Michigan Department
Of Transportation
5100B (05/13)

# CHECKLIST TO DESIGNATE AREAS OF EVALUATION FOR REQUESTS FOR PROPOSAL (RFP)

| | REQUISITION NUMBER | DUE DATE | TIME DUE |
|---|---|---|---|
| | 1299 | 8/26/2013 | noon EST |
| MDOT PROJECT MANAGER<br>Bradley Wagner | JOB NUMBER (JN)<br>Various | CONTROL SECTION (CS)<br>Statewide | |

DESCRIPTION
As Needed Bridge Load Rating Services - Complex Structures & Quality Assurance and Quality Control

| **MDOT PROJECT MANAGER:** Check all items to be included in RFP<br>WHITE = REQUIRED<br>** = OPTIONAL<br>Check the appropriate Tier in the box below | | | **CONSULTANT:** Provide only checked items below in proposal |
|---|---|---|---|
| ☐ **TIER 1 ($50,000 - $150,000)** | ☐ **TIER II ($150,000-$1,000,000)** | ☑ **TIER III (>$1,000,000)** | |
| ☐ | ☐ | ☑ | Understanding of Service ** |
| ☐ | ☐ | ☑ | *Innovations* |
| ☐ | ☐ | ☑ | Organizational Chart |
| ☐ | ☐ | ☑ | Qualifications of Team |
| Not required as part of Official RFP | Not required as part of Official RFP | ☑ | Quality Assurance/Quality Control ** |
| ☐ | ☐ | ☑ | **Location:** The percentage of work performed in Michigan will be used for all selections unless the project is for on-site p=inspection or survey activities, then location should be scored using the distance from the consultant office to the on-site inspection or survey activity. |
| N/A | N/A | ☐ | Presentation ** |
| N/A | N/A | ☐ | Technical Proposal (if Presentation is required) |
| 3 pages (MDOT Forms not counted) **(No Resumes)** | 7 pages (MDOT Forms not counted) | 14 pages (MDOT forms not counted) | Total maximum pages for RFP **not including key personnel resumes.** Resumes limited to 2 pages per key staff personnel. |

**PROPOSAL AND BID SHEET EMAIL ADDRESS –** mdot-rfp-response@michigan.gov

## GENERAL INFORMATION

Any questions relative to the scope of services must be submitted by e-mail to the MDOT Project Manager. Questions must be received by the Project Manager at least five (5) working days prior to the due date and time specified above. All questions and answers will be placed on the MDOT website as soon as possible after receipt of the questions, and at least three (3) days prior to the RFP due date deadline. The names of vendors 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 FORMS REQUIRED AS PART OF PROPOSAL SUBMISSION

**5100D** – Request for Proposal Cover Sheet
**5100J** – Consultant Data and Signature Sheet (Required only for firms not currently prequalified with MDOT)

**(These forms are not included in the proposal maximum page count.)**

# REQUEST FOR PROPOSAL



The Michigan Department of Transportation (MDOT) is seeking professional services for the project contained in the attached scope of services.

If your firm is interested in providing services, please indicate your interest by submitting a Proposal, Proposal/Bid Sheet or Bid Sheet as indicated below. The documents must be submitted in accordance with the latest (Consultant/Vendor Selection Guidelines for Services Contracts" and "Guideline for Completing a Low Bid Sheet(S)*, if a low bid is involved as part of the selection process. **Reference Guidelines are available on MDOT's website under Doing Business > Vendor/Consultant Services >Vendor/Consultant Selections.**

**RFP SPECIFIC INFORMATION**

☑ ENGINEERING SERVICES ☐ BUREAU OF TRANSPORTATION PLANNING ☐ OTHER

THE SERVICE WAS POSTED ON THE ANTICIPATED QUARTERLY REQUESTS FOR PROPOSALS

☑ NO ☐ YES DATED_____ THROUGH _____

☑ **Prequalified Services** – See the attached Scope of Services for required Prequalification Classifications.

☐ **Non-Prequalified Services** – If selected, the vendor must make sure that current financial information, including labor rates, overhead computations, and financial statements, if overhead is not audited, is on file with MDOT's Office of Commission Audits. This information must be on file for the prime vendor and all sub vendors so that the contract will not be delayed. **Form 5100J is required with Proposal for firms not currently prequalified with MDOT**

☑ **Qualifications Based Selection** – Use Consultant/Vendor Selection Guidelines

**For all Qualifications Based Selections,** the selection team will review the information submitted and will select the firm considered most qualified to perform the services based on the proposals. The selected firm will be asked to prepare a priced proposal. Negotiations will be conducted with the firm selected.

**For a cost plus fixed fee contract,** the selected vendor must have a cost accounting system to support a cost plus fixed fee contract. This type of system has a job-order cost accounting system for the recording and accumulation of costs incurred under its contracts. Each project is assigned a job number so that costs may be segregated and accumulated in the vendor's job-order accounting system.

☐ **Qualification Based Selection / Low Bid** – Use Consultant/Vendor Selection Guidelines. See Bid Sheet instructions for additional information.

For Qualification Review/Low Bid selections, the selection team will review the proposals submitted. The vendor that has met established qualification threshold and with the lowest bid will be selected.

☐ **Best Value** – Use Consultant/Vendor Selection Guidelines, See Bid Sheet Instructions below for additional information. The bid amount is a component of the total proposal score, not the determining factor of the selection.

☐ **Low Bid** (no qualifications review required – no proposal required.) See Bid Sheet Instructions below for additional instructions.

**BID SHEET INSTRUCTIONS**

Bid Sheet(s) must be submitted in accordance with the "Guidelines for Completing a Low Bid Sheet(s)* (available on MDOT's website). Bid Sheet(s) are located at the end of the Scope of Services. Submit bid sheet(s) with the proposal, to the email address: mdot-rfp-response@michigan.gov. Failure to comply with this procedure may result in your bid being rejected from consideration.

**PARTNERSHIP CHARTER AGREEMENT**

MDOT and ACEC created a Partnership Charter Agreement which establishes guidelines to assist MDOT and Consultants in successful partnering. Both the Consultant and MDOT Project Manager are reminded to review the **ACEC-MDOT Partnership Charter Agreement** and are asked to follow all communications, issues resolution and other procedures and guidance's contained therein.

**NOTIFICATION**
**MANDATORY ELECTRONIC SUBMITTAL**

## Proposals submitted for this project must be submitted electronically.

**The following are changes to the Proposal Submittal Requirements:**

- Eliminated the Following Requirements:
  - Safety Program
  - Communication Plan
  - Past Performance as *a separate section*
  - Separate section for DBE Statement of goals. Include information in Qualification of Team section

- Implemented the Following Changes:
  - All proposals require an Organization Chart
  - Resumes must be a maximum of two pages
  - Only Key (lead) staff resumes may be submitted
  - Tier III proposal reduced from 19 to 14 pages
  - Forms 5100D, 5100I, and 5100G combined – 5100D
  - Forms 5100B and 5100H combined – 5100B
  - RFP's will be posted on a weekly basis -- on Mondays

**The following are Requirements for Electronic Submittals:**

- Proposals must be prepared using the most current guidelines
- The proposal must be bookmarked to clearly identify the proposal sections (See Below)
- For any section not required per the RFP, the bookmark must be edited to include "N/A" after the bookmark title.
  **Example**: Understanding of Service – N/A
- Proposals must be assembled and saved as a single PDF file
- PDF file must be 5 megabytes or smaller
- PDF file must be submitted via e-mail to MDOT-RFP-Response@michigan.gov
- MDOT's requisition number and company name must be included in the subject line of the e-mail. The PDF shall be named using the following format:
  - Requisition#XXX_Company Name.PDF
- MDOT will not accept multiple submittals
- Proposals must be *received* by MDOT on or before the due date and time specified in each RFP

**If the submittals do not comply with the requirements, they may be determined unresponsive.**

The Consultant's will receive an e-mail reply/notification from MDOT when the proposal is received. Please retain a copy of this e-mail as proof that the proposal was received on time. **Consultants are responsible for ensuring the MDOT receives the proposal on time.**

****Contact Contract Services Division immediately at 517-373-4680 if you do not get an auto response****

**Required Bookmarking Format:**

I. Request for Proposal Cover Sheet Form 5100D
   A. Consultant Data and Signature Sheet, Form 5100J (if applicable)
II. Understanding of Service
   A. Innovations
III. Qualifications of Team
   A. Structure of Project Team
      1. Role of Firms
      2. Role of Key Personnel
   B. Organization Chart
   C. Location
IV. Quality Assurance / Quality Control Plan
V. Resumes of Key Staff
VI. Pricing Documents/Bid Sheet (if applicable)

**2/14/12**

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**NOTIFICATION**
**E-VERIFY REQUIREMENTS**

E-Verify is an Internet based system that allows an employer, using information reported on an employee's Form I-9, Employment Eligibility Verification, to determine the eligibility of that employee to work in the United States. There is no charge to employers to use E-Verify. The E-Verify system is operated by the Department of Homeland Security (DHS) in partnership with the Social Security Administration. E-Verify is available in Spanish.

