Ministry of Transportation (MTO)

Highway Infrastructure Innovations Funding Program (HIIFP)

Program Guide
for Ontario Universities and Colleges

Deadline for Application Submissions:
Wednesday, February 15, 2023 at 5:00pm

Submit applications to: HIIFP@ontario.ca

Posted: December 2022

2023-24 Fiscal

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1. Introduction

The Highway Infrastructure Innovations Funding Program (HIIFP) was first introduced in 2003. The objective of this program is to encourage Ontario's academic community to research projects that contribute to generating solutions to current technical challenges encountered by the Ministry of Transportation (MTO) in the construction and maintenance of the provincial highway infrastructure network. These research projects are funded through HIIFP.

A diverse range of specific research topics have been developed by MTO that outline: 1.) the background of the research requirement, 2.) the challenge or problem to be addressed, and 3.) the anticipated outcome and/or research deliverables.

An eligible institution may choose from one of the MTO provided specific research topics or submit their own research topic (i.e., an open research topic).

Research projects awarded the HIIFP grant shall submit a written technical report to be published in the MTO Library Catalog. The research team will also present their findings to the HIIFP Steering Committee and/or an MTO Technical Committee interested in the specific subject area.

2. Purpose of the Program

The objective of this program is to supplement the technical expertise at MTO by providing HIIFP funding to eligible Ontario universities and colleges (institutions). This funding encourages the academic community to conduct research that will contribute to the generation of innovative solutions to current technical challenges experienced during the construction and maintenance of the provincial highway infrastructure network. This research aids MTO in achieving its strategic plan.

Research on innovative approaches and methodologies contribute to solutions in several areas of transportation and infrastructure engineering which are included in this program, such as:

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

A majority of the research topics involve detailed technical issues identified by MTO that will require an innovative solution to address the specified problem. MTO further supports the research methodology and solution generation by assigning an MTO Technical Specialist in the relevant subject area to liaise with the Principal Researcher for all research projects awarded HIIFP funding.

3. Scope of the Program

3.1 Eligible Institutions

All of Ontario's 23 public universities and 24 colleges are eligible for funding under the HIIFP. The Principal Researcher must be a member of the faculty (full or part-time) at the sponsoring institution.

3.2 Eligible Research Topics

A diverse range of specific research topics have been developed by MTO that outline: 1.) the background of the research requirement, 2.) the challenge or problem to be addressed, and 3.) the anticipated outcome and/or research deliverables.

A majority of the research topics involve detailed technical issues identified by MTO that will require an innovative solution to address the specified problem. To qualify for HIIFP funding, an eligible institution's HIIFP application package must cover one (or several) of the specific research topics. An institution may also submit an HIIFP application package with their own research topic (i.e., an open research topic).

3.2.1 Specific Research Topics

Specific research topics are provided based on MTO's research needs in any given fiscal year. Some research topics will be identified as priority research needs for a particular MTO Office and/or subject area. Detailed descriptions of each specific research topic are provided in Appendix A.

The specific research topics included in Appendix A are summarized with the following information:

- **Subject Area:** Description of the general subject area.
- **Title:** Briefly describes the challenge for the subject area.
- **Background:** Discussion of the subject area and the impact to MTO, any previous work done to date, the current approach, thoughts on how to solve the challenge, any applicable reference information and/or literature that currently exists, etc.
- **Challenge:** A statement that outlines the challenge and why an improvement is necessary.

- **Anticipated Outcome(s) & Research Deliverables:** A typical deliverable is a technical report that demonstrates how the challenge was addressed and/or met and shows how improvements may be made. A presentation to an MTO technical committee is also expected.

- **Benefits to MTO:** A description or example of the expected result(s).

3.2.2 Open Research Topics

An open research topic describes a proposed research project that is not included in Appendix A of this Program Guide, however the Principal Researcher considers it to be relevant to the provincial highway infrastructure as well as to MTO's business needs.

If the Principal Researcher chooses to submit an HIIFP application package for an open research topic, they shall complete the Open Research Topic Form, 23-B (see Appendix B) and include it with their HIIFP application package. See Section 4.1 for details regarding the application package components. The Open Research Topic Form, 23-B shall not exceed two (2) pages in length, and the research topic should clearly identify how it will enhance MTO's practices and business needs. Upon inclusion of this form (23-B), MTO may accept and evaluate HIIFP application packages on open research topics. In the case of an application package for an open research topic, where a topic number is required, please insert the word "open" in the "Topic No." field.

If a Principal Researcher proposes to include fieldwork on MTO highways and/or right-of-ways (ROWs) for their open research topic, this fieldwork must be pre-approved prior to submission of an HIIFP application package (see Section 3.6).

3.3 MTO Technical Specialist Assignment

For each approved research project, an MTO Technical Specialist, in the relevant subject area will be assigned to liaise with the Principal Researcher. Timing of periodic meetings and/or telephone conference calls will be negotiated at the commencement of the research project.

Written Project Progress Reports, Form 23-F (see Appendix C) will be required a minimum of every six (6) months. The project progress report shall be sent to the assigned MTO Technical Specialist, with a copy to the HIIFP Coordinator.

3.4 HIIFP Funding and Ineligible Expenditures

The total HIIFP funding amount for any fiscal year is subject to provincial budget approval. MTO may be required to delay the award of HIIFP funds until the provincial budget has been approved.

MTO reserves the right to restrict and/or terminate HIIFP funding at any time, at its sole discretion and without any reasons.

The salary of the Principal Researcher is **not eligible** for funding under the HIIFP, nor is the Principal Researcher eligible to charge any fees in this respect.

3.5 Multi-Year Projects

MTO will consider application packages for research project proposals that are multi-year, meaning funding may be required for the current and future fiscal year(s). In such cases, MTO will endeavour to provide funding beyond the first fiscal year, however, MTO cannot guarantee funding in future years.

For awarded multi-year research projects, institutions will be required to provide written Project Progress Reports, Form 23-F (see Appendix C) a minimum of every six (6) months to be considered for funding in subsequent years. The project progress reports shall be sent to the assigned MTO Technical Specialist, with a copy to the HIIFP Coordinator. Failure to provide such project progress reports describing the percentage completion of the tasks as set out in the original application package may result in the institution being denied funding in subsequent fiscal years. Additionally, MTO reserves the right to revoke the funding in future years, at its sole discretion, and can terminate the research project upon written notice to the institution.

3.6 Fieldwork on MTO Highways and/or ROWs

If the Principal Researcher proposes to include fieldwork on MTO highways and/or ROWs for the research project, this fieldwork must be **pre-approved** prior to submission of an HIIFP application package.

Whether the institution is submitting an application package for a specific research topic (Section 3.2.1) or an open research topic (Section 3.2.2), the Principal Researcher must clearly define and describe the proposed fieldwork and seek pre-approval. Email the HIIFP Coordinator with the Subject Line: HIIFP Fieldwork Approval to receive written consent for proposed fieldwork. Be certain to include the written consent with the application package.

3.7 Information and Data Confidentiality

The Principal Researcher and the institution agree that all information and data that MTO provides in respect of the research project shall be kept confidential. The institution shall only use the provided information and data for purposes related to the submission of a written technical report to MTO for the research project. The institution shall ensure that reasonable methods are taken to secure the confidential information and data of MTO.

Failing to comply with this provision may result in the termination of the research project, where upon the institution shall return all information and data, return all monies paid by MTO and may result in the institution being precluded from the award of future HIIFP funds.

4. Application Package

4.1 Application Package Components

The HIIFP Steering Committee will deem the information contained in the submitted application packages as confidential. Refer to Section 6 for the evaluation criteria implemented by MTO for selecting research project proposals to be awarded HIIFP funding. The application package for a research project proposal shall consist of the following components:

1. HIIFP Application Form (see Appendix D, Form 23-A)

2. Research Proposal Summary (see Appendix E, Form 23-C)

    - 300 words maximum, Arial 12-point font, 1.08 line spacing.
    - Use plain language suitable for communicating with the public.
    - Portions of this summary may be used in a media release, therefore the language should be non-technical and free of acronyms or jargon.

3. Budget Summary (see Appendix F, Form 23-D)

4. Detailed Research Project Proposal

    Ten (10) pages maximum, Arial 12-point font, minimum 1.08 line spacing, and including the following information:

    - Understanding of the need for this research and the objective.
    - Proposed methodologies, innovative approaches, and potential outcomes.
    - Details of the analysis process.
    - Schedule of the activities to be undertaken during the research project, identifying key milestones and associated dates and/or timelines.
    - Qualifications of the Principal Researcher (applicant) in the subject area.
    - Related work performed by the applicant and others on the research team.

