MINISTRY OF TRANSPORTATION OF ONTARIO

Guidelines & Application Forms

Highway Infrastructure Innovation Funding Program

for Ontario Universities and Colleges

2008

ONTARIO MINISTRY OF TRANSPORTATION
HIGHWAY INFRASTRUCTURE INNOVATION
FUNDING PROGRAM
for Ontario Universities and Colleges
Guidelines 2008

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Note:

Deadline for Applications is Thursday, March 27, 2008 – 2:30:59 PM EST

1.0 INTRODUCTION

The Ontario Government seeks to invest in the future of Ontario's Transportation Infrastructure through its Highway Infrastructure Innovation Funding Program.

The Highway Infrastructure Innovation Funding Program provides a challenge to the academic community in Ontario to contribute to solutions in a number of areas including engineering materials, traffic operations, intelligent transportation systems, highway design, environmental, structures, geomatics, construction and maintenance. Some of these challenges involve detailed technical issues and others are open invitations for new ideas in a focus area. Your Institution is invited to submit one or more applications on how you can help us meet these challenges.

A glossary of terminology and acronyms used in these Guidelines are provided for your ease of reference:

- Institutions: Ontario universities (and their affiliated colleges, research centres, and institutes) and Ontario colleges of applied arts and technology
- Ministry: Ministry of Transportation of Ontario (MTO)
- HIIFP: Highway Infrastructure Innovation Funding Program

2.0 PURPOSE OF THE PROGRAM

The purpose of this program is to fund research at Ontario colleges and universities to encourage basic and applied research in transportation infrastructure in Ontario. This program is intended to solicit innovation from Institutions to assist the Ministry in meeting selected challenges, and to encourage undergraduate and graduate research in

transportation and infrastructure engineering by provision of funding to aid in such research. The present funding program is designed to supplement the research expertise at the Ministry with that available to the Institutions. The following areas of transportation and infrastructure engineering are included in this program:

- Traffic Operations
- Intelligent Transportation Systems
- Engineering Materials
- Highway Design
- Environmental
- Geomatics
- Bridges
- Construction
- Maintenance

A number of challenge statements have been developed that outline the technical background, the challenge or problem, and anticipated research outcome. Most of the challenge statements involve specific problems that will require innovation to solve. Typically, the anticipated research outcome includes a technical report, and a presentation to a Ministry technical committee.

The Highway Infrastructure Innovation Funding Program is intended to support and encourage research into highway infrastructure. The Ministry has identified a number of specific topics that offer an opportunity for learning, innovation, and results. The Ministry will support the researchers with the opportunity for direct contact with Ministry specialists and with interest in your proposal.

3.0 SCOPE OF THE HIGHWAY INFRASTRUCTURE INNOVATION FUNDING PROGRAM

3.1 Eligible Institutions

All Institutions are eligible for funding by the HIIFP. The principal researcher must be a member of the faculty (fu1l or part-time) at the sponsoring Institution.

3.2 Eligible Research Topics

A diverse selection of research topics in the area of transportation and infrastructure engineering are included in this program. **To be eligible for funding, HIIFP applications must cover one (or several) of the topics from the following categories:**

- **Specific Research Topics**
- **Open Research Topics**

3.2.1 Specific Research Topics

Each Specific Research Topic is defined as follows:

Subject Area:	General Subject Area
Title:	Title that identifies subject area
Background:	Discussion of the subject area, work done to date, thoughts on how to solve the challenge, reference information.
Challenge:	A statement or question that outlines the challenge.
Anticipated Outcomes:	Typical outcome is a technical report that demonstrates how the challenge was addressed and or met and shows how improvements may be made. A presentation to a technical committee is also an expected outcome. Sometimes the anticipated outcome provides more information on how to meet the challenge.

The following specific topics are included and detail descriptions of each specific topic are provided in Attachment A.

	Title
1	Best Practices - Bicycle Facilities / Lanes Passing Through Interchanges
2	Warrants for Roundabouts
3	Safety at Roundabouts with High Speed Approaches
4	Quantifying Pavement Sustainability
5	Development of Guidelines for Evaluation of the Pavements on Highway Ramps and Interchanges
6	Development of Guidelines for Estimation of Pile Capacity and Construction Control of Pile Driving
7	Development of Test Methods for Assessment of Concrete Durability for Use in Performance-Based Specifications
8	Polishing of Aggregates in Pavement Surfaces by Silica Fillers in Vehicle Tires
9	Comparative Evaluation of Proposed Test Methods for Self-Consolidating Concrete

	Title
10	Adhesive Anchoring Systems for Reinforcing Steel
11	Evaluation of Alternative Grades of Stainless Steel
12	Study to Assess the Treatment Efficiency of Highway Embankments and Ditches
13	Assessing Flexible Pipe Installation Standards
14	Updating the MTO Intensity-Duration-Frequency (IDF) Curves for Estimation of Rainfall Intensities
15	Investigation of the Influence of Air Turbulence from Large, High-speed Trucks on Bicycle Stability
16	Sustainable Solutions for Construction Site Runoff
17	Measuring the Effectiveness of Wildlife-vehicle Collision Mitigation Techniques
18	GIS Based Management and Distribution System for Raster Data in MTO
19	Non-Destructive Assessment of Grouted Prestress Cable Ducts in Post-tensioned Decks
20	Fibre Reinforced Concrete for Bridge Barrier Walls
21	Acceptance Criteria for Ultrasonic Impact Treatment (UIT)
22	Modular Bridge Expansion Joints: Development of a Splice Detail for Modular Bridge Expansion Joints Constructed in Stages
23	Innovative Methods to Mitigate Accelerated Corrosion in Weathering Steel Bridges
24	Seasonal Load Adjustment: Optimization of Seasonal Frost/Thaw Depth and Pavement Strength Predictions on Low Volume Highways in Ontario
25	Seasonal Load Adjustment: Development of Seasonal Load Adjustment Application Guidelines
26	Relation of Winter Friction Performance Measures to Maintenance Outcomes – Phase II
27	Chemistry of Multi-chloride Brines
28	SNOWDRIFT Environmental Simulation

3.2.2 Open Research Topic(s)

The MTO also encourages HIIFP applications on the following general theme areas, and other topics the principal researcher considers relevant to highway infrastructure innovation and the Ministry's business needs.

	General Theme Area
101	Limit State Designs for Retaining Walls for Highway Structures
102	Integrating Freeway and Arterial Transportation Management
103	Managing Traffic Through Highway Work Zones: Automated Enforcement, Variable Speed Limits and Managing Delay
104	Alternative Traffic Monitoring Technologies for all Transportation Facilities
105	Operational Concepts for the Use of Vehicle Pollution Levels as an Input to Traffic Management Strategies
106	Automated Mobile Collection/Reporting of Road Weather Information
107	Using GIS, GPS and Other Land Information Technologies
108	Development of Innovative Performance Tests for Evaluation of the Quality of Concrete Construction for Highways
109	Non-Destructive Test Procedures and Analytical Methods for Assessing the Condition of Steel and Concrete in Highway Structures
110	Materials Testing
111	Managing West Nile Virus within Highway/Roadway Right-of-Ways
999	Other Research Topic(s)

If you choose to submit an HIIFP application from one of these general themes listed above, or another research topic, please carefully outline to the Ministry a clear need for the research or the other research topic(s) including how its application will enhance MTO practices and business needs.

For more information contact:

Finlay Buchanan, BSc (Agr), MSc
Provincial Highways Management Division
Ontario Ministry of Transportation
Finlay.Buchanan@ontario.ca
(905) 704-2980

3.3 Ministry Assistance in Conducting Funded Research

For each application that is approved, a Ministry technical specialist in the relevant subject area will be assigned to liaise with the principal researcher.

Timing of periodic meetings or telephone conference calls and brief progress reports will be negotiated at commencement of the project. Note, brief written progress reports will be required a minimum of every 6 months; see Attachment E for sample template.

For most funded applications, a technical presentation of the study results will be required. The presentation will be held at the Ministry's office at 1201 Wilson Avenue, Toronto, Ontario.

3.4 Available Funds and Eligible Expenditures

The total value of the awards is expected to be about $500,000.00 next fiscal year beginning April 1, 2008. It is expected that approximately fifteen applications/projects may be funded. The Ministry reserves the right not to provide any funds in its sole discretion and without any reasons.