The State of Michigan is requiring, under Public Act 200 of 2012, Section 381, that as a condition of each contract or subcontract for construction, maintenance, or engineering services that the pre-qualified contractor or subcontractor agree to use the E-Verify system to verify that all persons hired during the contract term by the contractor or subcontractor are legally present and authorized to work in the United States.

Information on registration for and use of the E-Verify program can be obtained via the Internet at the DHS Web site: http://www.dhs.gov/E-Verify.

The documentation supporting the usage of the E-Verify system must be maintained by each consultant and be made available to MDOT upon request.

It is the responsibility of the prime consultant to include the E-Verify requirement documented in this NOTIFICATION in all tiers of subcontracts.

9/13/12

**Michigan Department of Transportation**

**SCOPE OF SERVICE**
**FOR**
**"AS NEEDED" DESIGN SERVICES**
**BRIDGE ENGINEERING ANALYSIS**
BRIDGE LOAD RATING SERVICES – COMPLEX OR UNIQUE STRUCTURES
BRIDGE LOAD RATING SERVICES – QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

**CONTROL SECTIONS:** Various

**JOB NUMBER:** Various

**PROJECT LOCATION:** Various locations throughout the State

**PROJECT DESCRIPTION:** Bridge Load Rating Services – Complex or Unique Structures, including QA/QC

This scope of service is to perform load rating analysis of bridges and Quality Assurance and Quality Control (QA/QC) of bridge load ratings and load rating software on an as needed basis in conformance with National Bridge Inspection Standards (NBIS) and MDOT policies and procedures. The majority of structures load rated in this project will represent complex structures including, but not limited to: arches, trusses, curved structures and deteriorated or damaged structures. Any bridge type in the Michigan bridge inventory including but not limited to: steel, reinforced concrete or prestressed concrete beams, arches, trusses and curved girders may be included in the QA/QC of bridge load ratings.

The load rating analysis consists of calculating the Federal Inventory, Federal Operating and Michigan Operating Load Ratings, including load posting requirements and Michigan Overload Class. Should the initial load rating determine that load posting or Overload Class reduction is necessary, more detailed analyses may be required. Services will be required as directed by the MDOT Project Engineer Manager; durations of time will be established at the time of assignment.

The QA/QC of bridge load ratings includes reviewing structural analyses of bridges performed by AASHTOWare™ BrR software, in-house analysis spreadsheets or other software. QA/QC also includes verifying changes and updates to standardized software and spreadsheets.

Full time services will not be required on all projects at all times. This scope is for "as needed" services, based on the intermittent needs of MDOT and is set up for approximately 50 structures (200 Spans) for complex load ratings and 50 structures (200 spans) for QA/QC. It must be noted that this is not a guarantee that MDOT will use the CONSULTANT'S services. Every attempt will be made to assign tasks at least one week prior to the need for personnel, however it is expected that any assignment made will be complied with within a 48 hour period. If the CONSULTANT is unable to fulfill the request, MDOT may utilize a secondary CONSULTANT for the services.

**Up to two (2) CONSULTANTS will be chosen for "as-needed" contracts of $1,000,000 each. Number of structures assigned to each CONSULTANT will be determined by future needs.**

**DBE REQUIREMENT:** N/A

**ANTICIPATED PROJECT START DATE:** December 1, 2013

**ANTICIPATED PROJECT COMPLETION DATE:** December 1, 2016, with the option to extend the contract for up to two additional years

**PRIMARY PREQUALIFICATION CLASSIFICATION**:
Bridge Load Rating Analysis
Complex Bridges

**SECONDARY PREQUALIFICATION CLASSIFICATION**:
None

**MDOT PROJECT ENGINEER MANAGER:**
Bradley M. Wagner, Load Rating Program Manager
Design Division
Van Wagoner Building
425 W. Ottawa
P.O. Box 30050
Lansing, MI 48909
Phone: (517)-335-1923
Fax: (517)-335-2731
Email: wagnerb@michigan.gov

**REQUIRED GUIDELINES AND STANDARDS:**
Work shall conform to current MDOT, FHWA and AASHTO practices, guidelines, policies, and standards (i.e., AASHTO Manual for Bridge Evaluation, AASHTO Standard Specifications for Highway Bridges, AASHTO LRFD Bridge Design Specifications, MDOT Bridge Analysis Guide, etc.).

**CONSULTANT REQUIREMENTS:**

Confidentially and Conflict of Interest Clause

A. The information obtained in the QA/QC portion of this contract is confidential to the unit being reviewed and MDOT. The CONSULTANT is restricted from releasing any information obtained under the contract to anyone other than the unit being reviewed and MDOT. Failure on the part of the CONSULTANT to maintain security of the records could result in legal penalties.

B. The QA/QC Engineer cannot perform QA/QC on a structure for which they performed the most recent load rating or for which they are the Engineer of Record. The CONSULTANT must notify the MDOT Project Engineer Manager of any task that may invoke this conflict of interest. The tasks affected will be replaced by another task without the conflict and the project estimate adjusted accordingly.

**GENERAL INFORMATION:**

The NBIS requires the analysis of all highway bridges to determine load capacity. FHWA requires that analyses use the Load Factor or Load and Resistance Factor methods for Federal Inventory Rating and Federal Operating Rating (see FHWA memo dated 10-30-2006, http://www.fhwa.dot.gov/bridge/nbis/103006.cfm). MDOT requires that bridges be analyzed for ability to carry Michigan legal loads and overloads, and this analysis may be done using any accepted methodology (Load Factor, Allowable Stress or Load and Resistance Factor) in accordance with the 2005 Bridge Analysis Guide with Interims and applicable MDOT Bridge Advisories.

**CONSULTANT RESPONSIBILITIES:**

The requirements of this project include, but are not limited to, the following tasks:

A. Communications/Meetings
   a. The CONSULTANT shall meet with the MDOT Project Engineer Manager at the Project Kick-Off Meeting to review the project, location of data sources and contact persons, and review relevant MDOT operations.
   b. The Project Kick-Off Meeting shall be held at the Van Wagoner Building in Lansing, within one week of Notice to Proceed.
   c. Prior to starting work, the CONSULTANT shall review and clarify project issues, data needs and availability, and the sequence of events and team meetings that are essential to complete the bridge load ratings by the project completion date.
   d. The CONSULTANT shall attend any project-related meetings as necessary and as directed by the MDOT Project Engineer Manager.
   e. The CONSULTANT representative shall record and submit type-written minutes for all project related meetings to the MDOT Project Engineer Manager within two weeks of each meeting. The CONSULTANT shall also distribute the minutes to all meeting attendees.
   f. The MDOT Project Engineer Manager shall be the official MDOT contact person for the CONSULTANT and shall be made aware of all communications regarding this project. The CONSULTANT must either address or send a copy of all correspondence to the MDOT Project Engineer Manager. This includes all Subcontractor correspondence and verbal contact records. AASHTOWare™ BrR Technical Support should be reported to the MDOT Project Engineer Manager for submission to the developer, if applicable.

g. On the first of each month, the CONSULTANT Project Manager shall submit a monthly project progress report to the MDOT Project Engineer Manager. The monthly progress report shall follow the guidelines in Attachment A and shall be submitted electronically to MDOT-Load-Rating@michigan.gov.

B. The CONSULTANT shall obtain STAAD.Pro with STAAD.beava (current version) or request approval from the MDOT Project Engineer Manager to use an alternate software program if a significant cost savings is identified over the use of STAAD.Pro. In addition, the CONSULTANT shall obtain the AASHTOWare™ BrR software (current version) by contacting the Bridge Load Rating Program at the Center for Technology & Training (http://loadrating.michiganltap.org/BLR-Software). The CONSULTANT shall have in-depth knowledge of and experience with the AASHTOWare™ BrR software.

