight and rigid, offers many advantages.

EPS is a light, low-density foam fill material that allowed for effective construction in poor soil conditions. The highway at the site featured a steep slope, a potential roadside hazard. EPS foam (up to 6 m thick) was used to raise the grade of the highway by approximately 3 m, which removed the slope and straightened the curvature of the highway over a length of 250 m. The result was a significant improvement to the vertical and horizontal geometry of the roadway, producing a suitable clear zone between the highway and roadside hazards. EPS has been used previously as a fill material in Ontario, but never in this massive confined matrix.

The installation of the new culvert system was completed in two halves. Each stage involved three procedures: first, a temporary Bailey Bridge was erected over the existing culvert; then the top and walls of existing timber were removed from beneath the temporary bridge; the new culvert and H pile foundations were then installed along with EPS approach fills. Staged construction allowed for continual traffic flow through the site without the use of expensive detours.

Environmental concerns were addressed through consultation with the Ministry of Natural Resources. As the new culvert featured an open footing structure, all construction took place outside of the waterway. This allowed the replacement to be completed without causing disturbance to the creek's fish habitat.

The culvert replacement at McKellar Creek was completed in the spring of 2005. The project was a resounding success that effectively saved the ministry millions of dollars, as potential alternatives included the costly construction of an entirely new route through rugged terrain. The matrix design implemented at McKellar Creek remains an advantageous option available to the ministry when faced with other sites featuring similar constraints. ●

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Pre-Cast Concrete Slab Repair Technology in Canada

Pre-cast Repairs show Potential

The Ontario Ministry of Transportation (MTO) is continually investigating emerging concrete technologies in an effort to improve the efficiency of provincial highway repairs. In November 2004, MTO conducted a trial project to evaluate construction techniques for pre-cast concrete pavement slab repairs. The trial, carried out on the heavily trafficked Highway 427, constitutes the first use of this technology in Canada.

Highway 427 is a major 12-lane freeway characterised by considerable pavement deficiencies. The existing pavement structure consists of approximately 230 mm of jointed plain concrete pavement over 150 mm of cement treated base. Major distresses included: severe to very severe joint-stepping, severe joint failures, severe joint and crack spalling, severe to very severe cracking, and severe to very severe joint sealant loss. Since its construction, the highway has received only reactive (unscheduled) maintenance activities.

Since Highway 427 is a major commuter route through Toronto, repairs can only be conducted in a narrow overnight timeframe, typically using fast-track concrete repairs or emergency hot mix patches. Fast-track repairs are not ideal, as they are problematic to construct, have a restricted construction timeframe (from May 1 to October 15), require the use of autogenous cylinders, and may not provide the desired life expectancy of 15 years.

In its search for an alternative method for long-term and emergency repairs, the ministry decided to test and evaluate an innovative technique - pre-cast concrete slab repairs. MTO perceived many advantages to the use of pre-cast repairs, including higher concrete quality, ideal curing conditions, minimal weather restrictions on placement, and a reduced waiting-time for concrete to cure prior to reopening the highway.

The pre-cast slabs were manufactured off-site using three methods: the Fort Miller Super-Slab™ Intermittent Method, the Fort Miller Super-Slab™ Continuous Method (both originating from the Fort Miller Co., New York), and the Michigan Method (originating from the Michigan Department of Transportation). All three methods involve the design and fabrication of pre-cast concrete slabs to replace sections of deteriorated concrete pavement. The methods differ in how the base is prepared and how the pre-cast slabs are installed and dowelled to the adjacent concrete slabs. Three full-depth pre-cast slabs, each measuring 2 m x 3.65 m x 230 mm, were constructed and placed using the Fort Miller Intermittent and Michigan Methods, while a 25 m trial section was used for the Miller Continuous Method.

Non-destructive testing using a Falling Weight Deflectometer (FWD) was conducted after construction to assess load transfer efficiency (LTE), and to detect loss of support underneath the pre-cast slabs. Twelve FWD measurements were taken for each slab. Pre-cast slabs are rejected if FWD results measure less than 70% LTE. Based on the average FWD calculation, each method provided suitable results above this minimum requirement. FWD testing will be carried out annually at the pre-cast trial locations to monitor their performance over time.