The Ministry will consider applications that are multi-year, where by funding is required in each year. For multi-year funding applications, in such cases the Ministry will endeavour to provide funding beyond next fiscal year ending March 31, 2009. However, the Ministry cannot guarantee funding beyond next fiscal year ending March 31, 2009 and reserves the right to not provide the funding and terminate the research on written notice to the Institution.

For approved multi-year applications, Institutions will be required to provide brief progress reports to the Ministry indicating progress made on the project by the Institution; see Attachment E for sample template. Failure to provide such progress report(s) that describes substantial completion of tasks set out may result in the Institution being denied funding in subsequent fiscal years.

The salary of the principal researcher is not eligible for funding under the HIIFP, and nor is the principal researcher to charge any fee in this respect.

3.5 Fieldwork on Ministry Highways

The Ministry must approve proposed fieldwork on Ministry highways, and any proposed fieldwork on Ministry highways must be discussed by the principal researcher with the Ministry prior to submitting an HIIFP application. The Ministry contact person is as noted below:

Finlay S. Buchanan, BSc (Agr), MSc
Provincial Highways Management Division
Finlay.Buchanan@ontario.ca
(905) 704-2980

3.6 Information and Data Confidentiality

The principal researcher and the Institution agree that all information and data that the Ministry may provide in respect of the research project shall be kept confidential and that the Institution shall only use the information and data for the purposes related to the submission of a final report to the Ministry for the research project. The Institution shall ensure that reasonable methods are taken to secure the confidential information and data of the Ministry. Failing to comply with this provision may result in the termination of the project, where upon the Institution shall return all information and data, return all monies paid by the Ministry and may result in the Institution being precluded from the award of future HIIFP awards.

4.0 APPLICATION PROCEDURE, DEADLINES

4.1 Application Components

The application consists of the following components:

1. **MTO HIIFP Application Form (Attachment B)**
2. **Summary** of Research Proposal (300 words maximum, in plain language suitable for communicating with the public **(Attachment C).** Portions of this summary may be used in a media release, so the language should be non-technical and free of acronyms or jargon.
3. **Budget Summary (Attachment D)**
4. Detailed **Research Proposal** (maximum 12 pages in 12-point font). Note, requirements are described in Section 4.2
5. **Budget** Details (see section 5.0 BUDGET).
6. ***Curriculum vitae*** of Principal Researcher and other principal research staff named in the Application Form (component 1, above). **Only ONE COPY of the *curriculum vitae* for each principal staff member need accompany the application. Submission of an NSERC Form 100 personal data form is acceptable.**
7. Appendices. Only **ONE SET** of the complete appendices containing papers, reports, and other relevant information need accompany each application.
8. **For Principal Researchers who received funding for research projects as part of the 2007 HIIFP, a brief Progress Report is required** for each respective research project that the Principal Researcher received HIIFP funding for in 2007. The principal researcher can provide a progress report as per sample template in **Attachment E** or copy(s) of written progress reports complete to date if within the previous 3 months.
9. If applicable, description of and reason for request for use of MTO Facilities and or work on MTO highways.

Section 6.0 SELECTION CRITERIA outlines the criteria used to assess the applications for HIIFP funding.

The Ministry reviewers will treat information contained in the submitted applications as confidential.

4.2 Detailed Research Proposal Requirements

The detailed research proposal must include a description of:

- Understanding of the need for this research and the objective
- Methodology and details of the proposed analysis
- Proposed innovation in approaches, methodologies and potential outcomes
- Schedule of the activities to be undertaken during the project, identifying key milestone and associated dates
- Qualifications of the principal researcher in the planned area
- Related work performed by the applicant and others on the team.

4.3 Deadlines & Address for Applications

Deadline for the receipt of applications is **Thursday, March 27, 2008 – 2:30:59 pm EST.** Completed applications and all supporting documentation must be received by this deadline. They must be submitted to:

Ministry of Transportation
Tenders Office
2nd Floor
301 St. Paul Street
St. Catharines, ON
L2R 7R4

Attention: Finlay S. Buchanan, BSc (Agr), MSc
Highway Infrastructure Innovation Funding Program
905.704.2980

Please submit:

- 5 hard copies of the application components as describe in 4.1 Application Components
- 1 electronic digital copy (adobe acrobat format), and
- 1 hard copy of the innovation funding application form with original signatures.

Only one copy of the appendices need be supplied.

5.0 BUDGET

5.1 General

The detailed budget must include a full account of purchases and activities to be financed by the HIIFP funding. The level of budget breakdown and supporting information provided should be sufficient to justify the items relative to the Research Proposal description.

As stated in Section 3.4, multi-year funding applications will be considered and provided on condition that sufficient information is provided.

The Ministry selection committee reserves the right to disallow expenditures in the budget that are not adequately justified. The committee may recommend partial support of a Proposal.

5.2 Budget Summary

Institutions must submit a budget summary as stated in 4.0 Applications Procedures, Guidelines, and having regard to the provision of Available Funds and Eligible Expenditures.

Furthermore, the following types of expenditures are eligible for funding:

5.2.1 Estimated Salaries and Benefits

Salaries, stipends, and related federal, provincial and institutional non-discretionary benefits for research work performed by research personnel (i.e., students, research associates, and technicians). The Ministry will not fund the salary of the principal researcher.

5.2.2 Estimated Equipment or Facility

Equipment or facility costs directly attributed to the research proposal may be funded. The researcher may propose to use Ministry materials and structural laboratory facilities in Downsview as part of their application, where facilities are not available in their Institution. The Ministry will not normally fund the purchase of major equipment, or the rental of existing equipment. However, in exceptional cases that satisfy the Ministry, major equipment purchases, rental of large shared equipment or purchase of computer time will be considered on a case-by-case basis.

5.2.3 Materials and Supplies

Materials and Supplies include materials directly attributable to the research proposal such as the purchase of engineering materials. Where the Ministry is supplying materials, this has been indicated in Section 3.2.1 Defined Research Topics and Attachment A.

Supplies include expendable materials, printing, photocopying, and other similar office supplies.

5.2.4 Travel

A presentation to a Ministry technical committee will normally be required. The presentation will be held at the Ministry's offices at 1201 Wilson Avenue West, Toronto, Ontario (Keele St. at Hwy 401). Travel and accommodation costs should be in accordance with the Institution's internal guidelines.

5.2.5 Dissemination Costs

Dissemination costs include costs associated with the preparation of the final report. The Ministry will require the technical report to be submitted in accordance with the Style Manual for Technical Publications of the Ministry's Engineering Standards Branch as shown in Attachment F Word document template. This Style Manual will enable researchers to submit in a consistent and cost effective format.

5.2.6 Overhead

Overhead may be included in the cost of your application. The Budget Summary form provided in Attachment D requires that you to identify the rate of overhead for your Institution.

6.0 SELECTION CRITERIA

Staff of the Ministry of Transportation will review applications for funds from the HIIFP. To assist Institutions/applicants in completing the forms, the selection criteria for applications are as follows:

- Experience and qualifications of the researcher(s) in the subject area(s)
- Demonstrated understanding of the need for the research and the objective
- Innovativeness of proposed research approach, methodologies and potential outcomes
- Adequacy and appropriateness of proposed research methodology and analysis
- Feasibility of accomplishing the research within estimated timelines and budgets using proposed methodology
- Value-for-money for the Ministry including overall costs to the Ministry
- Importance of research proposal to MTO business priorities
- If requested by principal researcher, availability of Ministry facilities for research and/or approval of proposed fieldwork on Ministry highways
- For principal researchers who received funding for project(s) from the 2007 HIIFP, satisfactory work in progress of their respective 2007 HIIFP research project(s). The evaluation of this criterion will be based on the brief progress reports requirement as described in Section 4.0 Application Procedures, Deadlines
- Level of funding secured or provided in-kind from other sources.

The Ministry selection committee may request clarification of points contained in the proposal of any applicant, by letter or personal interview.

7.0 NOTIFICATION OF AWARD

A letter announcing an award will be sent from the Ministry to the principal researcher at the beginning of the award period, and a copy is sent to the financial official of the Institution designated in the application. The letter provides authority to incur project expenses for items and amounts specified in the **approved**, detailed budget. Expenses incurred in excess of the approved budget are not the responsibility of the Ministry.

The holders of research awards and their associates are not considered employees of the Ministry of Transportation of Ontario or the Government of Ontario. The Ministry reserves the right to terminate an award without cause at any time by providing written notice of termination.

Any public announcements about the award of the funding for the HIIFP shall be made by the Ministry, unless the Institution obtains the prior written approval of the Ministry.