C. The CONSULTANT shall thoroughly review all assignments and notify the MDOT Project Engineer Manager of any potential issues before proceeding with the load rating. This includes, but is not limited to:
   a. The CONSULANT shall compare the BSIR and SI&A forms to the provided plans for consistency. The MDOT Project Engineer will locate incomplete plan sets and missing required information or the structure may be substituted.
   b. The CONSULTANT shall verify that there is no conflict of interest related to the structure. The MDOT Project Engineer Manager will substitute an alternate structure if the CONSULTANT is assigned a structure for which they are the Engineer of Record.

D. The CONSULTANT shall notify the MDOT Project Engineer Manager immediately if the structure requires load posting or reduction of the Overload Class. After MDOT Project Engineer Manager review, the MDOT Project Engineer Manager may ask the CONSULTANT to develop detailed explanations for any structures requiring load posting or reduction of Overload Class, including strengthening or repair recommendations, as appropriate.

E. The CONSULTANT shall be responsible for maintaining an ftp site, or similar, to allow for the electronic distribution of project materials.

F. The CONSULTANT shall be responsible for obtaining the following:
   a. AASHTO Manual for Bridge Evaluation, 2nd Edition with Interims
   b. AASHTO Standard Specifications for Highway Bridges, 17th Edition with Interims
   c. AASHTO LRFD Bridge Design Specifications, 6th Edition with Interims
   d. AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges, 2003 Edition
   e. Adobe Acrobat Software

f. Any other publications that may be necessary references for the analyses

The specific requirements for load rating analysis tasks for this project include, but are not limited to, the following:

G. The CONSULTANT shall rate each bridge using STAAD.Pro with STAAD Beava wherever possible. Hand calculations or other software may be approved by the MDOT Project Engineer Manager if a significant cost savings is identified over the use of STAAD.Pro. The Load Factor or Load and Resistance Factor method shall be used as described in the FHWA memo dated 10-30-2006 referenced above. The following ratings shall be computed:

a. Inventory Rating (NBI Item 66)
b. Federal Operating Rating (NBI Item 64F)
c. Michigan Operating Rating (MDOT Item 64MB) – This rating shall be computed in accordance with the MDOT Policy & Modeling Preferences document (Attachment F).
d. Michigan Overload Class and Overload Status (MDOT Items 193A & 193C). This class is determined according to the Michigan Structure Inventory and Appraisal Guide and as follows:
    i. Analyze the bridge for 20 trucks (Michigan Overload Truck 01-20 Class A. If the Rating Factor for each of these trucks is >1, then the bridge is Class A and steps ii and iii may be skipped.
    ii. If the bridge does not pass for Class A, then the bridge shall be analyzed for Class B trucks (Michigan Overload Truck 01-20 Class B). It is only necessary to analyze those vehicles where the rating factor for Class A was < 1.
    iii. If the bridge does not pass for Class B, then the bridge shall be analyzed for Class C trucks (Michigan Overload Truck 01-20 Class C). It is only necessary to analyze those vehicles where the rating factor for Class B was < 1.
    iv. If the bridge cannot pass for Class C, even allowing for engineering judgment, then the bridge will be classified as Class D. The bridge should be analyzed for the maximum axle loads allowed for each Overload Truck configuration, and this information should be given to the MDOT Project Engineer Manager immediately and included in the final submittal.

    Note: There is some room for engineering judgment when computing overload class. If any of the trucks do not pass for a given overload class, and the rating factor is > 0.97 for all of the trucks in that class, the bridge may still be designated as that class.

e. The analysis shall include any portion of the structure as required by the MDOT Project Engineer Manager including, but not limited to: the deck, gusset plates or other connections and substructure units. As per the

MDOT Bridge Analysis Guide, decks with original designs of H15 or less shall be load rated.

f. The analysis shall reflect any significant deterioration indicated by the BSIR or the detailed bridge inspection report, if applicable. Determination of significant deterioration shall be reviewed with the MDOT Project Engineer Manager prior to performing the analysis.

g. Based on (a) thru (e) above, the CONSULTANT will recommend the correct coding for the following:
   i. Structure Open, Posted, or Closed to Traffic (NBI Item 41)
   ii. Bridge Posting (NBI Item 70)
   iii. Posted Loading (NBI Item 141), if applicable
   iv. Method Used to Determine Operating Rating (NBI Item 63)
   v. Method Used to Determine Inventory Rating (NBI Item 65)
   vi. Michigan Operating Rating Method (MDOT Item 64MA)
   vii. Michigan Operating Vehicle (MDOT Item 64MC)

H. Additionally, the CONSULTANT shall perform a load rating assuming a proposed cross-section with new barriers and calculate the maximum overlay that will not change the Overload Class or posting status of the structure. The items required in Task (D) of this scope of work shall be completed assuming this proposed cross-section and overlay. These results will be reported according to Task (H) of this scope of work and will visibly identify that they are for the proposed scenario.

I. The CONSULTANT shall deliver the following electronic output to MDOT for each bridge analyzed:
   a. Bridge Analysis Assumption Form – Any assumptions made in the analysis (material properties, section losses, etc.) shall be listed. In addition, non-redundant or fracture critical structures/elements shall be identified. See Attachment B for a blank Assumption Form. The form shall be signed with an encrypted signature and then saved such that the form is no longer able to be edited. The form shall be marked with the CONSULTANT's logo and shall not be scanned.
   b. Bridge Analysis Summary Form – Completed per the results of Task (D) of this scope of work. In addition, non-redundant or fracture critical structures/elements should be identified. See Attachment C for a blank Summary Form. The form shall be signed with an encrypted signature and then saved such that the form is no longer able to be edited. The form shall be marked with the CONSULTANT's logo and shall not be scanned.
   c. PDF of any hand calculations, spreadsheets, etc. used to determine input into STAAD.Pro or other approved program. If formulas are hidden, a brief description of the procedure shall be included. Working versions of any spreadsheets, etc. used to conduct the analyses are also required.
   d. STAAD.Pro or other approved program input file.
   e. STAAD.Pro or other approved program summary output in PDF. When other programs are used, load and capacity information should be

provided at locations of interest, including but not limited to 10th points of the spans. Results from the Standard Analysis (Federal Inventory, Federal Operating, Michigan Operating and Michigan Legal Loads) should be in a separate file from the Overload Class results.

Items (a) thru (e) above shall be submitted electronically via the CONSULTANT maintained ftp site. All files for a structure shall be located in a folder bearing the task number and structure name (i.e. Task 100 – 11111-B01).

At the request of the MDOT Project Engineer Manager, high-priority structures will be submitted as soon as completed or in accordance with deadlines set at the time of assignment.

J. Quality Assurance and Quality Control (QA/QC) for all load rating tasks should occur as per the CONSULTANT'S QA/QC Plan.

The specific requirements for QA/QC tasks for this project include, but are not limited to, the following:

K. The CONSULTANT shall perform Quality Control of load rating software including, but not limited to: AASHTOWare™ BrR, STAAD.Pro, MDX, and in-house analysis spreadsheets to verify that methods and results are consistent with current MDOT, FHWA, and AASHTO practices, guidelines, policies, and standards
   a. The proposed scope of work shall be discusses and agreed upon by the CONSULTANT and the MDOT Project Engineer Manager prior to testing the software or spreadsheet version.
   b. The analysis in the software or spreadsheet shall be compared to the sample testing database, provided by MDOT. If the appropriate test cases are not already available in the database, they will be developed by the CONSULTANT and as approved by the MDOT Project Engineer Manager.
   c. The CONSULTANT shall prepare a report, categorized according to each major finding in the software or spreadsheet.
      i. The report will identify whether the CONSULTANT substantially agrees or disagrees with each major finding in the software or spreadsheet and the corresponding impact on MDOT load rating policy.
      ii. The report will present data explaining the position that the CONSULTANT is taking on the major finding.

L. The CONSULTANT shall conduct Quality Control of existing analyses created using software including, but not limited to: AASHTOWare™ BrR, STAAD.Pro, MDX and Microsoft Excel Spreadsheets to verify analyses are in accordance with MDOT policy and modeling preferences.
   a. The Quality Control review shall include, but is not limited to:

i. The CONSULTANT shall verify the accuracy of the load rating assumptions, software input and output, and support calculations.
ii. The CONSULTANT shall verify all supporting documentation is included with the rating and properly filled out.

b. If the MDOT Project Engineer Manager requests the CONSULTANT to finalize the analysis independent of the analysis being reviewed, the CONSULTANT shall deliver all electronic output as listed in Task (I) of this scope.

c. If the MDOT Project Engineer Manager requests the CONSULTANT to verify the analysis, the CONSULTANT shall provide assumption sheet checks, input verification checks, and output comparison in a separate file for each structure reviewed. The CONSULTANT shall also provide a signed and sealed letter which identifies and briefly reports on each bridge reviewed. This letter shall include and explain:
i. Any significant differences in assumptions
ii. Any significant differences in inputs
iii. The percent of difference in the rating results
iv. Resolution of any observed differences

d. All Quality Control review information shall be submitted electronically in PDF format.

