

GENERAL INFORMATION

Any questions relative to the Research Problem Statement must be submitted by e-mail to: mdot-research@michigan.gov. Questions must be received by **January 7, 2010 at 5:00 p.m. EST**. All questions and answers will be placed on the MDOT RFP Web site as soon as possible after receipt of the questions and at least three (3) days prior to the due date listed above. The names of organizations submitting questions will not be disclosed.

MDOT is an equal opportunity employer and MDOT DBE firms are encouraged to apply. The participating DBE firm, as currently certified by MDOT's Office of Equal Opportunity, shall be listed in the Proposal.

MDOT AND ORBP FORMS REQUIRED AS PART OF PROPOSAL SUBMISSION:

- 5100D – Request for Proposal Cover Sheet
- 5100G – Certification of Key Personnel
- 5100I – Conflict of Interest Statement
- ORBP Research Proposal Budget Form Worksheet
- ORBP Schedule of Research Activities Form
- ORBP Deliverables Table
- ORBP Implementation Project Recommendation Form

**OFFICE OF RESEARCH & BEST PRACTICES
MDOT RESEARCH PROGRAM
2010 PROBLEM STATEMENT**



PROBLEM TITLE

Re-Examination of the 1994 and Subsequent Sewer and Culvert Installations of Various Pipe Types, Sizes and Depths

ORBP NO.
OR10-048

STRATEGIC PRIORITY NO.

CRITICAL ISSUE CODE

MDOT PROJECT CATEGORY

PROBLEM TO ADDRESS

BRIEFLY DESCRIBE THE PROBLEM TO BE ADDRESSED AND WHY IT IS AN ISSUE FOR MDOT

In 1994, MDOT initiated a pipe study which reviewed the installed performance of flexible and rigid pipes at various locations across the state. It has been approximately 17 years since the study was completed and MDOT desires to reinspect the pipe from the original study to ascertain the current condition state of the pipe. In addition, MDOT desires to review additional pipe installations where new pipe products have been installed. The inspections will include mandrel testing where appropriate, as well as the use of a laser profiler to review pipe deformation in flexible pipes and to measure crack widths in rigid pipe. This study will be compared with the results to the 1994 study and the researcher will make recommendations to the department on pipe performance and whether corrective action is needed. Additional items in the review will be the condition of the pipe joints and end sections. The study will compare and calibrate the results of mandrel testing to the laser profiler. The pipes will be video taped to ensure that areas of concern can be reviewed. New technology in the form of a laser profiler mounted on a track system now exists to view, record and review the current pipe status. MDOT pipe policy is based on experiences with different pipe materials. This study would assist the department in determining if its current policies need adjustment based on field performance of the various pipe products.

RESEARCH OBJECTIVES AND TASKS

LIST THE RESEARCH OBJECTIVE(S) TO BE ACCOMPLISHED

1. Written report on the performance of the culverts/sewers per AASHTO tolerances: describe the condition, and state the changes to the culvert, what, if any, is the deflection percent, and if there is any joint separation, spalling, leakage, soil migration, cracking or other observed physical changes and noting the placements and measurements of these changes whether occurring circumferentially, transversely, and/or longitudinally. The format of the written report should be per MDOT's Special Provision on Laser Testing of Pipes, attached.
2. Determine the benefits of laser profiling and report on rigid and flexible culverts, versus simple visual video and reports of same. This determination should be included in the written report.
3. Determine the benefits of laser deflection testing and information gathering versus mandrel testing and information gathering. This determination should be included in the written report.
4. Determine the benefits of micrometer measuring device in relation to pipe cracks and separation of joints of the pipe.
5. Provide laser profiling equipment, and all associated hardware and software. Provide training to MDOT personnel in the use this equipment and software, and in the generation and interpretation of the laser report.
6. Researcher will utilize all sites from the 1994 test site, as shown in the document obtained by emailing MDOT at ORBP at MDOT-research@michigan.gov by January 5, 2010, plus other sites, including those in Upper Peninsula of northern Michigan, a section in Bad Axe, and those of 30-inch and 36-inch diameter pipe.