8.0 FINANCIAL ARRANGEMENTS & REPORTING REQUIREMENTS

Awards will be paid to the Institution in one instalment in each year of the award, around **May 15, 2008, for research starting in calendar year 2008**.

Recipients of funds under this program are requested to maintain periodic contact with MTO staff assigned to monitor the progress on the research. A **financial report** must be submitted to the Ministry by the designated official of the Institution upon completion of the research project. This report will include a full account of purchases and activities financed by the HIIFP. It will also include an itemized list of equipment that was purchased in whole or part with the funds. The following headings will be included in the financial report:

- Salaries and Benefits;
- Equipment or Facility;
- Materials and Supplies;
- Travel;
- Dissemination Costs;
- Other Costs

The Ministry reserves the right to audit any project. The Institution is required to keep for five years any records that may be required for a financial audit.

For approved multi-year applications, in order for an institution to be funded in subsequent years on a multi-year basis, Institutions will be required to provide brief

progress reports to the Ministry indicating progress made on the project by the Institution; see Attachment E for sample template. Failure to provide such progress report(s) that describes substantial completion of tasks set out may result in the Institution being denied funding in subsequent fiscal years.

Any surplus or funds not spent must be returned to the Ministry by the Institution. If the research is not started or terminated part way through a project, any unused portion of the research funding must be returned to the Ministry within 30 calendar days.

9.0 AMENDMENTS TO A RESEARCH PROPOSAL

The Ministry must be notified either in writing or orally in advance of any intention to:

- Alter the direction or intent of the research;
- Terminate the research;
- Reassign research responsibilities to other researchers, than those named in the original HIIFP application;
- Alter the work schedule.

The principal researcher must consult with the Ministry technical specialist named as contact at the time of the award and obtain written approval before any alterations in the project are implemented. If the Institution is uncertain as to what constitutes a major alteration in the project, he/she may contact the person named in Section 4.3 Deadlines & Address for Applications to discuss this matter. If the principal researcher is unable to provide a significant level of participation as originally set out in the application, then alternative arrangements for responsible supervision of the project must be submitted for Ministry approval prior to the start of the absence.

10.0 ANTICIPATED OUTCOME

The Institution shall submit a final report (typically about ten to fifteen pages in length) in both hard copy and electronic format no later than three months after the end of the funding period or after termination of funding by the Ministry. Some or all of the members of the Ministry application review committee that recommended support of the research will review the final report.

The report format shall be in accordance with the Style Manual for Technical Publications of the Engineering Standards Branch as provided in Attachment F. The final report shall be submitted in Adobe Acrobat format. The final report should include:

- Conclusions and discussion of applications of the new findings to the challenge statement
- Plans for publication and for dissemination of results

The Ministry will retain the final report.

Note: A copy of a student thesis or dissertation is **NOT** a substitute for a final report according to the above format

Reprints of publications or manuscripts submitted to journals and copies of papers presented at scientific meetings should be included with the final report. (Manuscripts and articles *in press* will remain confidential.)

The Institution or the principal researcher shall also provide the Ministry a copy of any follow-up publications which the researcher prepares following the project and which incorporates any portion of the research outcomes.

10.1 Disclaimer

Any publication resulting from research funded by Ministry of Transportation HIIFP should acknowledge the source of funds and include a disclaimer, indicating that the views of the authors may not necessarily reflect the views and policies of the Ministry of Transportation of Ontario.

> *Sample of Disclaimer to be used:*
> *This research was supported [in part] by a contribution from the Ministry of Transportation of Ontario. Opinions expressed in this report are those of the authors and may not necessarily reflect the views and policies of the Ministry of Transportation of Ontario.*

Should the Institution want to make specific reference to the Ministry and or name Ministry staff in the publication, the permission of the Ministry must be obtained prior to publication.

11.0 RESEARCH OUTCOMES

The Ministry may use the research outcomes from the HIIFP applications that are funded by the Ministry. In this regard, and as a condition of funding the research project, the Ministry shall be granted a non-exclusive, royalty-free license without charge to use the outcomes and or conclusions in the research outcomes for the Ministry's own non-commercial internal purposes including use on Ministry highway contracts and work conducted on behalf of the Ministry.

In the event the Institution is able to obtain patent protection for any of the outcomes and or conclusions in the research outcomes, the Ministry shall be granted a royalty-free non-exclusive license without charge to use the outcomes and or conclusions in the research outcomes with no right to sub-licence to third parties. The Institution shall arrange for the execution of the appropriate documents to give such licenses to the Ministry.

Should the research outcomes be further interpreted and or refuted by the Ministry, then the Ministry's findings and or conclusions shall become the responsibility of the

Ministry. Should the Ministry's findings and or conclusions differ from the findings and or conclusions in the research outcomes, the names of the principal researchers, original authors, and Institution shall not be associated with the Ministry's findings and or conclusions.

12.0 EXTERNAL PUBLISHING OF RESEARCH OUTCOMES

Researchers are encouraged to publish and present their research findings independently, but must notify the Ministry of the research findings and or conclusions, and or research outcomes being published or communicated must follow the procedure set out below, and must ensure the disclaimer described in Section 10.1 is attached there to:

12.1 In determining when the research findings and or conclusions in the research outcomes, or the research outcomes should be disclosed, both the Ministry and Institution shall be sensitive to the need for timely approval of graduate student theses and essays.

12.2 The Institution, using best efforts, shall provide to the Ministry, at least sixty (60) calendar days in advance of any proposed publication or presentation, an outline and associated abstract of any research findings and or outcomes, and or research outcomes (or any other matter related to this agreement) which it intends to publish or present.

12.3 For the purpose of section 12.2 the terms "disclosure", "publication" and "presentation" include articles, seminars and any other oral or written presentations as deemed appropriate by the Institution to the public, but does not include student theses or other communications submitted for the purpose of evaluating student performance.

12.4 The Institution retains the right to have graduate student theses reviewed and defended for the sole purpose of academic evaluation in accordance with the Institution's established procedures.

13. 0 OCCUPATIONAL HEALTH AND SAFETY

The Institution will be responsible for meeting all of the obligations under the Occupational Health and Safety Act (OHSA) and shall ensure that the research is carried out in accordance with the OHSA and all applicable regulations. This includes but is not limited to, the duties to: provide a safe workplace; provide information and educate the workers on workplace hazards; appoint a competent supervisor; prepare and provide a health and safety policy; implement a comprehensive health and safety program to support the policy; and take every reasonable precaution to protect the health and safety of workers.

Researchers intending to carryout fieldwork on Ministry right of way and researchers proposing to make use of Ministry laboratories must contact the Ministry for additional information on operational constraints and occupational health and safety requirements.

ATTACHMENT A – DETAILED DESCRIPTIONS OF SPECIFIC TOPICS

Subject Area:	**Traffic Operations**
Title:	**1. Best Practices – Bicycle Facilities / Lanes Passing Through Interchanges**
Background:	More and more pressure is being placed on the ministry to design bicycle friendly interchanges. Bicycle advocates are demanding that safe and efficient bicycle facilities be implemented on Ontario roads. Of particular interest to the ministry are arterial roads passing through interchanges, especially within the areas of free flow on-ramps.
Challenge:	Research existing bicycle facilities numerous jurisdictions throughout North America and Europe and develop a set of best practices or guidelines which could be implemented by the ministry. Such factors to consider include interchange design standards, climate, traffic volumes, maintenance concerns, cost, safety, property requirements, signing and pavement markings, public education.
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Traffic Operations**
Title:	**2. Warrants for Roundabouts**
Background:	The ministry is actively looking for suitable locations on Provincial Highways and at ramp terminals for roundabouts. However the conversion from a stop or signal controlled intersection to a roundabout has major cost implications. To assist in the decision making, a formalized process such as a warrant is considered necessary. This process should consider factors such as: traffic volumes, lane configuration, vehicle delay, collisions etc., similar to the warrants for traffic signals. Other factors that may be considered are; cost implications, speed limits, traffic calming effects, transit routes, pedestrian and bicycle volumes. In addition to a standard warrant consideration be given to development of specific methodology to support selecting between installing either an isolated rural signals or isolated rural roundabouts on Ontario Highways with high speed approaches. Roundabouts have been installed on collector and arterial roads and in subdivisions and industrial areas in municipalities in Ontario. The warrants should include these diverse uses of roundabouts. It is hoped that the process/warrant will help establish roundabouts as an alternative form of intersection traffic control in Ontario.
Challenge:	Develop a warrant or similar process for a roundabout.
Anticipated Outcome:	Technical Report detailing development of evaluation criteria, suitable for publication. The evaluation criteria will be in the form of an Excel spreadsheet. Presentation to technical committee.