M. The CONSULTANT shall perform Quality Assurance reviews of existing analyses to ensure proper Quality Control measures are being followed by the unit being reviewed.

a. Any significant findings in the Quality Control reviews will be summarized in a Quality Assurance report created by the CONSULTANT. This report will identify the finding and an action plan as agreed upon by the CONSULTANT and the MDOT Project Engineer Manager in order to address the significant finding. The determination of a significant finding will be at the recommendation of the CONSULTANT and per the approval of the MDOT Project Engineer Manager.

b. The action plan for significant findings will include recommendations for structure types to have future Quality Control reviews as described in Task (L) of this scope.

## MDOT RESPONSIBILITIES:

A. Schedule and/or conduct the following:
a. Project related meetings
b. Review of all submittals

B. Provide the following for each structure assigned:
a. As Built Plans and/or proposed construction plan information
b. Structure Inventory and Appraisal (SI&A) form
c. Bridge Safety Inspection Reports (BSIR)
d. Detailed Bridge Inspection Reports, if applicable

e. XML template file, if applicable

C. Provide the current version of the following, and updates as needed throughout the contract:
   a. Bridge Analysis Assumption Form (Attachment B)
   b. Bridge Analysis Summary Form (Attachment C)
   c. MDOT LFD Pin and Hanger Check spreadsheet (Attachment D)
   d. MDOT Naming Conventions (Attachment E)
   e. MDOT Policy & Modeling Preferences (Attachment F)
   f. MDOT Advanced Analysis Steps, with checklist (Attachment G)
   g. Bridge Analysis Guide 2005 Edition with Interims (via MDOT website)
   h. Bridge Design Guides and Manual (via MDOT website)
   i. Michigan Structure Inventory and Appraisal Guide (via MDOT website)
   j. Research Report R-1511 (via MDOT website)

D. Make project assignments and provide deadlines as needed

E. Provide known issues with the AASHTOWare™ BrR Software and work-arounds as appropriate

**CONSULTANT PAYMENT – Actual Cost Plus Fixed Fee:**

Compensation for this project shall be on an **actual cost plus fixed fee** basis. This basis of payment typically includes an estimate of labor hours by classification or employee, hourly labor rates, applied overhead, other direct costs, subconsultant costs, and applied fixed fee. The fixed fee for profit allowed for this project is 11.0% of the cost of direct labor and overhead.

The hours provided are only an estimate. The Consultant will be reimbursed a proportionate share of the fixed fee based on the portion of the authorized total hours in which services have been provided to the Department. The fixed fee for profit allowed for this project is 11.0% of the cost of direct labor and overhead. Fixed fee on “as needed” projects is computed by taking the percent of actual labor hours billed to labor hours authorized, then applying that percentage to the total fixed fee authorized.

All billings for services must be directed to the Department and follow the current guidelines. The latest copy of the "Professional Engineering Service Reimbursement Guidelines for Bureau of Highways" is available on MDOT's website. This document contains instructions and forms that must be followed and used for billing. Payment may be delayed or decreased if the instructions are not followed.

Payment to the Consultant for services rendered shall not exceed the maximum amount unless an increase is approved in accordance with the contract with the Consultant. Typically, billings must be submitted within 60 days after the completion of services for the current billing. The final billing must be received within 60 days of the completion of services. Refer to your contract for your specific contract terms.

Direct expenses, if applicable, will not be paid in excess of that allowed by the Department for its own employees in accordance with the State of Michigan's Standardized Travel Regulations. Supporting documentation must be submitted with the billing for all eligible expenses on the project in accordance with the Reimbursement Guidelines. The only hours that will be considered allowable charges for this contract are those that are directly attributable to the activities of this project.

For projects advertised May 1, 2013, or later, MDOT will reimburse the CONSULTANT for vehicle expenses and the costs of travel to and from project sites in accordance with MDOT's Travel and Vehicle Expense Reimbursement Guidelines, dated May 1, 2013. The guidelines can be found at http://www.michigan.gov/documents/mdot/Final_Travel_Guidelines_05-01-13_420289_7.pdf?20130509082418. MDOT's travel and vehicle expense reimbursement policies are intended primarily for construction engineering work. Reimbursement for travel to and from project sites and for vehicle expenses for all other types of work will be approved on a case by case basis.

The use of overtime hours is not acceptable unless prior written approval is granted by the MDOT Region Engineer/Bureau Director and the MDOT Project Manager. Reimbursement for overtime hours that are allowed will be limited to time spent on this project in excess of forty hours per person per week. Any variations to this rule should be included in the priced proposal submitted by the Consultant and must have prior written approval by the MDOT Region Engineer/Bureau Director and the MDOT Project Manager.

For projects advertised May 1, 2013, or later, MDOT will pay overtime in accordance with MDOT's Overtime Reimbursement Guidelines, dated May 1, 2013. The guidelines can be found at http://www.michigan.gov/documents/mdot/Final_Overtime_Guidelines_05-01-13_420286_7.pdf?20130509081848. MDOT's overtime reimbursement policies are intended primarily for construction engineering work. Overtime reimbursement for all other types of work will be approved on a case by case basis.

**ATTACHMENT A**

*SAMPLE*
**Control Section** Various
**Job Number** 100000
**Structure Number** Various
**Billing Period Ending** 07/31/13

**MONTHLY PROGRESS REPORT**

A. Work accomplished during the previous month.
- Received Tasks 39 – 53 on 7/1/13
- Submitted Load Rating for Tasks 25 – 38 on 7/11/13
- Submitted QC Results for Task 33 on 7/11/13

B. Anticipated work items for the upcoming month.
- Continue work on outstanding Tasks 13 and 23
- Continue work on outstanding QC review for Task 7
- Continue work on Tasks 39 – 53 due 8/2/13

C. Real or anticipated problems on the project.
- We foresee no problems at this time

D. Update of previously approved detailed project schedule (attached), including explanations for any delays or changes.
- Task 50 was moved to the top of the priority list due to current need as identified by Thomas Nelson, Jr. on 7/11/13

E. Items needed from MDOT.
- Waiting for direction on Task 43 (email sent 7/17/13)
- Waiting on direction on Task 47 (email sent 7/26/13)

F. Verbal Contact Records for the period.
- Discussed bridge and ramp geometries with Tom Meyers of MDOT Traffic and Safety Division on 7/24/13

# ATTACHMENT B

BRIDGE ANALYSIS ASSUMPTIONS

Bridge ID:_____ Most recent BIR date: [ ]

Does rating consider field condition of members?: [ ] _____

_____

Most Recent Year Constructed/Reconstructed*: _____

History of Work that impacts load rating: _____

_____

Superstructure Component: [ ] Fy/fc': ____ / ____ksi

Composite: [ ] Number of beams: _____ Shop Dwgs verified: [ ]

Size of Beams/Beam #'s and spans: _____

Deck thickness: ____ in Fy: ____ksi fc': ___ksi Deck Design load > H15: [ ]

Wearing surface material/thickness/unit weight: _____ / _____ in / _____ pcf

Barrier Type/weight: _____ / ___plf (L) _____ / ___plf (C) _____ / ___plf (R)

Sidewalks or brush blocks width/thick:____ / ___ in (L)____ / ___ in (C)____ / ___ in (R)

Clear roadway: _____ ft Design by LRFD: [ ] Rating Method: [ ]

Additional loads: _____

_____

Unique factors that affect capacity: _____

_____

* If the structure has been reconstructed, only include the information from previous constructions that is still relevant. Complete enough forms to identify all relevant information.