5. Budget Details Form (see Appendix G, Form 23-E). See Section 5 for details.

6. Curriculum Vitae (CV) for:

    - The Principal Researcher.
    - The Co-Applicants (if any) listed in the HIIFP Application Form (23-A).
    - See Section 4.1.1 for recommended information to include in the CVs.

7. Additional Approvals (where required). For example:

    - Pre-approvals (use of MTO facilities, work conducted on MTO highways, etc.)
    - Open Research Topic Form 23-B (if applicable, see Section 3.2.2 for details).

4.1.1 Curriculum Vitae (CV) Recommended Information

To encourage consistency across all submitted CVs when evaluating the HIIFP application packages, the following information is recommended for the CV of the Principal Researcher and any other Co-Applicants listed in the HIIFP Application Form.

CV Section	Recommended Information (where applicable)
Personal Information	• Name, Address, and Contact Information
Education	• Degrees and Diplomas
Recognitions	• Prizes, Awards, Distinctions and Honors – describe the recognition received and its importance
Employment	• Academic Work Experience – include the nature of your research, teaching, training, and/or other activities • Non-Academic Work Experience
Research Funding History	• List all sources of support (e.g., grants and research funding) held as an applicant or a co-applicant
Activities	• Supervisory Activities – students (e.g., postdoctoral, undergraduate, summer projects, etc.), research associates and technicians • Mentoring Activities – list all students you have mentored • Advisory Activities – for example, as an expert witness in a legal proceeding • Knowledge and Technology Translation Activities – list activities related to a practical application such as: community engagement and outreach, activities with industry, activities with government, and innovations • International Collaboration Activities – list all collaborations outside of Canada that may be relevant to the application
Memberships	• Committees and other memberships
Contributions	• Presentations (at conferences and events), Interviews and Media Relations, Publications (as author or co-author), Intellectual Property (patents, licenses, disclosures, registered copyrights, trademarks)

4.2 Application Deadlines & Submission Location

The deadline date for the receipt of application packages is:

Wednesday, February 15, 2023 at 5:00pm.

Completed application packages (including all supporting documentation) must be received by this stipulated deadline date.

An electronic PDF copy of the complete application package shall be submitted to the HIIFP Coordinator (HIIFP@ontario.ca) with the Subject Line: HIIFP Application Package.

Subsequent to emailing the HIIFP application package to the HIIFP Coordinator, the applicant (e.g., Principal Researcher) shall receive a return email confirming receipt of the HIIFP application package.

5. Project Proposal Budget

5.1 General

The detailed budget must include a full account of purchases and activities to be financed by the HIIFP grant. The level of budget breakdown and supporting information provided should be sufficient to justify the items relative to the Detailed Research Project Proposal (Item #4, Section 4.1).

Multi-year project proposals (see Section 3.5) may be considered and evaluated on the condition that sufficient information is provided in the application package. A Budget Summary Form (23-D) should be completed for **each** fiscal year in the multi-year project proposal requiring funding.

The HIIFP Steering Committee reserves the right to disallow expenditures in the budget that are not adequately justified.

5.2 Budget Summary & Details

A Budget Summary Form (23-D) and a Budget Details Form (23-E) shall be included in the application package. It is important to consider the provisions outlined in Section 3.4 which describes available funding and ineligible expenditures.

The following types of expenditures are eligible for funding, unless specified otherwise:

5.2.1 Salaries and/or Benefits

Salaries, stipends and related federal, provincial and institutional non-discretionary benefits for research work performed by research personnel (e.g., students, research associates, and technicians) may be included in the budget.

The salary of the Principal Researcher is **not eligible** for funding under the HIIFP and should not be included in the budget.

5.2.2 Equipment and/or Facility

Equipment and/or facility costs directly attributed to the research project may be funded. The Principal Researcher may propose to use MTO equipment and/or laboratory facilities as part of their application, where similar equipment and/or facilities are not available at their institution.

MTO will not normally fund the purchase of major equipment, or the rental of existing equipment. However, in exceptional cases that satisfy MTO, major equipment purchases, rental of large, shared equipment or the purchase of computer time will be considered on a case-by-case basis.

5.2.3 Materials and/or Supplies

Materials may include the purchase of engineering materials directly attributable to the research project proposal. Supplies may include expendable materials, printing, photocopying, and other similar office supplies.

Materials that are to be supplied by MTO will be indicated in the “Background” section of the Specific Research Topic included in Appendix A of this Program Guide.

5.2.4 Travel

A presentation of the research findings to the HIIFP Steering Committee and/or an MTO Technical Committee may be a key deliverable for the research project proposal. Travel and accommodation, if required, shall be in accordance with the institution’s internal travel policy and all associated costs shall be included in the budget summary.

5.2.5 Dissemination Costs

Dissemination costs include costs associated with the preparation of the written technical report. All written technical reports shall be in conformance with the Ontario Government accessibility requirements in order to be accepted by MTO. See Section 10 for details related to the requirements for written technical reports.

5.2.6 Overhead

Overhead may be included in the budget for the research project proposal. The Budget Summary Form (23-D) requires that the applicant identify the rate (as a percentage) of overhead for the institution. Please note that HIIFP funding is considered a research grant, therefore overhead rates should be calculated and presented accordingly. Overhead rates shall not exceed 25%.

6. Evaluation Criteria

MTO will **only** accept, review and evaluate application packages (see Section 4.1 for the required components of an application package) that are received by the deadline date specified in Section 4.2.

To assist institutions and applicants in completing their application package, the evaluation criteria implemented by MTO for awarding research project proposals HIIFP funding is summarized in the following subsections.

6.1 Application Package Content

Each of the following four items are awarded a numerical score, a maximum of 20 points for each item:

- Demonstrates an understanding of the research need and the desired objective(s)/outcome(s).
- Exhibits a degree of innovativeness to address the problem described in the research need.
- Feasibility of accomplishing the required deliverables within the proposed timelines and budget.
- Experience and qualifications of the Principal Researcher (and Co-Applicants, where applicable) in the subject area(s).

The maximum total for this section is equal to **80 points**.

6.2 Other Considerations

Each of the following four questions are awarded a numerical score based on the reviewer's response ("yes" = 5 points, "no" = 0 points):

- Does the overall cost of the research project provide good Value-For-Money to MTO?
- Is the research project of great importance to MTO?
- Does the MTO Office have a Technical Specialist available to support the research team for the duration of the project?

- Does the research project demonstrate the use of sustainable materials and processes?

The maximum total for this section is equal to **20 points**.

6.3 Final Recommendation

Evaluators will make a final recommendation for each application package by choosing one of three potential outcomes:

- **Yes**, recommend for HIIFP funding.
- **Yes**, recommend for HIIFP funding with suggested changes and/or modifications.
- **No**, do not recommend for HIIFP funding.

7. Notification of Award & Next Steps

A letter announcing the award of HIIFP funds will be sent at the beginning of the award period from MTO to the Principal Researcher. A copy of the award letter will also be sent to the Authorized Signing Officer of the Sponsoring Institution as designated in the HIIFP Application Form (23-A).

Upon receipt of the award letter, the institution accepts and agrees to: 1.) the provisions in the award letter, 2.) the contents of the submitted application package for the research project proposal, and 3.) the requirements set out in this Program Guide. The award letter also provides authority for the institution to incur project expenses for items and amounts specified in the approved Budget Summary Form (23-D). Note, expenses incurred in excess of the approved budget are not the responsibility of MTO.

Following receipt of the award letter and prior to beginning the research project, the Principal Researcher shall connect with the MTO Contact (MTO Technical Specialist) listed in the award letter. This communication between the institution and MTO is critically important to re-confirm all research project proposal items such as:

- The required resources.
- The project schedule.
- Any assistance requested of MTO.
- The specific project deliverables.

Recipients of HIIFP funding and their research team and/or associates are not considered employees of the Ministry of Transportation (MTO) or the Ontario Government. MTO reserves the right to terminate HIIFP funding without cause, at any time, by providing written notice of termination to the institution.

Any public announcements about the award of funding for the Highway Infrastructure Innovations Funding Program shall be made by MTO, unless the institution obtains the prior written approval by MTO.