Subject Area:	**Traffic Operations**
Title:	**3. Safety at Roundabouts with High Speed Approaches**
Background:	The ministry is actively looking for suitable locations on Provincial Highways for roundabouts. While the acceptance of roundabout use in low speed urban environments is increasing, some hesitation still seems to exist with the safety of high speed roundabout approaches. To assist in the promotion and installation of roundabouts on Provincial Highways with high speed approaches, a safety study of existing high speed roundabouts is considered necessary. This process should focus on roundabouts in Ontario, for example: Arthur St. at Sawmill Rd., Region of Waterloo. This was a signalized intersection on a former provincial highway with high speed approaches on three legs. Consideration of traffic volumes, lane configuration, pedestrian activity, collision types and unique design features should be examined. An estimate of the collision modification factors to be expected when a roundabout is installed on a high speed approach in Ontario. For the purpose of this study high speed should be considered as those roads with posted speed of 80km/h or higher
Challenge:	To evaluate the safety of modern roundabouts with high speed approaches
Anticipated Outcome:	Technical Report detailing development of evaluation criteria, suitable for publication. Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**4. Quantifying Pavement Sustainability**
Background:	The sustainability of pavement materials and construction processes has not been quantified to allow comparison of environmental considerations in life cycle costing. Research is required to assess the emission and energy requirements of different pavement materials and construction processes along with the use of non renewable resources and future recycling opportunities so that this may be considered during design selection.
Challenge:	Evaluate the emission and energy requirements of pavement materials and processes to determine their environmental costs, the requirements for the use of non renewable resources and the future opportunities for the pavement to be recycled. The evaluation shall include commonly used pavement alternatives including recommended maintenance and user delay impacts, the use of recycled materials and recycling processes (eg cold in place recycling, cold in place recycling with expanded asphalt material).
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**5. Development of Guidelines for Evaluation of the Pavements on Highway Ramps and Interchanges**
Background:	Highway ramps and interchanges make up about 5 percent, or 2000 lane-km, of the total Ontario highway system. There are approximate 1000 ramps and interchanges, with each having 3 or 4 ramps. Since a large amount of pavement is paved on the ramps, annual investment in the pavement maintenance and rehabilitation program is significantly affected by pavement conditions of the ramps and interchanges. These ramps also have operation performance impacts on highway safety, traffic capacity and serviceability. However, survey and evaluation of the pavements in these areas was not included in the pavement management system in the past. With the development of the new MTO pavement management system (PMS2), it has become possible to establish a highway interchange and ramp database for the purpose of pavement evaluation, maintenance needs analysis and special treatments. The PMS2 has a unique function dealing with maintenance management of the pavements in highway ramp and interchange areas
Challenge:	The challenges are to develop a practical approach to performing field surveys, data collection and pavement performance evaluation in a safe and effective manner, detailed as follows: • To design an appropriate pavement condition evaluation and field data collection operation procedure • To develop pavement distress manifestation manuals to facilitate MTO staff to conduct field evaluation of the pavements in highway ramp and interchange areas • To develop an effective program to collect pavement distress data with the assistance of modern data collection devices • To develop a program to upload pavement distress data into PMS2 and comply with all requirements.
Anticipated Outcome:	• Manual for field survey and evaluation of the pavements in highway ramp and interchange areas • Distress Manifestation for assessing pavements in highway ramp and interchange areas • Pavement condition data collection program and sample data collected from a number of highway ramps and interchanges • Benefits including the defendable allocation of investments for highway ramp and interchange areas based on pavement condition. • Technical Report • Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**6. Development of Guidelines for Estimation of Pile Capacity and Construction Control of Pile Driving**
Background:	Deep foundations consisting of driven piles support most bridge and other structures designed by the Ontario Ministry of Transportation. Estimation of pile load capacity is the most important aspect in pile design projects. Uncertainty over static capacity predictions based on soil mechanics principles is a frequent cause of conservative designs. Various interpretations of pile driving dynamics to assess in-situ static capacity are equally uncertain and require proof testing. Pile loading tests remain the most definitive way of measuring the static pile capacity. The MTO has been compiling pile loading tests since the mid-1950s. The latest publication summarizing the MTO data relates to 1993. A number of pile loading tests had been carried out since the last publication. These test results in conjunction with pile driving records and site-specific soil properties are invaluable for the assessment of various theoretical methodologies to predict the static pile capacity. To facilitate such studies the MTO data must be compiled, a database suitable for various analyses developed, and data analysed to establish the best predictive technique consistent with the pile loading tests and other data. A number of published studies show that no theoretical method or a dynamic pile driving formula can be considered superior to all others. However, the Hiley, Janbu, and Gates equations appear to be consistently among the best in published comparisons of formula predictions versus pile load tests.
Challenge:	Research is required to analyze data for driven piles in Ontario and to critically evaluate and calibrate various methods of predicting static pile capacities, with the aim of identifying or developing a method that is the most compatible with the MTO pile load test data. Conduct a critical analysis of published literature and research in progress on the basis of applicability, conclusiveness of findings, and usefulness for the analytical needs of this study. The results from this research will improve the safety and potentially reduce the costs of pile foundations for bridges and other structures.
Anticipated Outcome:	The anticipated outcome of the work is the development of a comprehensive database that includes all MTO pile load test data. Recommendations are to be made for the improvement of current MTO procedures for construction control of pile driving and estimation of pile capacity. Recommendations are also expected regarding the most suitable soil-specific methods of assessing the static pile capacity based on standard soil properties. Technical Report Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**7. Development of Test Methods for Assessment of Concrete Durability for Use in Performance-Based Specifications**
Background:	The ministry is moving towards use of performance-based specifications for construction acceptance of concrete in highway structures and pavements, where appropriate test methods exist. Unfortunately there is a lack of test methods that can be used to accurately evaluate long-term durability of concrete. The existing test methods require the removal of cores for testing, or preparation of samples for testing purposes, which may not reflect the performance of the concrete in place. Durability and service life of reinforced concrete depend on a number of factors among them permeability of concrete, effectiveness of curing, thickness of concrete cover over reinforcing steel, crack width, depth and frequency, degree of consolidation, resistance to aggressive ions, and resistance to frost. The Ministry is seeking suitable non-destructive test methods to assess durability as measured on hardened concrete in place.
Challenge:	Develop non-destructive test method(s) for evaluation of concrete durability in place and identify limits, for the measured property, that characterize durable concrete.
Anticipated Outcome:	Draft test method(s), the validity of which has been demonstrated in the laboratory and field. Recommendations for appropriate test limits for use in MTO contract specifications Technical report detailing background and development of test method, and validation/justification of recommended test limits, in a format suitable for publication Presentation to MTO technical committee

Subject Area:	**Engineering Materials**
Title:	**8. Polishing of Aggregates in Pavement Surfaces by Silica Fillers in Vehicle Tires**
Background:	Vehicle tire manufacturers have been increasingly using finely divided silica in the tread area of tires. This material is used as filler but is now being advertised as having a beneficial effect on pavement/vehicle friction. Silica (quartz) is one of the hardest natural materials that commonly occurs at the pavement tire interface. Coarse silica tends to scratch and restore friction to some extent. Fine silica (1 to about 10μm) acts as an efficient polishing agent. We have noticed in the past few years some polishing of the upper surface of granite and gneiss particles commonly used as our best "skid resistant" aggregates. Is the fine silica in these new tires causing this polishing? Will the adoption of more of these tires result in a reduction in pavement friction to other users due to polishing? Will we have to resurface our pavement more frequently if extensive polishing caused by these tires takes place? How should testing be conducted to evaluate the polishing capability of these tires compared to conventional tires? What does this testing tell us? We anticipate research into this topic would include microscopic examination of inorganic additives in vehicle tires and also the use of some kind of polishing evaluation to test the hypothesis.
Challenge:	Does the relatively recent adoption of fine silica in vehicle tires have an adverse effect on friction and safety?
Anticipated Outcome:	Technical Report Presentation to Geotechnical Committee of MTO.