Analyzed By- Signature and Date_____ [ ]

Checked By- Signature and Date _____ [ ]

# ATTACHMENT C

BRIDGE ANALYSIS SUMMARY

Bridge ID _____

The above structure was analyzed using: _____

Version or Other: _____

The analysis is based on field inspection dated: _____

The controlling component and failure mode are:

---

NEW INVENTORY CODING

| | |
|---|---|
| NBI Item 63- Operating Rating Method | |
| NBI Item 64F- Federal Operating Rating | |
| MDOT Item 64MA- Michigan Operating Method | |
| MDOT Item 64MB- Michigan Operating Rating | |
| MDOT Item 64MC and D- Michigan Operating Truck | |
| NBI Item 65- Inventory Rating Method | |
| NBI Item 66- Federal Inventory Rating | |
| NBI Item 41- Open Posted Closed | |
| NBI Item 70- Bridge Posting | |
| NBI Item 141- Posted Loading | US Tons |
| MDOT Item 193A- Michigan Overload Class | |
| MDOT Item 193C- Overload Status | |

Analyzed By- Signature and Date _____ _____

Checked By- Signature and Date _____ _____

Database Updated By- Initials and Date _____ _____

# ATTACHMENT D

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| OWNER | MDOT | | | SHEET NO. | 1 | OF | 2 |
| SECTION | B01 | of | 00000 | COMP. BY | | DATE | |
| DESCRIPT | Scenic Route Over Babbling Brook | | | CHECKED BY | | DATE | |

## *LFD/LFR PIN AND HANGER CHECK*

(AASHTO 17th Edition 1996 with 1997 - 2002 Interim Revisions)

### ORIGINAL/MEASURED SECTION PROPERTIES AND TRAFFIC DATA

| | Hanger | Web | Pin | |
|---|---|---|---|---|
| Steel Type | Grade 50 | Grade 50 | S21800 | |
| $F_y$ | 50 | 50 | 50 | ksi (This must be entered in ksi) |
| $F_u$ | 65 | 65 | 95 | ksi (This must be entered in ksi) |

| | | |
|---|---|---|
| $t_w$ | | in |
| $t_{p\ gross}$ | | in |
| $t_{p\ at\ hole}$ | | in |
| $t_{p\ back\ of\ hole}$ | | in |
| $W_p$ | | in |
| $e_p$ | | in |
| $D_p$ | | in |
| (hole in hanger plate without bushing) $D_{hole}$ | | in |
| Washer Thickness (one washer) $t_{wash}$ | | in |
| Web edge distance $W_v$ | | in |
| Redundancy | Non-Redundant | |
| ADTT | less than 2500 | Table 10.3.2A |

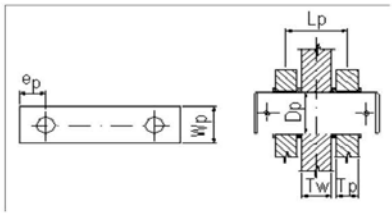

Figure 1: Pin and Hanger Assembly

### UNFACTORED LOADS

| | | | | | |
|---|---|---|---|---|---|
| $V_{NON\text{-}COMP\ DL}$ | | kip | 1-Unit $V_{LL+I}$ | | kip |
| $V_{COMP\ DL}$ | | kip | 2-Unit $V_{LL+I}$ | | kip |
| HS-20 $V_{LL+I}$ | | kip | 3-Unit $V_{LL+I}$ | | kip |
| HS-20 VLL+I (Single Lane Loading) | | kip | Overload (Single Lane Loading) | | kip |
| | | | Overload Class / Controlling Truck | | |

### MINIMUM GEOMETRY REQUIREMENTS

| | | | |
|---|---|---|---|
| $W_{net}/t_p$ | #DIV/0! | #### | 10.25.1: $(W_p - D_{hole}) / t_p <= 8$ |
| $D_{p\ min}$ | 0.0 | ok | 10.25.3: $D_{p\ min} = (3/4 + F_{y\ pin}/400) * (W_p - D_{hole})$ |

### TENSION OF HANGER PLATE

| | | |
|---|---|---|
| Gross Section Capacity, $P_{gross}$ | 0 kip | 10.46: $P_{gross} = W_p * t_{p\ gross} * F_{y\ hanger}$ |
| Net Section Capacity, $P_{net}$ | 0 kip | 10.25.1: $P_{net} = (W_p - D_{hole}) * t_{p\ at\ hole} * 0.80 * F_{u\ hanger} / 1.4$ |
| $P_{min}$ | 0 kip | |

| | | | |
|---|---|---|---|
| HS-20 Inv | #DIV/0! | 1-Unit | #DIV/0! |
| HS-20 Oper | #DIV/0! | 2-Unit | #DIV/0! |
| | | 3-Unit | #DIV/0! |
| | | Overload | #DIV/0! |

### BEARING ON HANGER PLATE

| | | | |
|---|---|---|---|
| $L_c$ | 0.00 | in | $L_c = e_p - D_{hole}/2$ |
| $R_{n\ geometry}$ | 0 | kip | 10.25.1: $R_n = L_c * t_{p\ at\ hole} * 0.80 * F_{u\ hanger}$ |
| $R_{n\ bearing}$ | 0 | kip | $R_n = D_p * t_{p\ back\ of\ hole} * F_{y\ hanger}$ |
| $R_{n\ min}$ | 0 | kip | |

| | | | |
|---|---|---|---|
| HS-20 Inv | #DIV/0! | 1-Unit | #DIV/0! |
| HS-20 Oper | #DIV/0! | 2-Unit | #DIV/0! |
| | | 3-Unit | #DIV/0! |
| | | Overload | #DIV/0! |

| | | | | | | |
|---|---|---|---|---|---|---|
| OWNER | MDOT | | SHEET NO. | 2 | OF | 2 |
| SECTION | B01 of 00000 | | COMP. BY | 0 | DATE | 1/0/1900 |
| DESCRIPT | Scenic Route Over Babbling Brook | | CHECKED BY | 0 | DATE | 1/0/1900 |

## *LFD/LFR PIN AND HANGER CHECK*

(AASHTO 17th Edition 1996 with 1997 - 2002 Interim Revisions)

### BEARING OR BLOCK SHEAR ON WEB PLATE

| | | | |
|---|---|---|---|
| $R_{r\ bearing}$ | 0 kip | $R_r = D_p * t_w * 1.2 * F_{r\ web}$ | |
| $R_W$ | 0 kip | $R_r = 0.9 * F_{r\ web} * W_W * t_w$ | |
| HS-20 Inv | #DIV/0! | | 1-Unit #DIV/0! |
| HS-20 Oper | #DIV/0! | | 2-Unit #DIV/0! |
| | | | 3-Unit #DIV/0! |
| | | | Overload #DIV/0! |

### BEARING ON PIN

| | | | |
|---|---|---|---|
| $R_{r\ bearing}$ | 0 kip | $R_r = 1.35 * D_p * \min(t_w, 2*t_{p\ back\ of\ hole}) * F_{y\ pin}$ | |
| HS-20 Inv | #DIV/0! | | 1-Unit #DIV/0! |
| HS-20 Oper | #DIV/0! | | 2-Unit #DIV/0! |
| | | | 3-Unit #DIV/0! |
| | | | Overload #DIV/0! |

### MOMENT AND SHEAR IN PIN

| | | | |
|---|---|---|---|
| $M_p$ | 0 kip*in | $M_p = D_p^3 * F_{y\ pin} / 6$ | |
| $V_p$ | 0 kip | $V_p = 0.58 * \pi * D_p^2 * F_{y\ pin} / 4$ | |
| a | 0 in | $a = t_p/2 + t_{washi}$ | |
| b | 0 in | $b = t_w$ | |
| R | 588 kip | ** Either Manually adjust to increase Capacity or use Solver** | |
| M | 0 kip*in | $M = R * (a + b/4)$ | |
| Capacity | #DIV/0! <= | $0.95 = (V/V_p)^3 + M/M_p <= 0.95$ | |
| HS-20 Inv | #DIV/0! | | 1-Unit #DIV/0! |
| HS-20 Oper | #DIV/0! | | 2-Unit #DIV/0! |
| | | | 3-Unit #DIV/0! |
| | | | Overload #DIV/0! |

### RATING FACTOR SUMMARY

| | | | |
|---|---|---|---|
| HS-20 Inv | #DIV/0! | 1-Unit (42 Ton max) | #DIV/0! |
| HS-20 Oper | #DIV/0! | 2-Unit (77 Ton max) | #DIV/0! |
| | | 3-Unit (77 Ton max) | #DIV/0! |
| | | Overload Class | #DIV/0! |

#DIV/0!

#DIV/0!

### FATIGUE (OPTIONAL)

| | | | |
|---|---|---|---|
| Multi-Lane Allowable Fatigue Stress | 10.00 ksi | Table 10.3.1A | |
| Single-Lane Allowable Fatigue Stress | NA ksi | Table 10.3.1A | |
| Multi-Lane Fatigue Stress | #DIV/0! ksi | $f_{fatigue} = HS\text{-}20\ V_{LL+I} / (2 * t_{p\ at\ hole} * (W_p - D_{hole}))$ | |
| Single-Lane Fatigue Stress | NA ksi | $f_{fatigue} = HS\text{-}20\ V_{LL+I} / (2 * t_{p\ at\ hole} * (W_p - D_{hole}))$ | |

#DIV/0!