8. Financial Arrangements & Reporting Requirements

HIIFP funds shall be paid to the institution in one instalment. As outlined in the award letter, the institution will be required to send an invoice to the HIIFP Coordinator for the specified funding amount.

Recipients of HIIFP funding are required to maintain periodic contact with the HIIFP Coordinator and/or the MTO Contact assigned to their research project.

A financial report must be submitted to MTO by the Authorized Signing Officer of the Sponsoring Institution upon completion of the research project. This financial report shall include a full account of purchases and activities financed by the HIIFP grant. The financial report shall also include an itemized list of equipment that was purchased in whole or part with the HIIFP funds.

The following items shall be included in the financial report:

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

MTO reserves the right to audit any research project. The institution is required to keep any records that may be required for a financial audit for a minimum of five (5) years.

For approved multi-year research projects, in order to be considered for funding in subsequent years, institutions will be required to provide written Project Progress Reports, Form 23-F (see Appendix C) a minimum of every six (6) months. The project progress report shall be sent to the MTO Contact, with a copy to the HIIFP Coordinator. Failure to provide such Project Progress Reports describing the percentage completion of the tasks set out in the original application package may result in the institution being denied funding in subsequent fiscal years. Additionally, MTO reserves the right to revoke the funding in future years and can terminate the research project upon written notice to the institution.

Any surplus or unspent funds must be returned to MTO by the institution. If the research project is not started or is terminated part way through the proposed timeframe, any unused portion(s) of the HIIFP funding must be returned to the HIIFP Coordinator within thirty (30) calendar days.

9. Amendments to a Research Project

The Principal Researcher shall notify the HIIFP Coordinator, in writing, in advance of any intention to:

- Alter the direction or intent of the research project.
- Terminate the research project.
- Reassign research responsibilities to other researchers, other than those named in the original HIIFP application package.
- Modify the research project work schedule.
- Reallocate funding described in the Budget Summary Form (23-D) and/or Budget Details Form (23-E) included in the original HIIFP application package.
- Alter the research project deliverables and/or timelines.

Written approval from the HIIFP Coordinator must be obtained before any alterations or amendments to the research project are implemented. Extensions for research projects may be granted if a valid reason for the research extension is provided in advance and an interim Project Progress Report (23-F) is submitted.

If the Principal Researcher is uncertain as to what constitutes an alteration or amendment to the research project, the Principal Researcher shall contact the HIIFP Coordinator and/or the assigned MTO Contact to discuss further.

10. Deliverables

For projects awarded HIIFP funding, the Principal Researcher, and their research team shall:

- Submit a written technical report, published in the MTO Library Catalog, demonstrating how the research need was addressed and/or met and recommendations where improvements may be made.
- Present their findings to the HIIFP Steering Committee and/or an MTO Technical Committee interested in the specific subject area.

10.1 Written Technical Report

The Principal Researcher shall submit a written technical report, no later than three (3) months after the research completion date (as specified in the submitted HIIFP Application Form, 23-A) or after termination of the funding by MTO.

The Principal Researcher shall use the HIIFP Report Template, an MS Word™ template (see Appendix H) as a baseline when preparing the written technical report to maintain consistency of all submitted HIIFP reports. The Technical Report Style Guide for the Engineering Materials Office (EMO), EMO-208 may also be used as a resource to aid the Principal Researcher in producing a written technical report that is well organized, functional, and professional.

To be accepted by MTO, all HIIFP written technical reports require inclusion of a Technical Report Documentation Page (see page ii of the HIIFP Report Template) and shall be submitted in a PDF format. Prior to converting the MS Word™ document to PDF, an accessibility check should be performed using the MS Word™ Accessibility Checker to ensure the written technical report is in conformance with the Ontario Government accessibility requirements. Some best practices for ensuring accessibility requirements are met when preparing written technical reports include:

- Placing a focus on accessibility early in the process of preparing the written technical report.
- Using the HIIFP Report Template, an MS Word™ template with accessibility choices, e.g., font type and size, paragraph spacing, line spacing, etc. pre-defined for the written technical report.
- Choosing font types that are sans serif, e.g., Arial, Calibri, Raleway, etc. and 12-point font size or larger.

- Avoiding large sections of text set in all caps, bold and/or italic.
- Limiting the use of underlined text, except for hyperlinks.
- Using meaningful and descriptive hyperlink text. Avoiding words like “click here” or “go here” for the hyperlink text.
- Avoiding the use of visual cues alone to convey important information, e.g., text effects, highlighting text, low contrast colours, serif fonts, etc.
- Avoiding over use of the **Enter** key, **space bar** or **Tab** key to create white space in the document. An individual who uses a screen reader will hear “blank” repeated several times and this can be distracting or lead the person to believe they have reached the end of the document.
- Performing an accessibility check using the MS Word™ Accessibility Checker prior to converting the source document (e.g., HIIFP written technical report) to PDF to ensure the written technical report meets digital accessibility requirements.
- Converting the source document in a way that ensures the accessibility considerations and information, e.g. cues, tags, styles, etc., are not lost during the conversion process.

MTO will retain the written technical report, generate an ISBN (International Standard Book Number) and publish the final report in the MTO Library Catalog. It is important to note that a copy of a student thesis or dissertation is **not** a substitute for an HIIFP written technical report.

Members of the HIIFP Steering Committee that recommended support of the research project may also review the written technical report.

The institution or Principal Researcher shall also provide MTO with a copy of any follow-up publications which the Principal Researcher prepares following the research project and which incorporates any portion of the research outcomes.

10.2 Presentation of Findings

Upon submission of the written technical report, the Principal Researcher and their research team shall prepare and present the findings of their research project to the MTO Contact assigned to the research project and/or any other interested MTO staff members. In coordination with Principal Researcher, the presentation will be scheduled by the HIIFP Coordinator within two (2) months of the submission of the written technical report.

The presentation shall be prepared using MS PowerPoint™, with consideration made for the following best practices:

- Ensure each slide title is meaningful and unique.
- Choose font types that are sans serif, e.g., Arial, Calibri, Raleway, etc. and 18-point or larger for slide content.
- Avoid large amounts of text set in all capitals, bold, italics, and/or underlined.
- For colour, ensure text and background colours have a contrast ratio of at least 4.5:1, or 3:1 (for large text, 14-point bold and larger).
- Do no use colour alone to convey important information
- Ensure sufficient white space is provided between text and graphics.
- Abbreviations and acronyms shall be fully explained and/or spelled out in their first instance in the presentation.
- Use the notes pane to provide supplementary information or longer descriptions, if required.

11. Research Outcomes

When MTO elects to use the findings from research projects funded by HIIFP, as a condition of the HIIFP funding, MTO shall be granted a non-exclusive, royalty-free license, without charge to use the research outcomes, data, tools, and/or conclusions for MTO's own non-commercial internal purposes. This includes use on MTO highway contracts and work conducted on behalf of MTO.

In the event the institution is able to obtain patent protection for any of the outcomes and/or conclusions in the research project, MTO 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-license to third parties. The institution shall arrange for the execution of the appropriate documents to provide such licenses to MTO.

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

Should MTO's findings and/or conclusions differ from the findings and/or conclusions in the research outcomes, the names of the Principal Researcher, original authors, and institution shall not be associated with MTO's findings and/or conclusions.

12. External Communication of Research Outcomes

For the purpose of this section, 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. This does not include a student thesis or other communications submitted for the purpose of evaluating the student's performance. The institution retains the right to have a student's thesis reviewed and defended for the sole purpose of academic evaluation in accordance with the institution's established procedures.

12.1 External Communications

The Principal Researcher and/or institution shall notify MTO of any external disclosure, publication and/or presentation of the research project findings, outcomes and/or conclusions by adhering to the information in the following sections, where applicable to the particular situation.

12.1.1 Disclosure

Both MTO and the Principal Researcher/institution shall be sensitive to the need for timely approval of a student's thesis and/or essay.

12.1.2 Publications or Presentations

The Principal Researcher/institution, using their best efforts, shall notify MTO at least sixty (60) calendar days in advance of any proposed external publication or presentation. The associated outline or abstract shall be submitted to the HIIFP Coordinator with the Subject Line: External Communication.

12.1.3 Publication Disclaimer

Any publication resulting from a research project funded through HIIFP shall acknowledge the source of the funds and include a disclaimer indicating that the views of the authors may not necessarily reflect the views and policies of MTO. Sample wording of a disclaimer to be used is as follows:

"This research project was supported [whole or in part] by a grant from the Ontario Ministry of Transportation (MTO). Opinions expressed in this report are those of the authors and may not necessarily reflect the views and policies of MTO."