LIST THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

ESTIMATED PERSON HOURS

1. Research Plan
 - a. Identify locations of culverts to test using old plans, as-built sets of plans, and other information. MDOT to make suggestions and initial selections. Locations must include all of the sites from the 1994 installations and 1995 report attached, other selected site locations, plus 30-inch and 36-inch ID culvert examples, of various rigid and flexible pipe types.
Note that the total length of pipe from the 1994 study was 4646 lineal feet: 8 sites with 1512 feet of concrete pipe, 465 feet of corrugated metal and 2669 feet of polyethylene. Other locations and pipe lengths and diameters to be included in this study are attached, and will include up to 36-inch diameters.
 - b. Obtain permits for any traffic lane closures from TSCs as needed. Note that these closures will follow the 2005 Michigan MUTCD Part 6 Temporary Traffic Control Manual from MDOT and MDOT form 2205 and MDOT form 2204. Note that fees are waived for work or research performed for MDOT. Also note that significant traffic work time restrictions may apply in the proposed research zones. Research must be performed in conformance within these restrictions. Researcher to provide traffic control devices and/or personnel as needed.
Obtain Michigan DNRE 301 permits for the culvert clean outs. There is much lead time needed for the DNRE to approve these permits. The successful researcher will want to begin this permitting process promptly.
 - c. Research staff will have the use of a laser testing device, mandrels of appropriate size and shape, pipe video equipment, personnel proficient in operating these devices, and software or hardware to record information.
 - d. Develop a testing plan for each culvert/sewer site selected.
 - e. Submit research plan to MDOT to obtain approval a minimum of ten working days before actual research field work begins in May of 2011.

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2. Field Work

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- a. Provide all equipment and personnel to set up correct lane closures, as permitted.
- b. Determine exact location and station of the chosen culverts/sewers in the field.
- c. Clean out of the culverts/sewers, and possibly stoppage of the flow in same for the testing according to requirements in the DNRE 301 permitting documents. All handling of clean out materials, process water and flow control measures must be in accordance with applicable federal, state, and local regulations and permit requirements. Materials removed during the cleaning of the pipes shall be properly transported and disposed of by a licensed hauler.

- d. Mandrel, video and laser of culvert/sewer, as applicable per pipe type.
- e. Any other items necessary to complete any and all research work.
- f. Field work to be completed and all field logs shared with MDOT by September 15, 2011.

3. Data Analysis - Analysis is to be based on current AASHTO Design Standards, Section 12, and AASHTO Construction Standards, Sections 26, 27, and 30, and other appropriate standards and requirements. 400

4. Deliverable 500, plus separate training session hours

- a. Draft report by January 2012.
- b. Field logs and all DVDs submitted to MDOT with draft report.
- c. Written report to contain
 - 1. Copies of field logs and inspection reports.
 - 2. Copies of mandrel test results.
 - 3. Assessment of pipes inspected with station designation of any findings that match stationing on the DVD of the pipe per instructions in the Michigan Department of Transportation Special Provision for Laser Testing, attached.
 - 4. Assessment on accuracy between Laser testing and Mandrel Testing.
 - 5. Laser test report and DVD per the instructions in MDOT Laser Testing Special Provision, attached.

d. Technology transfer sessions and materials for MDOT personnel on the use of the laser hardware and software, and how to produce and read the report it provides beginning by January 2012 through April 2012.

e. Laser testing device, all hardware, including cables and lifting/lowering devices, software and any manuals on use become property of MDOT, as do any guarantees and/or warranties on this equipment.

f. Written report on the performance and remaining service life of the culvert/sewer tested.

g. Written report to include recommendation of any specification changes based on data analysis that will result in cost savings while maintaining highest practical safety standards.

h. Written report to include description of distresses to the culverts and recommendations for repair and/or replacement of the tested sewers and culverts, based on analysis of data taken during this research.