# ATTACHMENT E

**MDOT Load Rating Naming Conventions**
Revised: 1-11-2013

- Material strength definitions should include either the ASTM or Grade reference or the actual strength.
  - For example, "33 ksi" as opposed to the library name "1936 to 1963" for structural steel and "4 ksi" as opposed to the library name "Grade A" for concrete.
  - All library definitions for prestressing strands are acceptable.
  - If using an MDOT provided sampled steel strength, both the material name and description should be modified to reflect the sampled steel strength.

- Bar Mark Definitions for concrete tee beam structures and culverts should match the designations used on either the plans or the shop drawings. If the designations differ between plans and shop drawings, indicate which naming convention is used.

- Superstructure Definitions should be named according to the span number.
  - For single spans, the Superstructure Definitions should be named "Span 1," "Span 2," etc.
  - If two spans are identical, the Superstructure Definition should be named "Span 1 or Span 4" to indicate that it applies to both spans.
  - For continuous spans, the Superstructure Definition should be named "Span 1 thru Span 4" or "Span 1 and Span 2" to indicate that it is a multi-span continuous bridge.
  - There may be a combination of the above conventions within a single bridge file.
  - If analyzing an existing Virtis file for proposed work, maintain both the existing and the proposed Superstructure Definitions within the Virtis file. The new Superstructure Definition should include the job number. For example, "Span 1 (JN 111111)".

- Member Alternative names should describe the beam location.
  - For example, "Typical Fascia Beam" and "Typical Interior Beam" would be used most commonly.
  - If a bridge has been widened, it is helpful to include that in the name, such as "Fascia Beam widened 1978," "Interior Beam widened 1978," "Original Fascia Beam," and "Original Interior Beam."
  - If a beam has a unique loading situation, it should be noted in the name. For example, if only one side of the bridge has a sidewalk – "Fascia w/ sidewalk" and "Fascia w/out sidewalk".
  - If most or all of the beams are being modeled, it would be appropriate to use the beam designations given in the plans, such as "Beam A," "Beam B," etc.

- Culvert Definitions and Culvert Alternatives should be named according to the type of culvert and the number of cells.
  - For example, "Box Culvert – Single Cell" or "Box Culvert – Twin Cell".
  - If there have been any changes to the culvert over its lifespan, such as adding or widening of sections, this should be referenced in the Culvert Definition name.
  - If analyzing an existing Virtis file for proposed work, maintain both the existing and the proposed Culvert Definitions within the Virtis file. The new Culvert Definition should include the job number. For example, "Span 1 (JN 111111)".

- Culvert Segments should be defined for both minimum and maximum fill depths.
  - For example, "Typical Section – Min Fill Depth" and "Typical Section – Max Fill Depth".
  - The minimum and maximum fill depths should be taken under the roadway (live load).
  - If there is a gap between roadways (i.e. Northbound, Median, Southbound), all cross-sections should be modeled for their minimum and maximum fill depths. For example, "NB – Min Fill Depth," "NB – Max Fill Depth," "SB – Min Fill Depth," "SB – Max Fill Depth".

- Bridge Alternative name should be the structure number and control section
  - For example, "B01 of 11111" or "B01-11111" or "11111-B01"
  - If analyzing an existing Virtis file for proposed work, keep both the existing and the proposed bridge alternatives within the Virtis file. The new bridge alternative should include the job number. For example, "B01 of 11111 (JN 111111)"
  - The Superstructure and Superstructure Alternative names should coincide with the Superstructure Definition name. For example, "Span 1" or "Span 1 thru Span 4"
  - The Culvert and Culvert Structural Alternative names should coincide with the Culvert Definition name. For example, "Box Culvert" and "Box Culvert-Single Cell".

# ATTACHMENT F

**MDOT Policy & Modeling Preferences**
Revised: 1/15/2013

- Vehicle Selection
  - For LFR analyses, analyze for Michigan trucks 5DL, 18DL and 23DL. If the rating factor is less than 1.05 for any of the three trucks, run all trucks within that "unit" category.
  - For LRFR analyses, always analyze for all Michigan DL trucks.
  - Always analyze for all overload trucks in a given overload class.
  - Always use "Designated Loading".

- Rating Factors
  - All ratings should be reported in rating factor, regardless of rating method.
  - Report using 2 decimal places.

- Overload Ratings
  - Ratings of 0.97 and greater are acceptable for Overload Class only (LFR and LRFR).

- Virtis Modeling Tolerances
  - 0.01 ft
  - 0.0001 in
  - 0.003048 m
  - 0.00254 mm
  - 0.01 mi
  - 0.01609 km

- LRFR Analyses
  - For Michigan Operating and Overload, always use 5000 ADTT load factors initially. If the rating does not pass, rerun the analysis with live load factors based on the actual ADTT at the site (provided with assignment for all structures except "local road over").
  - Note the ADTT used for live load factors on the assumption form under "Unique factors that affect capacity" (if other than 5000 ADTT).
  - Do not run overload vehicles as single lane loaded in LRFR.
  - All Michigan legal vehicles with GVW less than 100 kip shall be rated as "Legal - Routine" using the live load factors shown in the tables in the BAG.
  - All Michigan legal vehicles with GVW greater than 100 kips shall be rated as "Permit" with Frequency set to "Unlimited Crossing," Loading Condition set to "Mixed with traffic" and live load factors from the tables in the BAG. "Single Lane Loaded" should not be checked.
  - All overload vehicles shall be rated as "Permit" regardless of GVW, with the same settings as Michigan legal vehicles with GVW greater than 100 kips.
  - When opening older models, the impact/dynamic load allowance may default to zero. When running an older model for LRFR, verify all three locations in the model tree are using the correct impact/dynamic load allowance.

- Ratings for Proposed Construction
  - Indicate job number and proposed work on the assumption form under "Work Performed".
  - Indicate job number on the summary form under "Controlling Component/Failure Mode".
  - On *both forms*, clearly mark "(Prelim)" or "(Final)" as appropriate after job number.
  - If analyzing an existing Virtis file for proposed work, keep the existing superstructure definition(s) and bridge alternative(s) in the file. Create new superstructure definition(s) and bridge alternative(s), including the job number and "(Prelim)" or "(Final)" in the name. The proposed bridge alternative(s) should be checked "Existing" and "Current".

- Continuous Steel and Pin & Hanger Structures
  - Define composite regions as "composite". Do not enter the actual studs.
  - Define regions with no shear studs (negative moment region) as non-composite. Use these section definitions for calculation of both the section capacities and the bending moments and shear forces in the girders.
  - Diaphragm locations and stiffener locations must be entered as dimensioned on the shop drawings. Alert MDOT if shop drawings were not provided with the assignment.
  - For bridges with any skew, be careful when linking beams. Interior beams with equal diaphragm spacing may be linked. Fascia beams cannot be linked because maximum unbraced lengths are typically different.

- Pin & Hanger Ratings
  - If the width to thickness ratio, minimum pin diameter or allowable fatigue stress limits are exceeded (as identified on the spreadsheet), note "W/T Ratio", "pin diameter" or "P/H fatigue" on the summary form under "Controlling Component/Failure Mode".
  - If the pin & hanger controls the rating, enter this information on the summary form. It is not necessary to list the controlling girder rating as well.
  - The web edge distance (WV) used in the pin & hanger spreadsheet should be the smaller of:
    - the diagonal distance from the edge of the pin hole to the diagonal edge of the web
    - the horizontal distance from the edge of the pin hole to the vertical edge of the web

    MDOT recognizes that using the horizontal distance could be conservative but feels that it best incorporates the possible non-vertical movement of bridges in service. This value could be reevaluated on a bridge specific basis if it governs the rating.
  - For structures where girder alignment changes at the pin & hanger, it is acceptable to straighten out the beam, assuming no kink at the pin & hanger. Whenever possible, model as a "Girder System Superstructure". For cases with flared beams, it may be necessary to model each beam individually as a "Girder Line".

- Steel Serviceability
  - MDOT will not post a bridge based on LFR steel serviceability as long as the structure does not show signs of permanent deflection.
  - It is acceptable to ignore serviceability in order to avoid a *drop* in overload class, however, do not ignore serviceability in order to *raise* an overload class.
  - Review spec checks to confirm structure passes strength requirements.
  - Note controlling strength rating factors on summary form. It is not necessary to list the controlling serviceability girder rating as well.
  - Add "Serviceability Ignored" to the summary form under "Controlling Component/Failure Mode".