12.1.4 Reference Permission

Should the Principal Researcher/institution wish to make specific reference to MTO and/or name an MTO staff member in the publication, permission by MTO shall be obtained prior to publication. Permission requests shall be sent to the HIIFP Coordinator with the Subject Line: Reference Permission.

12.1.5 Media Inquiries

The Principal Researcher/institution should not speak directly to the media regarding the research project or any findings, outcomes and/or conclusions. Any Principal Researchers/institutions contacted by the media shall communicate the following:

"The Highway Infrastructure Innovations Funding Program policy is to refer all media inquiries to MTO's Communications Branch".

All media inquiries regarding awarded HIIFP research projects should be sent to the HIIFP Coordinator with the Subject Line: Media Inquiry. Once the request is received by the HIIFP Coordinator, they will refer the inquiry to the MTO Communications Branch where an Issues Advisor will draft an appropriate response. The reporter/media outlet that made the original inquiry will be sent an official response by an MTO Issues Advisor from the Communications Branch.

13. Occupational Health and Safety

The institution and Principal Researcher shall be responsible for understanding and complying with all legal obligations under the Occupational Health and Safety Act (OHSA). Any procedures undertaken as a result of the awarded HIIFP research project shall be carried out in accordance with the OHSA and all applicable regulations.

Principal Researchers intending to carry out fieldwork on MTO highways and right-of-ways and/or proposing to make use of MTO laboratory facilities shall contact MTO for additional information on operational constraints and occupational health and safety requirements.

Appendix A. Specific Research Topics

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Topic 1: Assessing Electric Vehicle (EV) Charging Infrastructure Gaps and Opportunities Across Ontario

Subject Area	Electric Vehicle Charging Infrastructure
Title	Assessing Electric Vehicle (EV) Charging Infrastructure Gaps And Opportunities Across Ontario
Background	• Ontario's transportation system is transitioning to an electric future. In order to help meet the federal target of 100% zero-emission vehicle sales by 2035, many more EV charging stations (EVCS) will need to be built across the province. While most charging is anticipated to happen at home, public charging plays an important role, particularly for (a) long-distance travel and (b) those without access to home charging. • In March 2022, the Ontario Ministry of Transportation announced a $91.1M investment in public EV charging infrastructure. This investment will make EVCS more accessible to the public across the province, including at highway rest stops, carpool parking lots, provincial parks, and in community hubs like hockey arenas and municipal parks. • MTO has developed preliminary estimates of public charging needs across the province, using industry benchmarks for EV-to-charger ratios and aligning with best practices across peer jurisdictions. Relevant research includes the federal government's Projections of Canada's Public Charging Infrastructure Needs (Dunsky, 2022) and Quebec's Assessment of Charging Infrastructure Needs (International Council on Clean Transportation, 2021). However, to date, no Ontario-specific analysis of comparable scope has been identified that quantifies provincial charging infrastructure needs.

Challenge	• There is an opportunity for research to help inform the number of public EVCS of each type (Level 2 and Level 3 of various power outputs) needed across Ontario, and at which locations. • Given the wide range of ideal EV-to-charger ratios cited across the literature, research is needed to provide Ontario-specific recommendations to (a) help guide future provincial investment in public chargers, and (b) support partners including municipalities, Indigenous communities, private businesses and other organizations in identifying strategies to appropriately deploy public EVCS. • Beyond headline figures (e.g. Ontario needs X chargers by year Y), more disaggregated research is needed to identify specific categories of underserved areas, including both along corridors and within communities across Ontario. The research would identify types of sites that are (a) most likely to achieve public benefit; and (b) least likely to be built in the absence of public supports. • Research needs to consider the various uncertainties facing the sector in the coming years, including the pace of technological advancement (e.g., EV battery range and charging speed), level of future private investment and attractiveness of EVCS business case, investment by other levels of government, and changes to the regulatory landscape (e.g., targets and mandates). • While significant focus is placed on light-duty vehicles, the research should also consider the types of public charging infrastructure needed to support commercial traffic including light, medium and heavy-duty vehicles.

Anticipated Outcome(s) / Research Deliverable(s)	1) A report providing an assessment of charging needs across Ontario (including the number and type of chargers needed province-wide, by geographic region, and by community size) from today to 2050. 2) An EVCS site selection tool to support MTO staff in identifying, evaluating and prioritizing appropriate locations for public EVCS, both on government lands and at third-party sites. This GIS-based tool would consider both macro and micro site attributes (macro considering the overall contribution to filling gaps and bolstering Ontario's network of EVCS, and micro considering site-specific criteria like local amenities). 3) A presentation to MTO staff and handover of the EVCS site selection tool.
Benefits to MTO	• This research would support Ontario's transportation electrification efforts by providing an evidence-based assessment of the magnitude and types of investments needed to achieve Ontario's electrification goals. • Specifically, the research would help MTO target the appropriate types and locations of EVCS to accelerate the transition to EVs while minimizing the likelihood of underutilized chargers.
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Topic 2: Researching the Effectiveness of Species at Risk (SAR) Bat Habitat Compensation Measures Implemented on Select Ministry of Transportation Projects

Subject Area	Environmental
Title	Researching the Effectiveness of Species at Risk (SAR) Bat Habitat Compensation Measures Implemented on Select Ministry of Transportation Projects
Background	In North America, populations of bat species have recently been declining due to a fungal disease called white-nose syndrome. The species also face threats to their survival due to habitat destruction and degradation. In Ontario, there are four bat species at risk included on the Species at Risk in Ontario list (O. Reg 230/08 made under the *Endangered Species Act, 2007*) 1) Little Brown Myotis (Endangered) 2) Northern Myotis (Endangered) 3) Eastern Small-footed Myotis (Endangered) 4) Tri-colored Bat (Endangered) The *Endangered Species Act* (ESA) prohibits killing, harming, or harassing species listed as threatened, endangered or extirpated and prohibits the damage or destruction of the habitat of threatened and endangered species. The ESA applies to MTO highway planning, design, construction, and maintenance activities that impact species at risk or their habitat.

	If an MTO project is going to negatively impact SAR bat species or their habitat, MTO will require an authorization (e.g. a permit or registration) under the ESA. If it is determined a permit is required, MTO will work with the Ministry of Environment, Conservation and Parks (MECP) to obtain a permit under the ESA. The permit will contain conditions related to mitigation, compensation and/or overall benefit measures that MTO must adhere to. The current approach includes compensation, overall benefit measures such as tree planting, installation of different style bat boxes, artificial bark, and rock piles for hibernaculum. In addition, there are monitoring requirements for the compensation and/or overall benefit activities including, but not limited frequent site reconnaissance activities, photographic records including evidence of bat usage, guano, etc., use of temperature loggers, and warranty for revegetation efforts to ensure long-term protection of the habitat. Monitoring activities are required to be documented in reports at frequencies determined by the overall benefit permits, which are issued by the MECP.
Challenge	MTO has received numerous ESA permits for SAR bats from MECP that have included a range of compensation, overall benefit measures and monitoring conditions. MTO is interested in exploring research opportunities to provide additional effectiveness of these permit conditions. Standardizing the types of compensation, overall benefit measures and monitoring requirements will allow for greater success in providing adequate information to facilitate in the recovery of SAR bats listed under the Act. Specifically, the researchers should: 1) Evaluate the effectiveness of compensation, overall benefit measures that have been included on MTO projects and explore any additional recommendations for the species, and 2) Evaluate the effectiveness of the monitoring conditions that have been included in the ESA permits and explore any additional recommendations for the species. The research initiative can focus on five (5) locations across Ontario where ESA permits have been received, located within West, Central, and East Region boundaries. MTO will provide further information on the permits received.