5. 00

ESTIMATED COST AND TIMELINE

ESTIMATE THE COST OF THIS RESEARCH STUDY (Please provide a cost range [min. and max.] associated with the person hours by task above)

PROVIDE A PROPOSED TIMELINE FOR THE PROJECT (At minimum, the expected duration of the project)
4/20/2011 to 4/20/2012

Pre- April 2011 - Begin Permitting process with MDNRE and MDOT for work

April 2011 - Present MDOT with Research Plan for approval for work to commence in May

May 2011 - Begin work on Project

May - August 2011 - Field Work on Project

September 2011 - Field Work Completed

January 2012 - Draft Written Report and/or copies of all Field Notes turned over to MDOT and training of MDOT personnel to begin on the laser equipment and recording device(s)

April 2012 - Final Written Report to MDOT, training sessions completed, all materials turned over to MDOT and in MDOT possession

REQUIRED COMPLETION DATE (At minimum, the date by which results are needed to be applicable)
4/20/2012

BUDGET INFORMATION

(For each FY, list suggested minimum and maximum budgets as targets. Indirect Cost Rate is for ORBP use only.)

TOTAL BUDGET (BY FY)	FY1	FY2	FY3	FY4	INDIRECT COST RATE

DELIVERABLES

WHAT DELIVERABLES SHOULD BE RECEIVED AT THE END OF THIS PROJECT? (e.g., usable technical product, design method, techniques, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tools, etc.)
A final report will be submitted that contains the following information:

The executive summary developed for high level understanding of the research conducted and the results obtained specifically focusing on the recommendations laser profiling and each pipe types performance based on the AASHTO Standards Sections 12, 26, 27, and 30.

The objectives of the research and scope of work will be stated.

The methodology will be outlined including an in depth description of the laser profiling device and its operation so that technology transfer can be achieved.

Researcher to provide an analysis of the various laser profiling devices and identification of the ones that meet the requirements outlined in this problem statement.

Researcher to provide a comparative analysis of the cost, benefits and shortcomings of laser profiling, video recording, and mandrel testing. Recommendations will be made on how to best implement the laser profiling based on the findings from this study.

Analysis of the current condition of the pipe in the field in comparison to expected performance as outlined in AASHTO standards. Conclusions drawn on the types of deflection pathways and recommendations to avoid these pathways, types of cracks encountered and recommendations to avoid cracking, joint separations discovered and recommendations to avoid joint separations, and same for any conditions encountered per AASHTO Construction Specifications Sections 26, 27 and 30.

Storm Sewer and Culvert specifications will be analyzed based on the findings of this study and recommendations made on how to improve the specifications to minimize deflection and other problems and realize savings.

Provide a Laser Profiler Device and all hardware and software to MDOT.

Recommendations for implementation of the Sewer and Culvert Specifications and a laser profiling strategy based on the research findings.

A final written report on serviceability and/or defects, if any, of the culverts/sewers originally and subsequently placed for MDOT testing purposes, results of the mandrel test, DVD and results of the video and laser profiles.

The report should include recommendations on the use of laser testing of all types of pipes.

The report should include insights on age of pipe post-installation versus its performance.

Also the report should include information on the laser testing device, its manuals, hardware and software should be per MDOT's Special Provision for Laser Testing of Pipes, attached to this Research document.

Training sessions should include a manual and time for each attendee to work with the equipment.

All field logs and inspection reports become MDOT possessions. Copies of all permits needed to perform the testing should be included.

Contact information about the researchers and contact information for the equipment provided to MDOT. Any item necessary for the proper functioning of the equipment and all warranties and/or guarantees.

MDOT INVOLVEMENT (What will MDOT provide for this project and when)

MDOT has the original documents from the 1994 installation, the 1995 inspection and other as-built sets for the subsequent pipe installations in Bad Axe, and the Upper Peninsula. This information will be made available for the contractor/researcher by request. Please email your request, by January 5, to ORBP at: MDOT-research@michigan.gov. These are written documents that could be scanned by the researcher into a computer for durability and ease of transport - or the researcher may come to MDOT Construction and Technology building to photocopy. MDOT will provide the locations of installations to be included as part of this research project. The laser device needs to be accurate for pipe diameters of 12-inch through 36-inch pipe.

URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION

HOW URGENT IS THIS RESEARCH? IS IT IMPORTANT THAT IT BE DONE SOON? IF SO, WHY?