Overall, the pre-cast trials produced positive results. Workmanship was a concern, however, this work was undertaken by a contractor carrying out pre-cast slab repairs for the first time under difficult conditions. The condition of the precast slab repairs was evaluated after six months of service - the slabs did not contain any cracking and did not rock. With the exception of slot failure within the Michigan Method, the precast slab repairs are performing well under daily traffic conditions.

The pre-cast repairs are similar in both ride and appearance to fast-track repairs along the same section of highway. MTO will continue to monitor the performance of these innovative pre-cast technologies, and will assess the cost effectiveness of this alternative to fast-track concrete repairs. Stay tuned to future issues of Road Talk for updates and results. ●

Placement of a concrete pavement slab.

A completed concrete pavement slab repair.

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Asset Management Update

Evolution of New Corridor Investments

The planning of a new freeway project is a long process involving extensive technical work, ministry-wide collaboration, and consultation with government and public bodies. The need to initiate this process is determined through long-range planning activities conducted by the Policy, Planning and Standards Division. Transportation studies examine future population and economic growth trends, and identify long-term transportation capacity needs. These studies provide the basis for an Individual Environmental Assessment.

Environmental Assessment Process

The environmental assessment (EA) process examines all the alternatives and environmental impacts of a major transportation initiative to determine a preferred solution. Transportation options considered include rail, transit, air, marine, and road improvements such as highway expansion or a new freeway.

The approval of Ontario's Minister of the Environment is required before proceeding with an Individual EA. An Individual EA describes all aspects of a project, including the purpose/need, alternatives, and environmental effects. This study involves consultation with agencies, stakeholders, and the general public. It takes two to four years to prepare, and results in the selection of a transportation alternative. Upon review, the Ministry of the Environment (MOE) decides if the EA is approved (with or without conditions), not approved, or referred to mediation or the EA Board for hearing.

Preliminary Design Study

This study is conducted to refine the route location work completed during the Individual EA, and considers design elements such as highway illumination, interchange design, and horizontal/vertical alignment. A technical recommendation is made based on costs, property impacts, and the performance measures for the Corridor Investment Plan. Soil investigations and pavement designs are carried out, in addition to preliminary plans for structure widening or the construction of a new structure.

Once MTO approves the preliminary design, a Class Environmental Study (for basic highway widenings, etc.) or Assessment Study (for new highway links) is undertaken, and a report is submitted to MOE for clearance. This phase requires approximately one to three years.

Property Acquisition

Property acquisition begins two to three years before construction. Where construction is not yet scheduled, owners may initiate the advance purchase of their property on a willing buyer/seller basis.

If the owner disagrees with the need to acquire his property, the Expropriations Act provides for a Hearing of Necessity. If the owner does not agree with the compensation offered, the Act also offers a dispute resolution mechanism.

Detailed Design

This stage includes the design of landscape, bridges, retaining walls, drainage systems, and environmental mitigation strategies. It also encompasses highway alignment plans, detailed surveys, the calculation of materials quantities, and detailed cost estimates. Detailed design requires approximately one to two years.

Award

MTO Regions prepare highway expansion contracts, which are then advertised on the ministry's electronic Highway Construction Bidding System (HCBS) for three to six weeks.

The Estimating Office prepares a detailed estimate of project costs. After the three low bidders' unit costs are received and reviewed, the Estimating Office makes a recommendation to senior management. If management accepts the recommendation, the successful bidder is notified. Upon completion of the documentation, the Region and the successful contractor are notified. Construction begins once the contractor mobilizes their resources at the site.

Corridor Investment Plan

Once the new highway section has been constructed, it is entered into a Corridor Investment Plan. The Corridor Investment Plan is used to establish the appropriate maintenance, operation, rehabilitation, and renewal strategies for the corridor over a 25-year period.