Anticipated Outcome(s) / Research Deliverable(s)	Draft progress reports every 6 months with a written technical report and a presentation that should include the following information: • Results of desktop research and field investigations outlining most effective monitoring requirements and compensation measures. • Analysis and methodologies for testing, evaluating and/or comparing all of bat compensation measures and monitoring conditions imposed on MTO projects through ESA permits. • Recommendations for the adoption of the most effective bat compensation measures providing consistence in future ESA permit conditions. • Design Guidelines for effective compensation structures and habitat
Benefits to MTO	Currently, there is insufficient research on the effectiveness of compensation, overall benefit measures, and monitoring. This knowledge gap has resulted in an inconsistent approach to compensation across MTO projects, and potentially not using the most resource effective methods to mitigate impacts to bats and bat habitat. The information received from this report will support in a more streamlined selection of the most effective compensation measures for projects. MTO will use this information to continue discussions with the Ministry of Environment, Conservation and Parks (MECP) during the development of future ESA permits for MTO projects that impact SAR Bats.
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Topic 3: Rheology Investigation of Hot Applied Rubberized Asphalt Waterproofing Membranes for Concrete Structures

Subject Area	Polymer chemistry, chemical engineering, mechanical engineering
Title	Rheology Investigation of Hot Applied Rubberized Asphalt Waterproofing Membranes for Concrete Structures
Background	Bitumen-based coatings are melted and hot applied to concrete bridge decks (and culverts) at a thickness of 5 mm to prevent water ingress. A protection board and asphalt pavement are then applied to complete the bridge deck. Over the past year, the waterproofing coating exhibited bubbles and voids on cooling which can compromise its waterproofing ability and lead to concrete degradation. Initial laboratory investigations involved pouring the hot applied membrane on dry and water immersed concrete slabs at different temperatures ranging from 23˚C to 60˚C. The bubbling occurred under all conditions but was less pronounced with water-soaked concrete slabs. The water likely caused an evaporative cooling effect at the concrete contact surface, preventing the propagation of air and water vapour through the coating. It is suspected that the present hot applied membrane is more elastic than previous samples, which supports the bubble retention as the material cools. A less elastic membrane would allow air voids to dissipate before cooling and solidification. The surface tension of the hot applied membrane may also play a role in favouring smaller bubbles coalescing into larger ones.
Challenge	The current quality assurance testing involves testing of the waterproofing below the melt temperature. These include room temperature toughness, indentation resistance, sag resistance, cold bend and relative density. The challenge is to determine which set of rheology testing would identify a waterproofing material’s tendency to form bubbles or voids on cooling.

	Suggested tests include the following on a dynamic mechanical analysis (DMA) rheometer with parallel plate or cone and plate fixtures. 1) Strain sweeps at different temperatures and frequencies to determine limits of linear viscoelastic region. 2) Frequency sweeps at different melt temperatures to determine shear thinning behavior or power law vs. Newtonian flow characteristics. 3) Dynamic temperature ramps (both heating and cooling) from 10˚C below softening point to 50˚C above softening point. This would reveal any hysteresis behavior attributed to material composition from the crossover temperatures. 4) Extensional or elongational viscosity near the softening temperature to predict the tendency to form a stable bubble. Any other suggestions for testing which can help to identify bubble – forming tendency is welcome.
Anticipated Outcome(s) / Research Deliverable(s)	Written technical report and a presentation to a ministry technical committee.
Benefits to MTO	Better understanding of the melt rheology of waterproofing materials and a test method to screen future materials. A simplified laboratory quality assurance test may be developed to identify and screen materials that tend to form stable bubbles.
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Topic 4: Investigating the Pavement Impact in Spring to Support Spring Load Restriction Impact in Asset Management

Subject Area	Pavement design and asset management
Title	Investigating the Pavement Impact in Spring to Support Spring Load Restriction Impact in Asset Management
Background	Ontario applies reduced load period (RLP) to restrict load on truck on provincial low-volume roads and municipal roads in order to protect these roads from damage during spring-thaw pavement weakening season. It is crucial to know the pavement strength during spring-thaw period, so that the RLP can be set as accurate as possible. The most effective method to determine pavement strength is based on the road deflection measurements using static and dynamic non-destruction methods. However, most municipalities impose RLP using a fixed-date approach. In 2021, concern has been raised from both municipalities and the trucking industry that the fixed RLP does not reflect the actual spring-thaw period accurately. MTO received a request from the municipalities to assist understanding the RLP needs of their road networks. In an effort to reduce economic hardship from the trucking industry and to support the municipalities to protect their road infrastructure, MTO is proposing a scientific-based approach to determine RLP as an interim-model for the entire province in 2022 by monitoring the thawing condition and performed the pavement deflection using falling weight deflection (FWD) to determine the pavement strength on 15 Seasonal Load Adjustment (SLA) sites during 2022 spring-thaw season.

Challenge	Pavement strength impacts during the spring-thaw depends on several factors, but not limited to, air temperature, pavement thickness, subgrade type, drainage condition and frost depth. The interim model was calibrated based on the pavement strength changes on 15 SLA sites during spring thaw, which may not be representing the pavement strength for all road infrastructure. Therefore, measure the network level pavement strength (throughout the province) during spring-thaw period using an effective and efficient deflection measurement method is vital to understand the pavement strength impact during spring-thaw, and improve the accuracy and optimize the timing of RLP.
Anticipated Outcome(s) / Research Deliverable(s)	Develop an effective and efficient network level measurement framework and to test and determine the pavement strength impact during the spring on varying pavement structure using multi-speed deflectometer (MSD). Classify the varying pavement structures that are already under spring load restrictions to: very weak, weak, medium and strong categories. Perform pavement deflection analysis using MSD and validate the measurement with other baseline deflection measurement method (i.e., FWD). The results collected on varying pavement structures in provincial and municipal setting can also be used to supplement the Ontario RLP model.
Benefits to MTO	The information can be used to validate the accuracy and feasibility of MSD for network level pavement deflection collection. In addition, the data collected can supplement the pavement strength impact on varying pavement structures during spring thaw period and to improve the RLP model accuracy for the entire province.
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Topic 5: Incorporating Climate Change into Rainfall Prediction

Subject Area	Drainage and Hydrology
Title	Incorporating Climate Change into Rainfall Prediction
Background	Downscaling climate change models to rainfall intensities at a specific location, duration and return period is a challenge. MTO currently accounts for climate change in the design of drainage infrastructure using a factor derived from statistical analysis of historical data. Climate Change Canada has a model which is based on temperature increase. There is significant variability between the models and different RCP level projections.
Challenge	Drainage infrastructure must be designed to function within performance standards to its end of service life. Selection of the appropriate climate change multiplier has a significant impact on cost. A methodology needs to be developed to identify the appropriate cost to risk associated with the climate change unknown.
Anticipated Outcome(s) / Research Deliverable(s)	A Risk Matrix to guide designers in selecting the appropriate change in precipitation for the design life of drainage infrastructure. Presentation of research and matrix. A policy document to support the implementation of the risk matrix in MTO.
Benefits to MTO	Updated guidance to designers on the application of climate change forecasts to rainfall. Increased confidence in adaptability of drainage infrastructure to climate change.
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Topic 6: Safe Accommodation of Active Transportation Through Highway Interchanges – Balancing the Needs of Cyclists, Pedestrians, and Motorists

Subject Area	Cycling and Active Transportation
Title	Safe Accommodation of Active Transportation Through Highway Interchanges – Balancing the Needs of Cyclists, Pedestrians, and Motorists
Background	Cycling is an integral part of Ontario's transportation system and an important alternative mode of transportation, having both health and environmental benefits. Interchange on and off ramps are high-risk locations for cyclists to cross due to the high-speed free-flowing environment. Cyclists and pedestrians are considered one of the most vulnerable road user groups as such careful consideration must be made. Stakeholders and experts expect the number of people choosing cycling as their mode of transportation to increase in the future.
Challenge	There is an increasing amount of pressure to modernize and provide enhanced guidance for safer crossing for cyclists at ramps and interchange crossings. Interchange ramps are dangerous for cyclists as they are typically at higher speeds and have multiple uncontrolled conflict points. The integration of cyclists at interchanges is often more complex than that for straight roadway segments. Interchanges possess unique characteristics and functions that present challenges when designing for the integration of cyclists especially when retrofitting cycling facilities on existing interchange structures. Cycling facilities may be able to be implemented for an existing interchange during an upgrade, as a retrofitting project, or as part of a new interchange design.