Subject Area:	**Engineering Materials**
Title:	**9. Comparative Evaluation of Proposed Test Methods for Self-Consolidating Concrete**
Background:	Self-Consolidation Concrete (SCC) can minimize consolidation problems and facilitate placement of concrete in heavily reinforced structures, narrow elements and areas where vibration is difficult, such as soffit repairs. SCC is an emerging technology and its increasing use has necessitated the development of new specifications and testing procedures. In response to contractors' requests to use SCC, and a paucity of standardized tests, the Ministry has developed a Special Provision for the use of SCC and has introduced new LS-Test Methods that measure the plastic properties of SCC. The MTO Special Provision includes testing requirements for plastic and hardened concrete. Plastic SCC can be characterized by the following key properties: 1) filling ability (flowability), 2) passing ability, and 3) stability (segregation resistance). Measured hardened properties include: 1) compressive strength, 2) air void system, 3) linear shrinkage, and 4) visual segregation review. Further research is needed to examine the accuracy of these tests in measuring the properties of SCC and the suitability of these tests as a means of assessing SCC performance. Specific areas of interest to MTO include: 1) correlation of the plastic tests with one another, 2) relationship between results of plastic tests and hardened tests for the same property, and, 3) relationship of both plastic and hardened test results to field performance.
Challenge:	Carry out an experimental programme to evaluate the suitability and accuracy of plastic and hardened test in measuring the important properties of SCC.
Anticipated Outcome:	Technical Report outlining findings of experimental programme and recommended changes, if any, to currently used test methods for SCC. Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**10. Adhesive Anchoring Systems for Reinforcing Steel**
Background:	A portion of the suspended ceiling system of the I-90 connector tunnel in Boston, Massachusetts, collapsed. The suspended ceiling in the collapsed section was comprised of concrete panels connected to steel hangers suspended from the tunnel concrete ceiling by an adhesive anchor system consisting of stainless steel anchor rods embedded in epoxy. A Technical Advisory issued October 17, 2007 by the U.S. Federal Highway Administration "strongly discourages the use of fast-set epoxy for adhesive anchor operations", and also "strongly discourages" systems using other adhesives for permanent sustained tension applications or overhead applications". Two products identified in the FHWA Technical Advisory as "Fast–Set epoxy" have been listed on the ministry's list of prequalified products for anchor applications; and have now been removed due to the Technical Advisory. The list currently includes both epoxy and acrylic-based adhesives. The ministry wishes to put into place a testing and approval process that will ensure identification of products suitable for use in our anchoring applications. Testing should include consideration of long-term creep under sustained tension loads and in overhead applications, and consideration of long-term durability in typical anchor applications (exposed to weather, moisture, chloride etc).
Challenge:	Are the acrylics and fast set epoxy adhesive currently used in MTO anchoring applications vulnerable to failure due to excessive creep when in sustained tension? Are they durable, and resistant over the long term to the impacts of the highway environment? Develop a testing protocol/program for evaluating the creep and durability characteristics of adhesives for anchoring applications, suitable for use by MTO as part of a prequalification process.
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Engineering Materials**
Title:	**11. Evaluation of Alternative Grades of Stainless Steel**
Background:	The rational for using stainless steel in highway structures is quite simple. These alloys are more resistant to chloride contamination than are carbon steels and they have a substantially higher chloride threshold. In order to provide the 75-100 year service life required by current specifications for highway bridges and other major structures in locations where de-icing salts are used the idea of using stainless steel is becoming increasingly attractive. . The ministry currently specifies stainless steel grades 316LN and duplex 2205. However, the recent increasing cost of stainless steel is of concern--the ministry is advised that this is due to increasing nickel and molybdenum costs. Consequently, there is interest in alternative grades of stainless steel with less expensive composition. Nitronic 32 is a relatively high manganese, low nickel, low molybdenum austenitic stainless steel. Grade 2101 “lean duplex” is a high chromium, low nickel, low molybdenum ferritic/austenitic stainless steel. The mechanical properties of both alternative stainless steels have been found to be acceptable in terms of physical properties of tensile strength and elongation. However, testing will be required to confirm the level of corrosion resistance that these promising stainless steels can provide.
Challenge:	The material costs of the two alternative stainless steels are approximately half the cost of the stainless steel grades currently being specified by the ministry. The challenge is to investigate the corrosion protection offered by these new alloys and compare them to the current alloys and to black steel reinforcement to determine whether the new grades are cost effective for future use by MTO.
Anticipated Outcome:	If the alternative stainless steels are shown to be acceptable for future ministry use, bridge construction costs could be significantly reduced. Also at the anticipated lower cost, greater use of stainless steel will be encouraged. This will result in longer lasting structures with lower life cycle costs. Technical Report Presentation to technical committee

Subject Area:	**Highway Design**
Title:	**12. Study to Assess the Treatment Efficiency of Highway Embankments and Ditches.**
Background:	Grass-lined highway ditches are the primary drainage feature associated with Ontario's highways. The Ministry of Transportation recently completed a study entitled The Effectiveness of Grass-lined Highway Ditches in Improving Water Quality, August 2005 (Highway Ditch Water Quality Study). The study included the development of a methodology that can be used by the designer to quantify the treatment efficiency of a highway drainage system. A key finding of the study was the recognition that runoff to ris expected to reach highway roadside ditches very seldom during the year, and primarily during the springtime water retention efficiency, due to infiltration, in roadside ditches. If this hypothesis is correct it can be quite significant in confirming that trapping performance of roadside ditches is better than they are generally credited for.
Challenge:	A literature search, desktop modelling and field monitoring study is required to identify the effectiveness of roadside ditch to retain water in response to rain events under a wide variety of highway drainage conditions including different climatic regions, highway and ditch characteristics, and soil texture and vegetation types. Following from the monitoring, the design methodology can be updated to account for the collected data. 1 - In consultation with MOE, refine proposed methodology. 2 - Technical information and data to support the finding on effectiveness of retention in roadside ditches for different condition. 3 - Methodology to assess retention efficiencies along Ontario's highways to enable the Ministry of Transportation to improve the design of highway drainage systems such that they more efficiently meet prescribed treatment objectives. 4 - Cost benefits associated with design and construction of stormwater management facilities accounting for roadside ditch performance. 5 - A comprehensive report summarizing all the finding which would enable the Ministry to demonstrate to other agencies the effectives of highway drainage systems.
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Highway Design**
Title:	**13. Assessing Flexible Pipe Installation Standards**
Background:	Currently, there are standard specifications for the installation of flexible pipe culverts and sewers on ministry highways. These standards are specified in contracts through the use of the 800 series of Ontario Provincial Standard Drawings for the installation in a trench or embankment situation. Flexible pipes include high density polyethylene (HDPE), polyvinyl chloride (PVC) and corrugated and spiral rib steel (CSP and SRSP) pipes. HDPE and PVC pipe manufactured to Canadian standards (CSA) require all diameters of pipes produced to these standards to have a consistent stiffness of 210 or 320 kPa. HDPE and PVC pipes manufactured to American standards (ASTM or AASHTO) require pipes produced to these standards to have ring stiffness constants consistent for each pipe diameter produced. The actual pipe stiffness, however, declines with increased pipe diameters. CSP and SRSP have similar pipe stiffness characteristics to that of the HDPE and PVC pipes produced to the American standards. Under static load conditions, flexible pipes interact with the surrounding soil to support the weight of the highway structure. These pipes deflect somewhat as the static loads are transferred into the soil structure. Under dynamic loading conditions, the pipes with a greater pipe stiffness factor may deflect differently than the pipes with the lower pipe stiffness factor. Since the pipe stiffness is constant for the plastic pipes produced to CSA standards as compared to the ASTM or AASHTO standards where the pipe stiffness differs with pipe diameters, does dynamic loading interact differently under the standard installation specifications used by the ministry? Is there changes needed to the standard installation requirements to reflect the different pipe stiffness factors?
Challenge:	Given factors such as soil weight, AADT and pipe stiffness are the current flexible pipe installation standards suitable for all flexible pipe materials that are currently acceptable for ministry contracts? Do flexible pipe installation standards need to be developed to reflect pipe stiffness differences? Identify factors that should be addressed when determining the installation requirements such as but not limited to AADT, height of fill, compaction requirements and benefit/cost analysis.
Anticipated Outcome:	Technical Report Installation standards for flexible pipe materials. Presentation to technical committee.