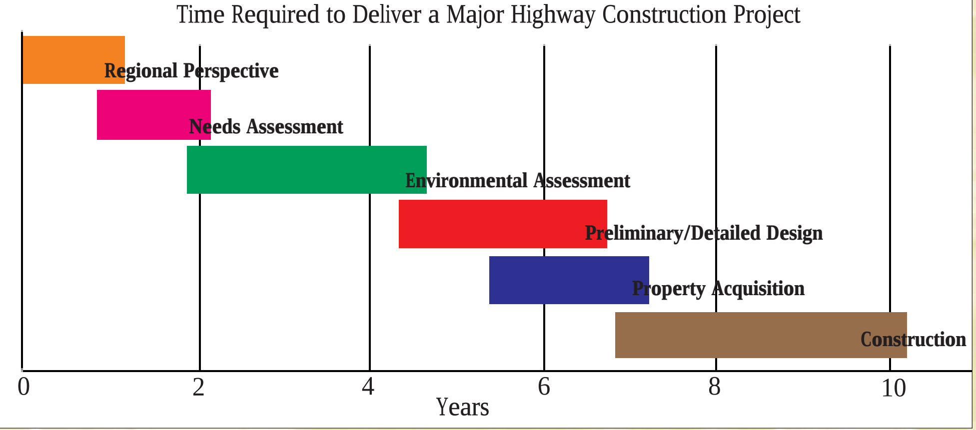
Summary

From conception to construction, seven to ten years are required to complete a new freeway project. A further two to three years are needed for its construction and opening to the public.

The ministry uses multi-disciplinary teams to access a broad base of MTO staff expertise. Transportation engineering consultants are retained to assist in various stages of planning, environmental assessment, and design.

Completing a new freeway project is a lengthy process that requires ministry staff to invest a substantial amount of time, effort, and financial resources. In view of this, MTO has adopted an Asset Management framework and tools to support the ministry's planning process and investment decisions. These tools include economic and non-economic analysis of projects within the Corridor Investment Plans. •

Time Required to Deliver a Major Highway Construction Project



For more information, contact Sarath Liyanage, Investment Planning Office, at (905) 704-2623, or at Sarath.Liyanage@mto.gov.on.ca.

Camera Monitoring Networks in Eastern Region

Keeping a Watchful Eye

MTO often experiences difficulty in providing real-time updates to motorists during highway construction projects. Currently, field inspectors provide ad hoc traffic updates to the contractor, who then reprograms Portable Variable Message Signs (PVMS) on the roadway to inform drivers of anticipated conditions. In an effort to improve this messaging process, Eastern Region (ER) is experimenting with the use of camera monitoring networks on two construction sites on Highway 401. The cameras provide off-site digital images of traffic flow that are used to determine appropriate messaging on PVMS signs positioned well in advance of the sites. This initiative is expected to better manage traffic flow through these areas, and to ensure the safest possible environment for motorists and workers.

The first construction site is one of a series of contracts to widen Highway 401 to six lanes across Kingston. The second contract involves the rehabilitation of the Salmon River Bridge between Napanee and Belleville, a site with significant traffic management concerns. The new monitoring systems are expected to help ER manage traffic flow through these construction sites over the next several years.

Both networks use camera technology similar to the COMPASS traffic monitoring system MTO uses in major centres like Toronto and Ottawa. By stripping down this equipment to its most basic form (i.e. removing remote-controlled movement capabilities such as pan and zoom), ER achieved significant cost savings. The recent decline in digital camera costs also resulted in savings.

The monitoring systems, while simple and inexpensive, are very effective. Digital cameras are placed on temporary wooden poles at the approaches to the sites; these cameras transmit video to ER's office in Kingston. Observers at this office receive real-time images of traffic conditions. Using this information, messages can be adjusted on six PVMS signs at each site to suit observed conditions.

To date, ER has completed the set up of the Kingston test site and is presently preparing the Salmon River location. The Kingston monitoring network uses advanced microwave technology to transmit camera images. A transmitter linked to the camera converts the video into a microwave signal, which is relayed to a receiver, then through a LAN to a computer in the ER office in Kingston. This method ensures very little signal loss, and produces high-quality digital imaging of traffic movements.

The Salmon River site is more remote and tests the flexibility of the monitoring system. Microwave transmission for this site is not logistically possible, as a receiver must be within 10 km of the camera to get a reliable signal. Since there is no MTO facility within 10 km of Salmon River, a standard telephone line with a dial-in connection will be used to transmit camera images. The fact that this monitoring system can adjust to different environments is a testament to its adaptability.