	Balancing the needs of traffic volumes and cyclists is difficult, a change that could make a crossing easier for cyclists could cause widespread gridlock. Transitioning cycling facilities through interchanges is difficult and takes room that is not always available.
Anticipated Outcome(s) / Research Deliverable(s)	• Jurisdictional Scan • Decision Matrix • Technical Report • Presentation to Technical Committee
Benefits to MTO	• Safety • Balance needs of cyclists, pedestrians, and motorists • Enhanced guidance • Congestion reduction • Greenhouse gas reductions
MTO Contact: Name Email Phone Number	Kyle Perdue kyle.perdue@ontario.ca 905-704-2258

Topic 7: Quantifying Greenhouse Gasses Emitted During Congestion, Construction Staging, and Other Temporary Traffic Conditions

Subject Area	Climate Change
Title	Quantifying Greenhouse Gasses Emitted During Congestion, Construction Staging, and Other Temporary Traffic Conditions
Background	The effects of climate change and extreme weather pose a serious threat to infrastructure, health, and standard of living, and can result in significant financial consequences unless immediate action is taken. Mitigation of greenhouse gas emissions is required to avoid the worst impacts of climate change. The Ontario government has committed through their Made-In-Ontario plan to take meaningful action to reduce greenhouse gas emissions to meet 2030 targets while helping communities prepare for the impacts of climate change. For the MTO to evolve its efforts against climate change, it is crucial to further investigate greenhouse gas emissions associated with congestion, construction staging, and other temporary traffic conditions.
Challenge	There is currently no standardized greenhouse gas tracking and mitigation method that can track emissions resulting from road closures and their subsequent backups on provincial highways. With a tool that could predict and model traffic backups, designers could better minimize related greenhouse gas emissions. Variable factors such as the number of lanes, number of interchanges in a work zone, length of a road closure, percent of electric vehicles, and emerging fuel efficiencies would all need to be considered. A challenge will be creating a tool that can be applied using minimal internal resources and be user-friendly for project managers and designers. Any tool developed cannot be labor-intensive, require specialized training, and must be intuitive to account for high staff turnover rates.

Anticipated Outcome(s) / Research Deliverable(s)	• Jurisdictional Scan • Decision Matrix • Technical Report • Presentation to Technical Committee • Tracking Tool / App
Benefits to MTO	• An intuitive tracking tool that can aid in the minimization of greenhouse gas emissions resulting from road closures and associated backups. • Fostering innovation by embracing emerging technologies in transportation and applying them to mitigate the effects of climate change on infrastructure and the environment.
MTO Contact: Name Email Phone Number	Kyle Perdue kyle.perdue@ontario.ca 905-704-2258

Topic 8: Key Performance Indicators (KPIs) and Targets for Demonstrating Sustainability and Climate Action Progress in Highway Design

Subject Area	Climate Change
Title	Key Performance Indicators (KPIs) and Targets for Demonstrating Sustainability and Climate Action Progress in Highway Design
Background	The effects of climate change and extreme weather pose a serious threat to infrastructure, health, and standard of living, and can result in significant financial consequences unless immediate action is taken. Mitigation of greenhouse gas emissions is required to avoid the worst impacts of climate change. The Ontario government has committed through their Made-In-Ontario plan to take meaningful action to reduce greenhouse gas emissions to meet 2030 targets while helping communities prepare for the impacts of climate change. The MTO has identified a number of potential approaches to include climate change mitigation and adaptation opportunities in MTO provincial highway design, construction, and maintenance. Many of these mitigation and adaptation opportunities are currently in use and are continually being refined for improved and expanded use in operations. Although greenhouse gas emissions can be estimated for some initiatives, there are many initiatives that cannot be measured or calculated. It is therefore important to develop key performance Indicators (KPIs) and targets to demonstrate sustainability and climate action progress in highway management.
Challenge	• The biggest challenge associated with key performance indicators is capturing the diversity of all activities in design, construction, and maintenance. Any targets and indicators must be robust to capture new and emerging practices as policies and innovations evolve.

	• A baseline for each KPI as well as a methodology to measure changes and trends must be established. KPIs must show how the province will measure the progress over time. Criteria need to be demonstratable, objective, and repeatable. • A further challenge is creating a process that can be applied using minimal internal resources. Any process developed cannot be labor-intensive, require specialized training, and must be intuitive to account for high staff turnover rates.
Anticipated Outcome(s) / Research Deliverable(s)	• Jurisdictional Scan • Decision Matrix • Technical Report • Presentation to Technical Committee
Benefits to MTO	• Develop ways to deal with the effects of climate change on infrastructure and take a leadership role in reducing transportation's environmental footprint. • Identify the transportation requirements of future generations so that Ontario can begin building for tomorrow. • Create an environment that fosters innovation within and beyond the organization through partnering, collaboration, and data sharing to enable new approaches and emerging technologies in transportation, and greater economic value for Ontario.
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Topic 9: Foundation Frost Penetration Depths for Northern & Southern Ontario

Subject Area	Geotechnical & Foundations Engineering
Title	Foundation Frost Penetration Depths for Northern & Southern Ontario
Background	OPSD 3090.100 and OPSD 3090.101 provide contour lines that estimate the depth of frost penetration that should be accounted for by pavement & structural designers when direct geotechnical information is not provided. Reference: Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures, Research Report RR225, MTC, 1981.
Challenge	The data shown in these two OPSD documents is based on a 1981 publication, "**Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures**" and while the drawings were last reaffirmed in 2010, and there does not appear to be any additional technical updates to these standards using current meteorological data. Research is proposed to utilize updated meteorological data and geotechnical information to better estimate the depth of frost penetration using data that has been collected within the last five years.
Anticipated Outcome(s) / Research Deliverable(s)	The final output will consist of a written technical report, a presentation to MTO and OPS staff and committee members and updated revisions to the OPSD 3019.100 and OPSD 309.101 documents.
Benefits to MTO	Allow pavement designers, municipalities and contractors the ability to quickly evaluate if the proposed frost penetration depths that were used in the pavement and structure designs conform to anticipated penetration depths without the need for a detailed geotechnical study.
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Topic 10: Investigating Impacts of Construction Contaminants to Fibre Reinforced Polymer (FRP) Internal Reinforcing Bars

Subject Area	Bridge Engineering
Title	Investigating Impacts of Construction Contaminants to Fibre Reinforced Polymer (FRP) Internal Reinforcing Bars
Background	MTO has been constructing bridges with Glass Fibre Reinforced Polymer (GFRP) internal reinforcing bars since 2005, however it is still a relatively new material with less research and history of use than reinforcing steel. Construction practices impact the reinforcing bars on site but there is no known research on some of these impacts to GFRP bars. Two impacts are abrasive blasting of concrete adjacent to installed GFRP, and spatter contamination from adjacent concrete placement operations. It is currently conservatively assumed in MTO specifications that concrete spatter and abrasive blasting of bars is detrimental to the mechanical properties of the GFRP bars. The bars are required to be protected, and if they are contaminated with spatter, GFRP bars shall be replaced. References: • SSP 999S02, October 2021, Requirements for Glass Fibre Reinforced Polymer (GFRP) Reinforcing Bar • OPSS 904, November 2019, Concrete Structures • OPSS 929, November 2017, Abrasive Blast Cleaning – Concrete Construction • Guidelines for Inspection and Field Acceptance of Glass Fibre Reinforced Polymer (GFRP) Reinforcing Bars, September 2022 • CSA S6:19, Canadian Highway Bridge Design Code • CSA S807:19, Specification for fibre-reinforced polymers • CSA S806:12 (R2021), Design and construction of building structures with fibre-reinforced polymers

Challenge	According to OPSS 904 and OPSS 928, all surfaces of structural steel or concrete, against which new concrete shall be placed, shall be abrasive blasted cleaned according to OPSS 929. This includes construction joints which can have protruding GFRP reinforcement. The current approach is to assume that any abrasive blasting of FRP bars will cause detrimental damage to the mechanical and durability properties of the bars. Bars must be individually wrapped/protected or the concrete must not be abrasive blasted next to embedded GFRP reinforcing bars; these approaches are costly and/or detrimental to the properties of the concrete construction joint. The first challenge is to evaluate the impact of abrasive blasting on GFRP internal reinforcing bars. This might involve mechanical and durability properties of bars, various blast media and blasting distances, various impact areas/depths of GFRP bars and quantification of how much damage (if any) is too much i.e., material rejection criteria. Embedded internal reinforcing bars are at risk of contamination by concrete spatter during staged concrete placement operations. The most common operation is placement of a concrete deck which involves a construction joint at the base of concrete barrier wall and projecting reinforcing bars. Methods to protect or clean projecting bars of concrete spatter contamination have had varying effectiveness. The second challenge is to evaluate the impact of concrete contamination on GFRP internal reinforcing bars. How does concrete spatter on GFRP bars affect their bond, strength, and durability? Variables that could be investigated include surface area of contamination, thickness of contamination, and consistency. Potentially, also the effectiveness of cleaning concrete contaminant from bars, for example wiping the surface with a cloth when the spatter is wet, or cleaning spatter with a wire brush after it has dried. Designated Sources of Materials (DSM) listed GFRP products have different surface profiles and it is desirable to test all listed suppliers' products.