Subject Area:	**Highway Design**
Title:	**14. Updating the MTO Intensity-Duration-Frequency (IDF) Curves for Estimation of Rainfall Intensities**
Background:	In 1989, MTO published District Intensity-Duration-Frequency (IDF) curves of rainfall data for use in the design and analysis of highway drainage systems. These IDF curves were developed for MTO districts from data published in the "Rainfall Frequency Atlas of Canada" (1985), published by Environment Canada. It has been almost 18 years since the publication of the MTO District IDF Curves. Since then MTO's five administrative regional boundaries have changed and the district organization no longer exist. Furthermore, there is evidence that more frequent and sever rainfall events are beginning to be reflected in recent precipitation records. It is in the ministry's interest to maintain up-to-date documentation of rainfall data that reflects the latest data using modern analytical techniques to design the important highway drainage infrastructure elements such as bridges, culverts, storm sewers, and ditches.
Challenge:	Research is required to analyze the current MTO I-D-F Curves with the aim of identifying and developing methods to regularly update I-D-F curves based on the latest available rainfall data, modern statistical techniques and scientifically based boundaries such as climatologically homogeneous regions.
Anticipated Outcome:	Technical Report, including a thorough review of the current IDF Curves and identifying the deficiencies in them. Recommendations for updating the existing MTO I-D-F Curves for the entire province and identifying the most suitable and modern statistical methodologies for rainfall intensity analyses that are currently in use in North America, Europe and Australia. The report is to address how the new data will be used to update the I-D-F curves at specified intervals. Presentation to technical committee

Subject Area:	**Highway Design**
Title:	**15. Investigation of the Influence of Air Turbulence from Large, High-speed Trucks on Bicycle Stability.**
Background:	Large trucks create air turbulence in their vicinity, depending on their speed, size and shape. The effects of such turbulence may be increased by the influence of wind, either cross-wind or head-wind. The effects of turbulence and wind is relatively unknown but may cause a bicycle and rider to be deflected laterally. The bicycle rider may attempt corrective measures which could further reduce stability. This may cause a bicyclist to fall, move towards the truck or move into the path of following vehicles. Paved shoulders, partially paved shoulders or separate bike paths will allow and encourage cyclists to ride further offset from the travelled way, where the effects of turbulence from large trucks may be reduced. The relationship between clearance and turbulence severity is not well understood, but may be investigated. High two-way traffic volumes on two-lane roads will reduce opportunities for vehicle drivers to pull away from the edge of travelled way to allow greater clearance from cyclists.
Challenge:	Research existing technical publications to determine whether or how this subject has already been investigated. Investigate accident reports involving fatality or injury to bicyclists where air turbulence around trucks may have been a contributing factor. It may be possible to model truck turbulence and its severity at different speeds and offsets. Carry out an analysis to determine risk exposure to bicyclists, based on truck traffic volumes, bicycle traffic volumes and width of travelled way, including paved shoulders of various widths. Estimate (determine) appropriate *safe* offset distances for bicycles relative to the edge of the driving lane. Establish the extent that current Ministry standards meet such *safe* offset distances and perform a Benefit/Cost analysis, as applicable, to justify any possible proposed changes to related standards. Research should focus on infrastructure where bicycle separation is not provided from vehicular traffic and in a typical rural cross-section roadway (non-freeway situations).
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Environmental**
Title:	**16. Sustainable Solutions for Construction Site Runoff**
Background:	Silt-laden runoff is a perennial and perpetual problem on highway construction contracts. Various methods and techniques currently exist to control earth surface erosion and the transportation of deleterious substances. Results have been mixed and inconsistent. American federal legislative implementation of the National Pollutant Discharge Elimination System (NPDES), Phase II stormwater regulations has mandated strict erosion and sediment control of all construction sites one acre or larger. This action has created significant research and development of new products and technologies to deal with the demand. MTO has a fairly traditional and conservative set of standards and specifications for dealing with construction runoff. These new products and technologies purport to offer better control, significant removal of contaminants and a design tools to facilitate application.
Challenge:	Evaluate the new technologies and products promoted and available for erosion protection, control of sediment-laden runoff and removal of contaminants.
Anticipated Outcome:	Technical Report Presentation to OPS Environmental Committee

Subject Area:	**Environmental**
Title:	**17. Measuring the Effectiveness of Wildlife-vehicle Collision Mitigation Techniques**
Background:	Northeastern Region has undertaken to install, or install in the near future, measures to mitigate wildlife vehicle collisions. These include wildlife passages on Highway 69 and wildlife fencing on Highway 11.
Challenge:	The effectiveness of various wildlife-vehicle collision mitigation measures has not been measured in Ontario, and in particular in Northern Ontario. Given terrain conditions, highway placement and other factors, measuring the effectiveness of installed measures and recommending improvements or alterations for future instalments would ensure that money is spent in the most appropriate and effective way possible. Monitoring may include, as examples, wildlife collaring and tracking, counting of wildlife tracks, and video surveillance.
Anticipated Outcome:	A monitoring report outlining the current effectiveness of installed measures, recommendations to improve these measures and recommendations on alternative measures that would be more effective or appropriate. Presentation to technical committee.

Subject Area:	**Geomatics**
Title:	**18. GIS Based Management and Distribution System for Raster Data in MTO**
Background:	To manage and distribute MTO's raster and vector data, Geomatics Office is using the ArcSde server platform combined with an in-house application (TMI). Raster data, in contrast to vector, requires large storage space and consequently uses more bandwidth when accessed through any network. To fit MTO's needs, the Geomatics Office is buying more storage space to load all required raster data. The raster data location and storage technique, as well as the platform used, have a direct impact on distribution and use by clients province-wide. In an attempt to lower the storage space cost for different government levels, MNR is working on a Web Mapping Service (WMS) for raster data. Using this WMS, government agencies will have common access to specific raster data through the web.
Challenge:	The proposed research project should provide a clear understanding of the best GIS based system for storing, managing and distributing MTO raster data. The research project will address the following: 1) Assess the current and future MTO needs in regard to image storage and distribution. Is the current data storage and management strategy flexible enough to fit future MTO needs and stay cost effective? 2) The "Image Server" is an ESRI product dedicated to manage and distribute image data. Is this platform a viable and cost effective alternative for MTO? If yes, what is the impact of its implementation on the existing platforms and applications (especially TMI)? If not, is there any third party alternative, compatible with ESRI platform, which will best fit MTO's needs? 3) MNR is working on a WMS (Web Mapping Service) dedicated to imagery data. It is also developing other methods of accessing raster data in general (such as DTMs). What are the benefits and limitations of such services for MTO? How can MTO best leverage these services? A pilot project should be considered to show the effectiveness of any proposed solutions or techniques.
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Bridges**
Title:	**19. Non-Destructive Assessment of Grouted Prestress Cable Ducts in Post-tensioned Decks**
Background:	Post-tensioned concrete deck bridges have been in service in Ontario for more than 30-40 years and many of them have been operating without any waterproofing/asphalt protection from their initial construction. Concerns currently exist as to the condition of the prestressing cables in the grouted ducts particularly in the negative moment regions where the cables are closest to the deck surface. Assessment of the conditions of these prestressing cables/ducts is presently all but impossible without invasive concrete work involving major concrete removal to expose the ducts for visual inspection.
Challenge:	Investigate/develop a non-destructive inspection methodology or procedure to assess the conditions of the grouted prestressing ducts and cables inside.
Anticipated Outcome:	Laboratory evaluation of the proposed technique, including sample field evaluations Technical Report Presentation to technical committee.

Subject Area:	**Bridges**
Title:	**20. Fibre Reinforced Concrete for Bridge Barrier Walls**
Background:	Barrier walls on bridges have to conform to crash testing requirements for strength and geometry. They are also in a severe exposure condition where premature deterioration could occur due to corrosion of the steel reinforcement caused by de-icing salt. MTO is currently using either stainless steel or GFRP in bridge barrier walls in order to achieve a 75 years service life. However, designs using stainless steel or GFRP are expensive due to the high costs of the materials. The cost is further increased due to the necessity to provide two mats of reinforcement in order to conform to the crash tested details. The walls have to be thickened to accommodate the 2 layers of reinforcement. MTO is aware of macro structural fibre that could be added to the concrete to provide post-cracking tensile capacity. These structural fibre could potentially reduce the amount of reinforcement required in the walls, resulting in more economical designs while maintaining durability.
Challenge:	To develop a prototype design for PL2 and PL3 barrier walls using FRC; both stainless steel and GFRP should be considered for the normal reinforcement. The prototype design should be load tested statically in the laboratory for comparison with current standards using steel reinforcement.
Anticipated Outcome:	Technical Report Presentation to technical committee.