- Rolled Steel vs. Built-up vs. Plate Girders
  - Superstructures that consist of a mixture of rolled beam, built-up and/or plate girders cannot currently be modeled in Virtis. It is acceptable to approximate the rolled beam section as either a built-up or as a plate girder section.
  - Document any approximations on the assumption form.

- Bearing Stiffeners for Plate Girders
  - Include bearing stiffeners in rating, however, MDOT will not post a bridge based on bearing stiffener rating.

- If stiffener rating is less than 1.0, choose the "Ignore bearing stiffener" control option and report the controlling girder rating on the summary form.
- Add "Brg Stiffeners Ignored" on the summary form under "Controlling Component/Failure Mode".

- A373 Steel
  - "Allow Plastic Analysis" control option can be used for A373 (fy=32ksi) steel even though the MBE states only for steels at or above 33 ksi.
  - MDOT has investigated the material properties of A373 steel and has determined that plastic analysis is appropriate.

- Reinforced Concrete Structures
  - Inclined stirrups can add to shear capacity if needed. This must be calculated by hand and manually entered into Virtis. Also note on assumption form under "Unique factors that affect capacity".

- Prestressed Concrete Structures
  - Model all multi-span prestressed concrete structures as simply supported.
  - List prestressing strand $f_s$ under beam $F_y$ on assumption form.
  - "Use transformed section properties" control option can be used to increase LRFR ratings if necessary.
  - Do not include top prestressing strands which are cut or debonded at midspan in the Virtis model.
  - For box beams with skewed stirrups at ends, stirrups should be entered as dimensioned along one face of the beam. For fanned stirrups, this reflects the tighter spacing at one end of the beam and the wider spacing at the other end.
  - ~~For box beam structures, the value of $d_e$ is incorrectly being calculated from the centerline of the fascia beam to the face of barrier instead of from the centerline of the exterior web to the face of barrier in the LRFR live load distribution factor calculation. This has been reported to Baker (2/29/12). The LRFR distribution factors for fascia box beams should be calculated by hand and entered into Virtis until this bug is fixed.~~ This has been fixed in v6.4.1.
  - To model a prestressed concrete beam as composite using the AASHTO LFD engine, the "Extend into deck" box must be checked under the Vertical Shear Reinforcement Ranges tab. We have confirmed with Baker (9/19/12) that entering horizontal stirrups will not make the beam composite.
  - It is acceptable to use Appendix B5 for the shear computation method in LRFR analyses.

- AASHTO 1979 Interim Code Shear Specifications
  - Appropriate only for prestressed concrete structures with large shear stirrup spacing for entire length of span.
  - Appropriate only if no shear cracks/shear deficiency is reported in Bridge Safety Inspection Report (BSIR).
  - Use only when necessary to avoid posting or dropping overload class.
  - Ask MDOT before using on newer structures (i.e. designed after 1990).
  - Add "1979 Shear Specs" to summary form under "Controlling Component/Failure Mode".
  - ~~The 1979 Shear Specs do not work correctly in the AASHTO engine at this time (Version 6.3.1). The Virtis Standard engine should be used if the 1979 Shear Specs are necessary.~~ This has been fixed in v6.4.1.

- Flared Structures
  - MDOT's preference is to model all flared structures as flared within Virtis.
  - Because of the time involved in calculating and entering all of the distribution factors independently, beam spacings varying by less than 6" perpendicular to the beam can be modeled straight assuming the largest beam spacing. Be aware of changes in span length when making this assumption. A "fictional" deck cross section width may need to be calculated to account for the altered beam spacing.
  - Note any changes on the assumption for under "Unique factors that affect capacity."

- Live Load Distribution Factors
  - Use lever rule on fascia beams as applicable.
  - Can use AASHTO 1994 Design Guide Specs to improve rating. Note that both the shear and moment distribution factors must be used.
  - Can use a reduced distribution factor (lever rule or zero, as appropriate) if there is a non-mountable sidewalk which limits vehicular live load from affecting the beam. Non-mountable is defined as a vertical or near vertical face 6 inches or greater in height. Pedestrian live load should be considered on the sidewalk. If the reduced distribution factor is zero, 0.01 should be used if Virtis won't allow 0.0.
  - For spread box beam structures, use the 1994 distribution factors for the single lane loaded case for interior beams. We do not feel Equation 3-33 (Section 3.28.1, AASHTO 17th Edition) is applicable for single lane use. It is acceptable to use the lever rule for fascia beams.
  - For spread box beam structures with beam spacing that does not meet the spacing requirements of the AASHTO code (both LFR and LRFR), Virtis uses the lever rule to calculate the live load distribution factors. If this results in a member not passing load rating requirements, contact MDOT to discuss a refined distribution factor.
  - Note any changes to standard distribution factors on assumption form under "Unique factors that affect capacity".

- Pedestrian Live Load
  - Pedestrian live load should be distributed only to those beams whose tributary width includes a sidewalk. The load on each beam shall be the reaction assuming the deck acts as a simple beam.

- Dead load distribution
  - Stage 2 dead load distribution is set to "Uniformly to all girders" by default. Changing to "By tributary area" may help rating of interior girders (typically increases barrier load to fascia girders).

- Overlays
  - Shallow overlay – Model the average overlay thickness as non-structural wearing course.
  - Deep overlay – Include the minimum overlay thickness as part of the structural slab, with the average of the remaining overlay thickness modeled as non-structural wearing course.
  - An overlay should be modeled as DC2 load case if it is detailed in the design plans or is field verified. If the overlay is estimated, such as a measurement based on exposed toe of barrier, HMA log job or HMA mill and fill, use DW load case if core data is not available.
  - Do not remove depth of scarification or hydrodemolition from the structural slab thickness. (For example, if an existing 8" deck is scarified ¼" and overlaid with a 1.75" overlay, model as an 8" deck and 1.5" overlay.)

- Include overlay calculation on assumption form under "Unique factors that affect capacity". Indicate that the minimum overlay depth is included in the deck thickness for deep overlays.

- Deck Thickness
  - Use full depth of deck per plans – do not omit the AASHTO 1.5" sacrificial wearing surface from the structural thickness.

- Haunches
  - In all cases except for deck replacements, include haunch weight as a member dead load but do not include the haunch depth in the structural capacity unless the haunch is specifically dimensioned on the plans. Assume 2" haunch for weight.
  - For deck replacements, review plans (including screed details) to determine haunch thickness at bearings. If it appears that haunches vary significantly between girders, or are significantly greater than 2", the plan verified haunches should be included in the structural section. Otherwise, a 2" haunch can be assumed for weight only. For cases where haunches vary significantly between girders, model multiple girders to verify capacity with maximum and minimum haunch.
  - In any case where necessary to increase capacity, haunch thicknesses can be calculated from plan sheets and included in the structural section. For cases where haunches vary significantly between girders, model multiple girders to verify capacity with maximum and minimum haunch.
  - Version 6.4.1 does not correctly calculate negative haunch moment. Negative haunch load must be added as member dead load.

- Linearly Varying Overhangs
  - A linear distribution factor can be entered using the "Advanced Method" on the Live Load Distribution tab.

- Varying Width Overhangs (curved deck on straight beams)
  - Use minimum overhang width plus 2/3 of the difference between minimum and maximum overhang widths for weight calculation and live load distribution.
  - Use minimum overhang width plus 1/3 of the difference between minimum and maximum overhang widths for effective flange width calculation.
  - A "fictional" deck cross section width must be calculated to account for assumed overhang widths.

- Mountable/raised shoulders
  - Should be included in clear roadway width on assumption form and as part of travelway in Virtis.

- Dependent Backwalls
  - Can be modeled as a stiffener to increase shear capacity at abutments of steel beams if needed. Stiffener can be centered at face of backwall or bearing centerline. Stiffener should be sized such that it does not control the rating.
  - Additional stirrups can be entered at dependent backwall of concrete beams to increase shear capacity if needed. Spacing should be such that the portion of the beam within the backwall does not control the rating.