Anticipated Outcome(s) / Research Deliverable(s)	Anticipated outcomes: • How does abrasive blasting impact performance of GFRP internal reinforcing bars (mechanical and durability properties)? • If abrasive blasting negatively impacts bars, what is the point where the product would be considered deficient within a construction contract? • How does concrete spatter contamination affect the performance of the internal GFRP reinforcement? • If concrete spatter contamination negatively impacts the reinforcement, what is the point where the product would be considered deficient within a construction contract? Deliverables: • Written technical report • Photographs quantifying level of damage/contamination due to abrasive blasting / concrete spatter for the GFRP visual guidelines. Potentially like TC-54 quality illustration in OTM Book 7 (Figure 16).
Benefits to MTO	• More certainty in the use of GFRP internal reinforcing bar. • Potential for reduced construction cost, and faster construction. • Reduced conflict during construction. • Maintain position at the forefront of GFRP research / standards.
MTO Contact: Name Email Phone Number	James Combe, P.Eng. James.Combe@ontario.ca 289-241-2576

Topic 11: Development of Simplified Design Methodology for Specification of Galvanic Anode Systems in Bridges

Subject Area	Bridge Rehabilitation
Title	Development of Simplified Design Methodology for Specification of Galvanic Anode Systems in Bridges
Background	The Ministry uses galvanic corrosion protection (GCP) as an important strategy in the ongoing defence against corrosion in bridges. The Ministry has spent over $6M on GCP systems in bridges over the last 10 years and this technology will continue to be more prevalent in rehabilitation design. The electrochemical process for corrosion of reinforcing steel in concrete has become better understood and GCP products to combat corrosion have been proven to be effective in various academic and practical studies. However, the design of GCP systems is specialized and not part of the training of bridge and structural engineers. Specialists are currently relied upon to design anode quantities and spacing as part of bridge design work. A simplified design procedure to determine GCP requirements for various bridge components and reinforcement densities is needed.
Challenge	Currently, the design of GCP systems is conducted by third party specialists with a NACE (National Association of Corrosion Engineers)/ AMPP (Association of Materials Protection and Performance) certification. Specialists with these certifications are limited in the industry and often the supplier is directly relied upon to design the quantity of product to be used in the GCP design. With limited knowledge in the industry, these designs are typically not independently verified. The Ministry and its designers are in need of a practical design tool to assist with the specification of GCP anode systems.

Anticipated Outcome(s) / Research Deliverable(s)	A technical report outlining the designs steps and key parameters/ inputs that are required. The report should contain a detailed explanation of the background of the electrochemical process, variability in predicted results, and impacts of concrete parameters (E.g. resistivity). The design procedure should relate directly to exposure conditions and service life required.
Benefits to MTO	The impact of reinforced concrete corrosion costs the Ministry significant dollars with over $500M spent on bridge rehabilitation annually, a large portion of which is dedicated to fighting corrosion deterioration. The introduction of a GCP design procedure will help promote the use and understanding of GCP systems on a more consistent basis and expand GCP as an effective rehabilitation strategy to increase the service life and reliability of various bridge components.
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Topic 12: Risk Based Analysis of Bridge Inspection Frequency Depending on Type and Age of Bridge

Subject Area	Bridge Engineering
Title	Risk Based Analysis of Bridge Inspection Frequency Depending on Type and Age of Bridge
Background	Ontario formally adopted a bridge inspection frequency of 2 years in 1997 with the enactment of O. Reg. 104/97, made under the Public Transportation and Highway Improvement Act (PTHIA). Since that time the inspection frequency for major culverts (≥3m span) was increased to 4 years if they were in good condition as outlined in the Ontario Structure Inspection Manual (OSIM). The frequency of inspection can be shortened if the bridge is in poor condition, but the frequency cannot be extended regardless of the condition or structure type.
Challenge	Complete a jurisdictional scan of various jurisdiction on bridge inspection frequencies and practices. Complete a risk based analysis for bridges to determine a rational approach to extend the inspection frequency, either across the board for all bridges of a certain age or condition or based on structure type.
Anticipated Outcome(s) / Research Deliverable(s)	The final output will consist of a presentation of results to the MTO and a written technical report. Multiple recommendations can be explored for a refined inspection frequency based on several variables, or a simple bridge inspection frequency strategy that could be put into Legislation (Regulations).
Benefits to MTO	If the bridge (structure) inspection frequency can be safely reduced, it would reduce inspection costs and associated disruption to traffic. It would also allow the MTO to focus on the truly needy bridges to ensure they have adequate levels of safety. It will ensure that bridges receive the optimal inspection, either reduced or increased depending on the structure type and condition, so that MTO may manage the bridges efficiently and cost-effectively.
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Topic 13: Backfill Between Piling and CSP in Integral Abutment Bridges

Subject Area	Bridges
Title	Backfill Between Piling and CSP in Integral Abutment Bridges
Background	CSPs (Corrugated Steel Pipes) of 600 mm or 800 mm diameter are used as part of Integral Abutment design to permit movement of piles installed within a typical 5 metre depth beneath the abutment. The annular space between the installed pile is backfilled using a sand of a specified gradation.
Challenge	The performance of the CSP sand backfill with alternating movements due to expansion and contraction is unknown and has never been monitored on MTO projects. Bridge Engineers are concerned that the current state of practice does not provide the flexibility (equivalent free cantilever) of the piles in the sand stating that the sand backfill may not be loose enough to allow pile movement. This could potentially cause a real problem in construction if pile movement is not achieved at the expected jacking loads. Uncertainty also exists regarding whether the connection is hinged or fixed. Research and analysis is required to investigate other methods and materials. FEM analysis is required to assess soil-structure interaction and p-y relationships. A parametric analysis comparing CSP inclusion/exclusion different CSP sizes and properties, different backfill materials and different installation sequences (e.g. placement of backfill prior or after pile installation) is required. A load test program, complete with an instrumentation monitoring program to measure displacements and forces, is to be developed for application on MTO projects to calibrate the FEM model.
Anticipated Outcome(s) / Research Deliverable(s)	• Guideline to assist MTO Designers to validate the performance of integral abutment piles. Revise drawings and specifications for construction and construction management. • Presentations to be included.

Benefits to MTO	• Upgrade Technical Standard • Improve Integral Abutment Performance • Improve Constructability • Improve Consistency and Reproducibility
MTO Contact: Name Email Phone Number	Tony Sangiuliano Tony.J.Sangiuliano@ontario.ca 647-330-3743

Topic 14: A Project to Scope Pilot Implementation of Green Light Counters at Standard Traffic Signals to Better Understand Their Impact on Vehicle Collisions at Signalized Intersections in Ontario

Subject Area	Implementing a Pilot Project to Research the Impact of Traffic Signal System with Greenlight Countdown Timers in Ontario by the Ministry of Transportation (MTO), Research and Evaluation Office (REO).
Title	A Project to Scope Pilot Implementation of Green Light Counters at Standard Traffic Signals to Better Understand Their Impact on Vehicle Collisions at Signalized Intersections in Ontario
Background	In Ontario, many pedestrian crossings are equipped with countdown timers, to assist pedestrians in assessing the time remaining for crossing. South Korea has implemented traffic lights with countdown timers for green lights in recent years. These countdown timers are attached to traffic signals to assist drivers much in the same way pedestrian countdown timers are designed to assist pedestrians. According to a paper by Chang and Jung (2017) in the Journal of the Ergonomics Society of Korea, a simulation study has shown that traffic signals equipped with countdown timers for the green light improves drivers' reaction time (and satisfaction score) compared to the standard traffic signal system. The paper found that traffic signals with countdown timers reduce the zone at intersections known as the "driver's dilemma zone." In a standard theoretical economic sense, agents make better, more informed choice(s) when more information is available, whether it involves making choices to maximize one's utility/welfare or when making a decision to slow down/stop/proceed at intersections. However, it is worth noting that some international studies found some mixed results of the traffic signal countdown timers. For example, Krukowicz et al. (2021) found it has increased the red-light violations while lowering the number of amber light crossings in Poland. In a related study, Richmond et al. (2013) found mixed results of the pedestrian countdown signals in Toronto, Canada.