Evaluations will be made when the two projects are completed. Successful findings could result in more traffic cameras and construction signage being implemented across the province, which would offer accurate and up-to-date information to more road users in the near future, along with anticipated benefits to driver and worker safety. ●

A monitoring camera with a microwave transmitter at the Kingston site.

For more information, contact Dave Pearson, Contracts Office, at (613) 545-4702 or at Dave.Pearson@mto.gov.on.ca.

Left: A monitoring camera records traffic flow at the Salmon River test site.
Bottom: A PVMS at Wymans Road, Salmon River, positioned in advance of the construction site.

Heat-straightening Repair Workshop

Fixing with Flame!

MTO is always investigating new ways to enhance its technical operations. In November 2004, MTO's Bridge Office collaborated with the American Federal Highway Administration (FHWA) to host a workshop on the use of heat-straightening technology to repair structural steel. The workshop, which took place in Downsview, Ontario, consisted of two days of training, classroom instruction, and hands-on laboratory projects. The participants represented a wide range of engineering interests, and completed the workshop with a comprehensive knowledge of both the method and the applications of heat-straightening.

Heat-straightening is used to repair steel structures (typically bridge infrastructure) damaged by traffic accidents, vehicle overloads, fabrication flaws, or installation errors. Damage often involves twisting of the steel member or bending about the major or minor axis, and may occur either over a large segment or be confined to localized areas that undergo plastic deformation. Heat-straightening involves the controlled application of torch heat to defined areas of damage. The heat is applied in repeated cycles using specific patterns, with each pattern corresponding to a certain type of damage. Constant heating and cooling cycles cause the steel to alternately expand and contract, eventually 'straightening' to its original condition with the judicious use of external restraints to movement. Heat-straightening repairs should only be conducted by trained professionals, as the incorrect application of heat to steel structures can cause significant damage (i.e. loss of temper and load bearing capability).

MTO recently used heat-straightening to correct an installation accident that occurred during the construction of the Frog Rapids Bridge.

Heat-straightening repair offers several advantages: it does not adversely affect the mechanical properties of steel, it allows repairs to take place without temporarily shoring or closing a bridge, it limits the need for traffic detours, and it is an efficient, cost-effective technique that can be applied to various types of damage. Although this method is widely known, until now there has not been a well understood or properly documented analytical approach available to engineers that would provide confidence in the repair outcome. Heat-straightening has been used only sporadically in North America over the last fifty years, and is commonly considered to be more of an art form than a scientific repair technique. Recent research efforts led the FHWA to develop a comprehensive manual for the utilization of heat-straightening techniques. The goal of the workshop was to educate various bodies regarding the standards, practices, and benefits of this practical repair method.

MTO has used heat-straightening for many years on a limited basis (i.e. for minor camber adjustments or to correct fabrication errors). Last year, this procedure was used to correct an installation accident that occurred during the construction of the Frog Rapids Bridge at the Sioux Lookout. While MTO's previous uses of heat-straightening have been based on qualitative methods and operator skill, the FHWA workshop introduced MTO representatives and participants to a new quantitative method that may enhance the ministry's use of heat-straightening.

A quantitative method allows for a carefully engineered solution with a well-defined outcome. The damage investigation process involves an initial site inspection, followed by a detailed examination of damages. This is followed by a planning and design phase, which includes the analysis of damages, the selection of appropriate heating patterns and cycles, and the development of repair plans and specifications. Repairs are then executed through a coordinated effort by the engineer (who designs the repair), the project supervisor, and the contractor. Ultimately, to ensure successful repairs and to prevent damages during the repair process, this method stresses the importance of quality control and quality assurance. This rational approach has been used to great success in many American states, most notably by the Louisiana Department of Transportation.

The application of a heating pattern to a steel member.

The workshop provided 48 MTO participants and other representatives from the transportation industry with the information needed to assess, design, coordinate, execute, supervise, and inspect heat-straightening repairs using FHWA's quantitative method. Thanks to the FHWA workshop, the ministry now possesses the tools required to apply this effective repair method on an as-needed basis. Should the need arise, the Bridge Office is now able to develop procedures for the implementation of heat-straightening repairs. •

Special thanks to FHWA's Krishna Verma and Dr. Avent of LSU for leading the workshop, and for the materials provided by Ganawa Company Ltd. and Steve Parks of Central Region. Technical information obtained from FHWA's "Heat-Straightening: A Technical Guide and Manual of Practice."