Laser testing is the cutting edge technology in culvert/sewer inspection. Michigan would benefit in safety assurance and potential financial savings by using this new technology to determine performance of in place culverts/sewers. The in place culverts and sewers would provide information on the longevity of each type, based on actual information, rather than summations.

DESCRIBE HOW THE PROPOSED RESULTS OF THIS PROJECT CAN BE IMPLEMENTED AT MDOT

Information on the current culverts will be utilized to determine economical decisions on culverts and sewers in the future. Information on laser technology will be crucial to determine the efficacy of the use of this method of testing versus the conventional mandrel and video taping of sewer/culvert.

DESCRIBE HOW MDOT WILL BENEFIT FROM THE IMPLEMENTATION OF THIS PROJECT AND WHO THE BENEFICIARIES WILL BE. INCLUDE A DISCUSSION OF HOW MDOT DIVISIONS, OTHER THAN THAT OF THE PROBLEM SUBMITTER, WILL BENEFIT AND HOW.

Information on the current culverts will be utilized to determine economical decisions on culverts and sewers in the future. Information on laser technology will be crucial to determine the efficacy of the use of this method of testing versus the conventional mandrel and video taping of sewer/culvert. Other MDOT regions will benefit from this information by cost savings in less replacements, fewer repairs to culverts/sewers, keeping lanes open to traffic, lack of failures as the infrastructure ages. In addition, other DOTs will benefit from this MDOT research by learning along with MDOT about laser testing of pipes and culverts. If laser testing proves to be a useful tool, MDOT could potentially eliminate the mandrel test in favor of the laser test.

POSSIBLE INVESTIGATOR(S)

DESIRED QUALIFICATIONS IN AN INVESTIGATOR

Knowledge of work in road right of ways, and permitting of work in the same. Knowledge of structural inspection of culverts. Knowledge of culvert cleaning and needed cleanliness of pipes to have accurate video and laser testing. Must have knowledge and minimum two years experience in the use of the laser profiler. Minimum two years experience performing mandrel tests. Experienced in use of video equipment and software as part of the video and laser equipment. Experienced report writer proficient in the topic of research. Experienced in producing and providing training materials and training MDOT personnel. Researcher/company/team/members and all subcontractors must submit MDOT form 5100 I (07/07) Conflict of Interest Statement at time of application for research and disclose to MDOT all possible conflicts of interest.

POTENTIAL OBSTACLES

WHAT RISKS OR OBSTACLES MAY MAKE CARRYING OUT THIS PROJECT DIFFICULT? WHAT STRATEGIES WILL YOU USE TO OVERCOME THEM?

Any time workers are in or near traffic there is a risk. Sewer gases can be hazardous. The successful researcher will have extensive knowledge in these safety concerns, as well as confined space entry if applicable.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
LASER INSPECTION OF SEWER AND CULVERT PIPE

DES:TRK

1 of 3

C&T:APPR:SJU:DBP:07-14-10

a. Description. Provide all materials, equipment and labor necessary to conduct laser profile and measurement survey of sewer and culvert pipe identified on the plans. This work includes cleaning the pipe and disposal of waste material as necessary prior to the profiling.

b. Materials. None specified.

c. Construction. All work must be done in accordance with the standard specifications and federal, state and local ordinances as applicable. Entry into the sewers, if necessary, must follow guidelines for confined space entry as prescribed by the Occupational Safety and Health Administration (OSHA). Conduct the inspection for sewers under pavement after the required backfill placement and compaction of the trench has been achieved, and between 5 to 10 working days before pavement surfacing or completion of the grade, except as otherwise approved by the Engineer.

Prior to profiling, dewater or divert flow in the pipe as necessary for the inspection and taping. Remove all debris, silt and other material from the sewer within the limits of the inspection to assure profile accuracy. Waste material must be disposed of as approved by the Engineer.

To perform the work use a combination color CCTV pipeline survey system with distance counter, non-contact video micrometer, inclinometer, laser projection system and associated measurement tools and software. The equipment and software must be tested and certified by a recognized independent testing group to meet or exceed an accuracy of 0.5 percent and a repeatability of 0.12 percent. References for the equipment calibration are ASTM E 691 and ASTM E 177. Recalibration of the equipment must be performed if the laser profiler or camera is modified.