	Overall, the studies provide mixed results of the issue, and that the overall net benefit of countdown timers may depend on unobservable factors such as changes to driver behavior, which may vary from region to region. In this study, we will scope the implementation of a pilot project for the installation of green light countdown timers at busy signalized intersections so that data can be collected to better understand whether traffic signal countdown timers reduce collisions and address both theoretical and empirical questions related to countdown timers.
Challenge	In Ontario, there are no traffic signals with green light countdown timers. As a result, no comparable studies can be utilized/adopted. The implementation of a pilot study (described below) along with a qualitative survey would be essential to inferring the potential benefits of installing green light countdown timers at traffic signals in Ontario.
Anticipated Outcome(s) / Research Deliverable(s)	**Phase 1)** Qualitative study within OPS • Create questionnaires, receive/incorporate feedbacks. Survey questions should include, whether one uses pedestrian countdown timers (whenever available) while driving, whether one feels greenlight countdown timers would help them make better choices as a driver etc. • Implement the survey questionnaires in platforms like Qualtrics. Consult with IT department for additional support. • Rollout of the survey for 7-8 weeks. Work with IT and Marketing teams for survey participation support including emails and newsletters. • Final report of the completed qualitative study (**final week of the anticipated time frame for Phase 1**).

	Phase 2) Identify Pilot Project areas • Determine intersections/regions based on the methodology used in Safety Analyst, available in TES, to identify sites with potential safety improvements. • Additionally, several characteristics could be considered as a basis for choosing pilot project locations, including intersections with different speed limits (high vs. low-speed limits). • Final report of the completed analysis done for pilot project location selection (**final week of the anticipated time frame for Phase 2**). **Phase 3)** Technology selection and its costs • Consult with other offices within OPS for recommendations on the types of technology available for greenlight countdown timers, purchase and installation costs, installation times, compatibility with existing signal equipment etc. Additionally, reach out to other jurisdictions that have adopted greenlight countdown timers for possible consultation (e.g., research authors of relevant papers, Ministry of Land, Infrastructure and Transport of Korea (MOLIT) regarding the technology used in South Korea for greenlight countdown timers, its costs, installation time etc. • A summary report that outlines the types of available technology and expected costs of the device(s) and installation costs (**final week of the anticipated time frame for Phase 3**). **Phase 4**) Pilot Project Scoping Document • Develop of scoping document for the implementation of a pilot project for the use of greenlight countdown timers in Ontario • Scoping document shall include but is not limited to: - Feasibility including challenges and how to mitigate - Technology - Operating recommendations (i.e., pedestrian countdown timers are based on intersection width, walking speeds, etc. and must also take into consideration situations where green signal is extended) - Costs to implement, maintain and remove at end of pilot - Pilot project sites

	- Evaluation methodology - Recommended duration of pilot - Present pilot scoping to MTO
Benefits to MTO	Traffic signals with green light countdown timers may reduce vehicle collisions that result in PDO, minor/major injuries and fatalities at signalized intersections in Ontario. According to ORSAR (2019), there were 79 fatal, 9,756 personal injury and 35,515 property damage collisions occurring at intersections. A report by MADD (2013) showed that the average social cost for per fatal, average injury and PDO were $13,600,000, $44,000 and $8,000, respectively. Therefore, better understanding of the impacts of green light countdown timers may greatly benefit road-users in Ontario.
MTO Contact: Name Email Phone Number	Jamie Lee jamie.lee3@ontario.ca 647-532-0492

Appendix B. Open Research Topic Form (23-B)

Ontario

Open Research Topic Form

Notes: Form shall not exceed two (2) pages in length. Include a detailed description of the open research topic and clearly identify how it will enhance MTO's practices and business needs (i.e., benefits to MTO).

Subject Area	
Title	
Background	
Challenge	

Anticipated Outcome(s) **and** **Research Deliverable(s)**	
Benefits to MTO	
Principal Researcher (name, email, phone number)	

Appendix C. Project Progress Report (23-F)

Ontario

Project Progress Report

		For Ministry Use Only	
		Project Number	
Date (dd/mm/yyyy)		HIIFP Funding Year	
Principal Researcher (print name)		Email Address	
Institution Name		Institution Address	
Telephone No. (of Applicant)			

Topic No.	Title of Research Topic

Start Date		Completion Date (estimated)	

Brief Description of Progress Completed to Date.
Include information about: (1.) the status of major tasks (2.) the status of outcomes and/or the final report (3.) changes and/or issues (if applicable)

…..continue on Page 2 (if necessary)

Signatures

	Principal Researcher	Head of Department	Authorized Signing Officer of Institution
Print Name			
Signature			

Ontario

		For Ministry Use Only	
		Project Number	
Date (dd/mm/yyyy)		HIIFP Funding Year	
Principal Researcher (print name)		Email Address	
Institution Name		Institution Address	
Telephone No. (of Applicant)			

Topic No.	Title of Research Topic

Start Date		Completion Date (estimated)	

Brief Description of Progress Completed to Date. (continued)
Include information about: (1.) the status of major tasks (2.) the status of outcomes and/or the final report (3.) changes and/or issues (if applicable)

…..continued from Page 1.

Appendix D. HIIFP Application Form (23-A)

Ontario

HIIFP Application Form

	For Ministry Use Only
	Application Number

Principal Researcher (print name)	Email Address
Institution Name	Institution Address
Telephone No. (of Applicant)	

Co-Applicants (Name, Email Address, Institutional Affiliation)	
1.	
2.	
3.	

Topic No.	Title of Research Topic

Brief Purpose of Research

Start Date		Completion Date (estimated)	

Financial Summary

Total Funds Requested from MTO	Total Funds Requested from Other Sources	Total Funds Requested (MTO + Other Sources)
		$ 0

Have you applied to any other funding agencies in support of this research?

YES ☐ (provide details) **NO** ☐

Signatures

It is understood that the provisions outlined in the MTO HIIFP Program Guide AND the details contained in the Research Project Proposal submitted by the Institution are hereby accepted and agreed to.

	Principal Researcher	Head of Department	Authorized Signing Officer of Institution
Print Name			
Signature			

Appendix E. Research Proposal Summary (23-C)

Ontario

Research Proposal Summary

Topic No.	Title of Research Topic

Principal Researcher (print name)	Email Address

SUMMARY OF RESEARCH PROPOSAL
(Non-technical language, 300 words maximum, Arial (12-point) font, 1.08 Spacing)

Appendix F. Budget Summary Form (23-D)

The attached MS Excel™ file (Form 23D_Budget Summary.xls) may also be used to complete this form.

Ontario

Budget Summary

Note: For multi-year proposals, complete one form for each fiscal year requiring funds.

Principal Researcher (print name)	Fiscal Year Ending
	March 31, _____ (insert year)

Topic No.	Title of Research Topic

Research Items	**Direct Costs [$]**	**Overhead Costs [%]** not to exceed 25% of Direct Cost	**Funds Requested from:**	
			MTO [$]	**Other Sources [$]**
Salaries and/or Benefits				
a) Students				
b) Post-doctoral fellows				
c) Technical/Professional Assistants				
d)				
Subtotal:	0		0	0
Equipment and/or Facility				
a) Purchase or Rental				
b) Operation & Maintenance costs				
c) User fees / Other fees				
Subtotal:	0		0	0
Materials and/or Supplies				
a)				
b)				
c)				
Subtotal:	0		0	0
Travel				
a) Technical presentation				
b) Field work				
c)				
Subtotal:	0		0	0
Dissemination Costs				
a) Publication costs				
b)				
Subtotal:	0		0	0
Other Costs (specify)				
a)				
b)				
Subtotal:	0	0	0	0
Column Total:	$ 0		$ 0	$ 0
Total Budget (MTO Portion):	**$ 0**			

Appendix G. Budget Details Form (23-E)

Ontario

Budget Details

Principal Researcher (print name)	Total Funds Requested from MTO

Topic No.	Title of Research Topic

Research Item	**Direct Cost [$]**
Salaries and/or Benefits	
Equipment and/or Facility	
Materials and/or Supplies	
Travel	
Dissemination Costs	
Other Costs (specify)	
Overhead Cost (_____ % overhead on all Direct Costs) =	$0

Appendix H. HIIFP Report Template

See attached MS Word™ template (HIIFP_Report Template.docx).

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