Subject Area:	**Bridges**
Title:	**21. Acceptance Criteria for Ultrasonic Impact Treatment (UIT)**
Background:	Ultrasonic Impact Treatment is a method of treating weldments so that the fatigue capacity of the detail is improved. In other countries, this technique has been used for a number of decades and it has been used on at least one occasion by MTO. In MTO's case, contradictory opinions were obtained about the acceptability of the work that was done. Required inspection and non destructive testing, whether any micro cracking is acceptable, equipment requirements, indentation frequency and diameter etc References: Appendix R3 (esp. hammer peening) of CSA W59, Lehigh University
Challenge:	Is it possible to confirm that a weld detail treated by UIT has been treated correctly and that the final product satisfies the design requirements?
Anticipated Outcome:	Technical Report Presentation to technical committee. Draft Specification (QA or QC portion)

Subject Area:	**Bridges**
Title:	**22. Modular Bridge Expansion Joints: Development of a Splice Detail for Modular Bridge Expansion Joints Constructed in Stages**
Background:	To suit traffic needs, MTO often needs to construct bridges in stages. At the ends of long bridges, modular expansion joints may need to be installed. When these joints are installed in stages, they need to be spliced in order to connect the separation beams that support the traffic. Over the years, many such splices have proven to be weak points of the joint, they have failed prematurely and have required much repair and maintenance. It is expected that the proposed splice will be proven analytically according to CSA S6, verified with finite elements for a range of realistic joint configurations and tested for specified fatigue loading. References: NCHRP 402
Challenge:	To develop a splice detail for modular expansion joints
Anticipated Outcome:	Technical Report Presentation to technical committee. Draft standard drawing(s) for the separation beams that may be used by manufacturers of modular joints

Subject Area:	**Bridges**
Title:	**23. Innovative Methods to Mitigate Accelerated Corrosion in Weathering Steel Bridges**
Background:	Weathering steel has been used almost exclusively for structural steel components in highway bridges in Ontario since 1968. It is a low alloy steel containing up to three percent of elements such as copper, nickel, chromium and silicon. During service, under suitable conditions, a stable and compact oxide film (patina) is expected to form at the outer surface which protects the steel from further corrosion. This oxide film or patina is a rough, dark brown coloured layer often with a purplish hue that usually develops after a period of 18-36 months in service. However, over the years the ministry has observed accelerated corrosion in a number of these structures at localized areas such as, in the vicinity of the leaking expansion joints and near the bottom flange of plate girders and more recently at sections of box girders over the driving lanes. Studies conducted by the ministry in collaboration with a steel manufacturer, on compositional analysis of corrosion products, have shown that oxide layers in these locations contain mainly akaganeite (β-FeOOH), an oxide hydroxide of iron, which is formed in chloride rich environment and only a small percentage of goethite (α-FeOOH), another oxide hydroxide of iron, which is found in high proportions in tightly adhering, stable patina. Japanese researchers have shown that it is possible to alter the corrosion process towards the formation of a stable patina in chloride rich environment by using weathering steel containing 3% nickel as an alloying element. However this type of advanced weathering steel would be cost prohibitive for use in bridge components. According to a new study, stable patina formation in high damp and chloride rich environment could also be promoted by employing an ‘active coating’ containing alloying elements found in weathering steel along with other active compounds, to quickly react with the local corrosive environment to force the formation of the oxides that are impervious to the diffusion of chloride ions to the surface. This innovative approach, which could potentially be used to mitigate accelerated corrosion in existing bridges, may be a cost effective option to extend the life of unpainted weathering steel bridges and needs further investigation.

Challenge:	The ministry currently has a cooperative research projerct with an Ontario university studying the performance of coating systems including metallizing for remedial painting/coating of weathering steel structures. The focus of this proposed research should not duplicate the work currently underway, but to specifically look at methods that would promote the formation of a stable, protective patina over the surface of weathering steel components in chloride rich environment.
Anticipated Outcome:	The ministry needs a cost effective surface treatment methodology to mitigate accelerated corrosion in our steel bridges and to promote the formation of tightly adhering, stable patina, to extend the service life of the weathering steel structures. It is also paramount to understand the role of alloying elements including nickel, in the formation of stable patina in chloride rich environments. This would certainly help in the development of improved grades of weathering steel for bridge application. Technical Report Presentation to technical committee

Subject Area:	**Maintenance**
Title:	**24. Seasonal Load Adjustment: Optimization of Seasonal Frost/Thaw Depth and Pavement Strength Predictions on Low Volume Highways in Ontario.**
Background:	Pavements in northern Ontario with seasonal traffic loads are susceptible to damage due to a high number of freeze-thaw cycles and to extended periods of sub-base and sub-grade saturation during the thaw period. Winter weight premiums or spring load restrictions are applied to highways which are not structurally designed to carry heavy loads during saturated periods. These can minimize pavement damage, pavement maintenance costs, and economic loss to industries (i.e. transportation, mining, logging) if the application and removal dates coincide with load-carrying ability of the pavements. Local variance to calendar dates specified in the legislation are typically based on personal expert experience and subjective judgement (i.e. visual observation). However, it is difficult to accurately determine the required pavement strength using the existing methods and this may lead to excess pavement damage or economic loss to industry. This can be reduced through the development of a scientific basis to load adjustment dates that is based on actively measured or predicted frost conditions and pavement response. Preliminary pavement strength and damage risk analyses and pavement frost and thaw depth prediction models have been developed through previous HIIFP grants. Future research and analyses are required to test, refine and expand these models and apply them to the range of pavement and subgrade structures, moisture and temperature conditions of low-volume resource highways across northern Ontario. Continuous subsurface temperature profiles are available from 2006-07 for one site. Air and subsurface temperature profiles, precipitation, soil moisture and soil pressure data are available for that site and 6 others for winter 2007-08. Structureal/Geotechnical profiles are available for all sites. Periodic Portable Falling Weight Deflectomenter data are available for the winter-spring period for two sites. Four sites are located in Thunder Bay area and three in North Bay – New Liskeard area.

Challenge:	The challenges in this projec are. 1. To calibrate, test, optimize and compare various approaches to frost and thaw depth prediction applicable to Seasonal Load Adjustment on highways using data available from the Ontario RWIS network or Environment Canada weather observing stations. The investigation shall include sensitivity of model coefficients to highway structural conditions. As a minimum, the models and testing shall include: • Freeze-thaw index model developed under a previous HIIFP (Bais et al, 2007) • Heat flow model using Finite Element or Finite Difference approach (such as Metro, Temp W) • Models shall be tested against a variety of pavement structures and types such as, but not limited to paved, surface-treated and gravel roadways and different subgrade structure conditions. 2. To predict pavement strength as measured by a Lightweight or Portable Falling Weight Deflectometer, as a function of frost and thaw depths, pavement structure, and other variables. Data and results will be shared with other HIIFP related projects.
Anticipated Outcome:	Technical Report: 1. Literature Review 2. Methodology 3. Measurement Data 4. Prediction Models 5. Results 6. Conclusions 7. Recommendation of frost/thaw depth prediction models for typical Northern Ontario pavement/subgrade structures. Presentation to technical committee in May 2009.

Subject Area:	**Maintenance**
Title:	**25. Seasonal Load Adjustment: Development of Seasonal Load Adjustment Application Guidelines**
Background:	Pavements in northern Ontario with seasonally heavy traffic loads are susceptible to damage due to a high number of freeze-thaw cycles and to extended periods of sub-base and sub-grade saturation during the thaw period. Winter weight premiums and spring load restrictions are applied to low volume highways which are note structurally designed to carrying heavy loads during saturated periods. These can minimize pavement damage, pavement maintenance costs, and economic loss to industries (i.e. transportation, mining, logging) if the application and removal dates coincide with load-carrying ability of the pavements. Local variance to calendar dates specified in the legislation are typically based on personal expert experience and subjective judgement (i.e. visual observation). However, it is difficult to accurately determine the required pavement strength using the existing methods and this may lead to excess pavement damage or economic loss to industry. This can be reduced through the development of a scientific basis to load adjustment dates that is based on actively measured or predicted frost conditions and pavement response... Preliminary pavement strength and damage risk analysis and pavement frost and thaw depth prediction models using forecast air and pavement temperatures have been developed through previous HIIFP grants. Further research and analyses are required to test, refine and expand these models and apply them to the range of pavement and subgrade structures, moisture and temperature conditions of low-volume resource highways across northern Ontario. Additional data are being collected at seven test sites in winter 2007-08 to characterize the environmental conditions and associated, seasonal strength variation. The data include structural and geotechnical characterization at instrumentation site, continuous monitoring of air temperature, pavement temperature profiles (frost and thaw depths), precipitation, soil pressure, soil moisture content, and periodic structural measurement with a portable Falling Weight Deflectometer. Four sites are located in Thunder Bay area and three in North Bay-New Liskeard area.