Laser profiling and measurement equipment must be certified by the manufacturer to be in compliance with the calibration criteria.

Equipment with the ability to directly measure pipe diameter are not required provided reports generated from laser inspection gives direct measurements.

The Crawler must be an all wheel drive or track mounted unit that does not obstruct the camera's view or interfere with the proper recording of the conduit conditions. The Crawler speed must be adjustable while recording.

The camera must have an adjustable height so that it can be centered in the pipe vertically and horizontally. The camera must have a minimum combined optical/digital zoom ratio of 40:1 with a minimum optical zoom ratio of 10:1. The camera must have a light source that allows all areas of concern to be readily observed including the entire periphery of the pipe. The camera must be capable of 360 degree rotation as well as the ability to pan and tilt to 90 degree angles

to the axis of the pipe.

Field calibrate measuring devices according to the manufacturer's requirements. Provide all certification, calibration data and applicable manufacturer's recommendations for calibration and use to the Engineer prior to starting the work.

The laser projection head must be positioned, in relationship to the camera, so that the laser ring fills a minimum of 75 percent of the monitor screen height and the alphanumeric distance display does not interfere with the laser ring image. The camera and laser projection head must be moved through the pipe at a speed not to exceed 30 feet per minute, and must provide a 360 degree pan and zoom view of every pipe joint and anomaly. 2D technology will be utilized for conduit up to 36 inches. 3D technology must be utilized for conduit 36 inches or larger.

The laser profile and measurement survey must be documented with a digital recording and corresponding written report. The video documentation must be provided to the Engineer on a DVD at a minimum resolution of 640 x 480. The video image must be clear, focused and relatively free from roll, static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. The video will include identification before each section of pipe filmed. The identification must include the MDOT project number, the structure number corresponding to the plans, the size of pipe, the date and time, and must indicate which pipe is being filmed if multiple pipes are connected to the structure. The documentation must include the actual recorded length and width measurements of all cracks within the pipe, actual recorded separation measurements of all pipe joints, pipe deflection and deformation measurements, a visual and written description of pipe overall quality including damage or defects, joint gaps and joint misalignment, improper gasket placement, pipe leaks, debris, spalling or slabbing, etc.

The Contractor must provide a letter sealed by a Professional Engineer licensed in the State of Michigan which certifies that all aspects of this special provision have been met, including the accuracy and calibration requirements of the profiling equipment and software.

The Contractor will remove, replace, and retest any new pipe failing to meet the specific deflection requirements for the type of pipe installed at no cost to the Department. Also, all joint separations greater than the pipe manufacturer's maximum limit, or joints showing evidence of leakage or soil migration, must be repaired or replaced.

Concrete pipe having longitudinal or transverse cracks with widths equal to or greater than 0.01 inches, but less than 0.10 inches must be replaced or sealed and/or sleeved by a method approved by the Engineer at no cost to the Department. Pipes having cracks 0.10 inches in width and larger must be replaced at no cost to the Department.

Concrete pipe sections experiencing spalling, as defined by AASHTO 27.6.6, or slabbing, as defined by AASHTO 27.6.7 must be replaced.

Flexible pipe with deflections of 5 percent or more of the certified actual mean diameter of the pipe at final inspection must be replaced at no cost to the Department. For corrugated metal pipe deflection measurements are taken at the point of the smallest diameter on the corrugations. Mandrel testing must be conducted as necessary according to the standard specifications.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following contract item (pay item):

Contract Item (Pay Item)

Pay Unit

Laser Inspection of Sewer and Culv Pipe, __ inch.....Foot

Laser Profiling Sewer and Culv Pipe, __ inch for the pipe shown on the plans, includes all labor, equipment and materials necessary to divert the flow, clean the pipe of debris, silt and other materials, inspect, videotape, and provide laser profile survey documentation as specified herein. Also, included is the cost of all labor, equipment, and materials necessary to seal minor cracks in concrete pipe.