For information, contact Ranko Mihaljevic, Bridge Office, at (905) 704-2351, or Ranko.Mihaljevic@mto.gov.on.ca, or visit www.fhwa.dot.gov/bridge/heat.htm.

TWD Truck Roadeo

Hit the Roadeo!

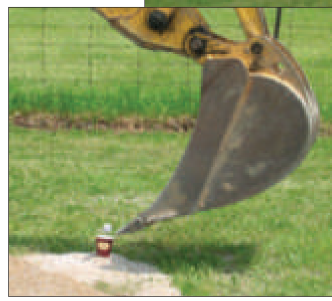
The sixth annual TWD Truck "Roadeo" took place on June 8, 2005, at the Patrol 52 yard in Brockville, Ontario. The Roadeo, hosted by Eastern Region area maintenance contractor TWD Roads Management Inc., tested the expertise of the region's maintenance workers by allowing them to compete in several skills-based events. With the benefit of technical support from MTO, TWD has expanded this event to utilize a broad range of equipment for safety training purposes.

The courses prepared for the event tested each operator's ability to manoeuvre around obstacles and pass tight clearances. In the offset alley course, operators had to guide trucks through barriers placed offset to one another. The serpentine course tested the participants' ability to avoid obstacles set on both sides of the truck's path in an 'S' shape. Drivers had to navigate through the course, both in forward and in reverse, without touching any of the barriers. The diminishing clearance and stop course challenged the operator to stop within 24 inches of a stopping block while also dealing with barricades set on either side of the path that reduced clearance levels as the truck advanced.

Maintenance operators direct vehicles through an obstacle course.

The Roadeo's most unique contest is the backhoe event, in which participants had to perform precise operating procedures with backhoe equipment. In one particular challenge, operators had to use a spoon fastened to a bucket tooth to move a golf ball from a pile of sand into a coffee cup. Such trials tested the operational aspects of the backhoe and incorporated safety practices as well. Participants were also required to perform pre-trip vehicle inspections with an emphasis on technique, time, and the ability to identify five pre-established defects incorporated in each vehicle.

MTO Maintenance Superintendents, Maintenance Coordinators, and Regional Fleet Coordinators judged and scored the skill testing events. The top finalists were Mike Woods of Patrol 51 (1st place), Doug Warren of Patrol 54 (2nd place), Donnie O'Donahue of Patrol 53 and Andy Winkler of Patrol 51 (tie for 3rd place).



An operator uses a backhoe to place a golf ball into a coffee cup.

The ministry places a high value on the competency and skill of maintenance operators - events such as the TWD Truck Rodeo, which allow operators to demonstrate and learn new skills, are central to MTO's objectives. TWD plans to hold another Roadeo in their Bancroft area maintenance contract at the end of June. •

For more information, contact Terry Nuttall, Contracts Office, at (613) 540-5167 or at Terry.Nuttall@mto.gov.on.ca.

Reader Response

Please help Road Talk become more effective

Send us any ideas, comments, or suggestions concerning local innovations, workshops, or seminars that you would like to see included in future issues.

Road Talk is also available in French.

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Upcoming Conference Information

July 23-27, 2005
2005 National LTAP-TTAP Conference
Dubuque, IA

August 7-10, 2005
Committee on Landscape & Environmental Design
2005 Midyear Meeting
Austin, TX

August 13-18, 2005
8th International Conference on Concrete Pavements
Colorado Springs, CO

August 24-26, 2005
2005 Midwest Region Context Sensitive Design & Solutions Workshop
Minneapolis, MN

September 11-14, 2005
2005 APWA International Public Works Congress & Exposition
Minneapolis, MN

October 5-6, 2005
Fall Maintenance Expo
St. Cloud, MN

October 11-12, 2005
2005 AirTAP Fall Forum
Brainerd, MN

November 8-9, 2005
Toward Zero Deaths Conference
St. Cloud, MN