Challenge:	The challenge of this project is to expand previous analyses relating pavement strength to damage risk and lifecycle cost, and to apply results to pavements with structural and loading characteristics of the instrumented sites. The challenge involves development or calibration of models that provide an understanding of relationships among variations in highway load capacity related to frost and thaw depth, highway lifecycle costs and economic costs to industry of load surplus or restriction. The project output will include a framework for adjusting load allowance in response to frost and thaw depths, and specific recommended maximum load criteria that can be used to set start and end dates for load premiums and restrictions based on real-time pavement strength estimates. Data and results will be shared with other related HIIFP projects.
Anticipated Outcome:	Technical Report: 1. Literature Review 2. Methodology 3. Results 4. Proposed Guideline 5. Conclusions and Recommendations Presentation to technical committee in May, 2009.

Subject Area:	**Maintenance**
Title:	**26. Relation of Winter Friction Performance Measures to Maintenance Outcomes – Phase II**
Background:	The performance measure for winter maintenance on Provincial highways is based on duration of snow cover as monitored by maintenance patrollers. While bare pavement is intuitively related to the risk of driving during winter storms, the qualitative measure prevents a direct link with road safety. A developing performance measure based on the objective, continuous and quantitative measurement of tire-pavement friction may be more directly related to agency goals of road safety and traffic throughput. Such a relationship would allow the adjustment of performance measures to achieve the desired outputs. Planned completions to summer 2008 include: o literature review o development of research methodology o classification of pavement snow cover and bare pavement status from continuous friction measurements, o benchmarking of friction-based performance measures to conventional road condition measures and to bare-pavement reports, o compilation, integration and investigation of a database of pavement condition during winter storms and associated road safety and mobility measures
Challenge:	The challenge is to investigate and estimate relationships between winter maintenance performance standard, road safety and mobility during winter storms, which can be applied to adjust performance measures and standards to achieve desired levels of road safety and traffic flow.
Anticipated Outcome:	Technical Report and peer reviewed conference paper for Transportation Research Board or similar. Presentation to technical committee.

Subject Area:	**Maintenance**
Title:	**27. Chemistry of Multi-chloride Brines**
Background:	Chloride brines containing rust inhibitors are applied to highways in advance of winter storms to prevent frost formation and to facilitate plowing of snow, through an activity called anti-icing or Direct Liquid Application (DLA). The safety and effectiveness of DLA requires that the brines maintain viscosity similar to water, do not freeze and do not form precipitates at ambient storage and operating temperatures and in the presence of previously applied sodium chloride or other contaminants on the pavement. Operating guidelines for DLA were designed around sodium chloride brine. The physical properties of other brines such as calcium chloride, magnesium chloride and mixtures of two or more chlorides plus inhibitors are different from properties of sodium chloride and have not been fully characterized under winter conditions on highways.
Challenge:	A theoretical and physical analysis is required to characterize the properties of anti-icing brines that impact their safety and effectiveness for winter maintenance. The analysis should provide general guidance on the properties of chlorides over the range of temperature, humidity and surface contaminant conditions relevant to snow control operations on highways. It should be applicable to any single or mixed chloride brine, with emphasis on those that are more hygroscopic such as calcium and magnesium.
Anticipated Outcome:	Technical Report 1. physical-chemical theory 2. literature review 3. highway environment 4. laboratory analysis 5. implications for DLA operating guidelines 6. conclusions and recommendations for further work Presentation to MTO technical committee in May 2009.

Subject Area:	**Maintenance**
Title:	**28. SNOWDRIFT Environmental Simulation**
Background:	Drifting snow following the end of a snow storm increases the demand for road salt and plowing by 30% in open terrain areas. Mitigative treatments such as snow ditches, hedges or fences are included in highway designs in such areas. A semi-empirical model was developed to aid in the planning and design of snow treatments by estimating the amount of drifting snow and the depth of accumulation along at 4 m cell intervals over a 1 km area. Inputs include hourly environmental data, and digital elevation and ground cover models. It is implemented as an ArcView extension and has been used for highway planning and forensic analysis of accidents. While each component algorithm is based on verified science, predictions of the system as a whole have not been empirically verified.
Challenge:	The challenge is to acquire data and test predictions of the SNOWDRIFT model and, where predictions can be improved, to recommend improved coefficients or algorithms.
Anticipated Outcome:	Technical Report Presentation to technical committee in May 2009.

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ATTACHMENT B – APPLICATION FORM

For Ministry use only	
Application Number:	

Principal Researcher (Name & Business Address):	Location of Research (address):
Institution:	Applicant's Business Telephone No.
	Applicant's Email Address

Co-Applicants (name, institutional affiliation, city):	
1	
2	
3	

Title of Research including Ministry Topic Number:	

Brief Purpose of Research

FINANCIAL SUMMARY:

Funds Requested From MTO	Funds Requested from Other Sources	Starting Date:	Estimated Completion Date:

Total Budget (MTO and other sources):	

Have you applied to any other funding agencies for support of part of this Research?

YES ☐ **NO** ☐ If YES, please provide details below:

Signatures: It is understood that the provisions of the Ontario Ministry of Transportation HIIFP as outlined in the 2008 HIIFP Guidelines are hereby accepted and agreed to.

Principal Researcher	Head of Department	Dean/Director of Research or Authorized Signing Officer of Sponsoring Institution
Name and Title:	Name and Title:	Name and Title:

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ATTACHMENT C – RESEARCH PROPOSAL SUMMARY

Short Title of Research including Ministry Topic Number:	
Principal Researcher	
SUMMARY OF RESEARCH PROPOSAL (Non-technical language; 300 words maximum)	

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ATTACHMENT D – BUDGET SUMMARY

Note: For multi-year applications, complete one form for each Ministry Fiscal Year ending March 31.
FISCAL YEAR ENDING: March 31, _____(INSERT YEAR)

Principal Researcher:				
Short Title of Research including Ministry Topic Number:				
RESEARCH ITEMS	**Direct Costs of Research**	**Percent Overhead (%)**	**Net Funds Requested from MTO**	**Amount from other sources**
SALARIES AND BENEFITS				
a) Students				
b) Postdoctoral fellows				
c) Technical/professional assistants				
d)				
SUBTOTAL:				
EQUIPMENT OR FACILITY				
a) Purchase or rental				
b) Operation and maintenance costs				
c) User fees				
d)				
SUBTOTAL:				
MATERIALS AND SUPPLIES				
a)				
b)				
c)				
d)				
SUBTOTAL:				
TRAVEL				
a) Technical presentation				
b) Field work				
c)				
SUBTOTAL:				
DISSEMINATION COSTS				
a) Publication costs				
b)				
SUBTOTAL:				
OTHER (specify)				
a)				
b)				
c)				
SUBTOTAL:				
	Direct Costs of Research	**Net Overhead**	**Net Funds Requested from MTO**	**Amount from other sources**
COLUMN TOTAL:				
TOTAL:				

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ATTACHMENT E – PROGRESS REPORT TEMPLATE
PAGE 1 OF 2

For Ministry use only	
Application Number:	

HIIFP Funding Year:	Date:
Principal Researcher (Name & Business Address):	Business Telephone No.
Institution:	Email Address:

Title of Research including Ministry Topic Number:	
Start Date of Research:	
Estimated Completion Date of Research:	

Brief Description of Progress completed to date including 1) status of major tasks, 2) status of outcomes/report, and if applicable, 3) changes and or issues:

Continue on page 2

Signatures:

Principal Researcher	Head of Department	Dean/Director of Research or Authorized Signing Officer of Sponsoring Institution
Name and Title:	Name and Title:	Name and Title:

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ATTACHMENT E – PROGRESS REPORT TEMPLATE – PAGE 2 OF 2

Principal Researcher (Name & Business Address):	Date:

Institution:	
Title of Research including Ministry Topic Number:	

Brief Description of Progress completed to date including 1) status of major tasks, 2) status of outcomes/report, and if applicable, 3) changes and or issues:

Continued from page 1