- Deterioration / Field Condition
  - Always review BSIR for Deck (SIA-58), Superstructure (SIA-59) and Substructure (SIA-60) conditions. If any of these fields are rated 4 or less, complete the load rating without deterioration included and alert MDOT of noted deterioration at time of submittal. Indicate "No" in the assumption form field "Does rating consider field condition of members?" and add "Deterioration not considered" to the summary form under "Controlling component and failure mode."
  - For ratings of 5 or greater for SIA-58, SIA-59 and SIA-60 where BSIR indicates deterioration relevant to the load rating, consider whether the observed deterioration impacts the structural capacity of the controlling members.
    - If the observed deterioration will not impact the structural capacity, complete and submit the load rating per normal procedure, indicating "Yes" in the assumption form field "Does rating consider field condition of members?"
    - If the observed deterioration will impact the structural capacity, complete the rating without deterioration and alert MDOT of noted deterioration at time of submittal. Indicate "No" in the assumption form field "Does rating consider field condition of members?" and add "Deterioration not considered" on the summary form under "Controlling component and failure mode".
  - The assumption form field "Does rating consider field condition of members?" should be "Yes" if field condition was reviewed and no deterioration was noted.
  - Include Superstructure rating (SIA-59) on assumption form under "Does rating consider field condition of members?"

- Temporary Supports
  - Notify MDOT if BSIR indicates bridge has temporary supports.
  - NBI Item 41 should be listed as "D – Shored" on the summary form.

- Posting Required
  - See "MDOT Load Rating Advanced Analysis Steps" guidance document before recommending posting of a structure.
  - If requested by MDOT to finalize a load rating indicating posting is required for a structure:
    - NBI Item 41 should be listed as "B – Requires posting" on the summary form.
    - NBI Item 141 on the summary form should list the appropriate posting load for 1, 2 and 3 unit trucks.
    - MDOT Item 193A - Overload class should be listed as "D" even if calculations indicate a higher capacity.

- MDOT Item 193C – Overload Status
  - Structures controlled by an H15 designed deck should be listed as "S – Slab Controls" on the summary form.
  - If the deck analysis controls a rating, the maximum permissible overload class is "B" even if Virtis output indicates a higher capacity.
  - Girder- floorbeam structures or structures with center-to-center girder spacing of 10'-0" or greater should be listed as "R – Gage restricted to 8-ft" on the summary form.

- Culverts
  - Use Standard Soil 1 from the library unless the plans indicate a different backfill was used.
  - Installation method should be "Embankment" unless the plans indicate that a different installation method was used. If a different method was used, note on the assumption form under "Unique Factors that Affect Capacity".
  - "Use NCHRP 647 LL Distribution" control option should be used for LL distribution for LRFR ratings.
  - The End Conditions "Provide Side Sway Support" box should be unchecked.
  - Use 0.0 ft for water height. Note: Virtis does not consider water height for load ratings even if entered.
  - Use 2.0 ft for LFD and LRFD live load surcharge heights.
  - For structures where the rebar diameter is not given, or where welded wire fabric is used, calculate an equivalent spacing based on an assumed bar size and indicate as such on the assumption form under "Unique Factors that Affect Capacity".
  - Shear capacity may be an issue in locations where a member transitions from two layers of reinforcement to one layer. Virtis uses a "d" value of 0.0, which results in 0.0k shear capacity. Use hand calculations or engineering judgment to determine if the shear capacity contribution from the positive moment reinforcement and/or concrete is sufficient at the controlling location. Note this on the assumption form under "Unique factors that affect capacity" and use the following workaround in the model:
    - Create a new Bar Mark Definition named "Negative Shear Workaround" defining a #4 bar with length equal to the culvert width or wall height.
    - Add the "Negative Shear Workaround" bar to the model with the same clear cover as the corner bar and bar spacing equal to 120".
  - If the depth of fill causes live load to be neglected, enter "Live Load neglected due to excessive fill depth" on the summary form under "Controlling Member/Failure Mode". The Live Load Surcharge should be set to 0.0 ft.
  - The clear roadway width should be calculated and entered on the assumption form. If there is a gap between roadways, such as a median, the clear roadway entry should be left blank and the individual clear roadway widths entered under "Unique factors that affect capacity".
  - Include fill depth calculations under "Unique factors that affect capacity" on the assumption form.
  - Items on the assumption form which are not applicable can be left blank.

# ATTACHMENT G

**MDOT Load Rating Advanced Analysis Steps**
Revised: 9-5-2012

Occasionally, a load rating analysis yields results that result in a drop in overload class or a posting recommendation. MDOT has developed the following process that should be followed before finalizing the recommendation.

- Should the findings be severe and/or severe distress is indicated in the BSIR such that the Load Rater judges immediate action is required, contact the Load Rating Specialist Engineer or the Load Rating Program Manager immediately. MDOT will take appropriate action and instruct the Load Rater how to proceed.

- Verify the accuracy of the model and identify any conservative assumptions. Adjust the model as necessary.

- Review the BSIR and note any field observations that correspond to the analytical results (i.e. shear cracks, deflections, vertical cracks at midspan). If the field observations validate the analysis results, review the field observations with the Load Rating Specialist Engineer (Consultants) or the Load Rating Program Manager (MDOT staff) before proceeding.

- Adjust the distribution factors:
  - Use the AASHTO 1994 Design Guide Specs if using LFR.
  - Calculate the lever rule for cases where code equations may not apply.

- Remove the pedestrian load from the Overload Class analysis. It is highly unlikely that significant pedestrian loading will coincide with maximum Overload Class vehicular loading (MBE 6A.2.3.4).

- For Virtis models analyzed using the AASHTO engine, re-analyze using the Virtis Standard Engine to confirm the results. If the results differ significantly, contact the Load Rating Specialist Engineer (Consultants) or the Load Rating Program Manager (MDOT staff) to determine whether additional investigation is necessary.

- For LFR structures, analyze the bridge using LRFR method.

- For concrete structures not meeting current AASHTO shear requirements using the LFR method, verify that the BSIR does not indicate the presence of shear cracks. If no shear cracks are present, apply the "Use AASHTO 1979 Interim Code" control option if applicable (i.e. uniform stirrup spacing throughout span length).

- For steel members not meeting steel serviceability requirements, verify that the BSIR does not indicate the presence of excessive deflection (negative camber). If excessive deflection is not present, apply the "Ignore overload operating rating" control option (available in Virtis v6.4).

- For steel members not meeting moment requirements at the strength limit state, apply the "Allow plastic analysis" control option if applicable.

- Consider whether a QA/QC analysis in another program may refine and therefore improve results and request approval from the Load Rating Specialist Engineer (Consultants) or the Load Rating Program Manager (MDOT staff) if appropriate.

If the above steps produce desirable results, note the applied steps on the assumption or summary form as applicable and submit the load rating. Otherwise:

- For steel members, identify whether steel samples may be warranted. The yield strength can be increased by as much as 20% based on steel sample testing. A 10% increase in yield strength can consistently be achieved.

- For steel members, explore whether addition of stiffeners will produce a desirable rating.

- For steel members failing in negative moment areas, explore whether the addition of cross frames will produce a desirable rating.

- For concrete members, identify whether concrete cores may be warranted. Cores can typically be more helpful if a structure is deficient in shear. With moment deficiency, the reinforcement usually controls.

If the above steps produce desirable results, send an email response to the Load Rating Specialist Engineer (Consultants) or the Load Rating Program Manager (MDOT staff) with your recommendation of how to proceed. If steel or concrete samples may be warranted, please indicate what yield or compressive strength would be necessary to produce desirable ratings. If cross frames are warranted, please indicate proposed location. MDOT will take appropriate action and instruct the Load Rater how to proceed.

If none of the steps included in this document produce desirable results, submit the load rating and outline which steps were investigated and describe the impacts of each applicable step.

*Once a submittal has been received, MDOT will determine whether to proceed by taking material samples of the structure or by performing a refined analysis (or both). If none of these options produce a desirable rating, or if field observations confirm analytical findings, an overload class reduction or posting will be implemented.*

**MDOT Load Rating Advanced Analysis Steps Checklist**

| | | | | | |
|---|---|---|---|---|---|
| CS/STRNO | B01 of 11111 | COMP. BY | ABC | DATE | 10/1/2012 |
| DESCRIPTION | Pleasant Road Over Raging River | CHECK BY | DEF | DATE | 10/9/2012 |
| | | CONSULTANT | Joe Consultant | TASK: | 42 |

This checklist must be used for all structures when the initial load rating analysis results in a drop in overload class or posting recommendation. See "MDOT Load Rating Advanced Analysis Steps" guidance document for additional information.

Instructions:
- Complete "Impact on Analysis" for **each step**.
- Include comments for **all** applied steps.
- Complete "Summary" and "Recommendations" on Page 2.

Impact on Analysis Key:
- "Not Applicable" = Does not apply to structure type.
- "Not Considered" = Step was not necessary, and thus not considered.

| | Item to Review | Impact on Analysis | Comments |
|---|---|---|---|
| 1. | Verify model accuracy and identify conservative assumptions. Adjust as necessary. | | |
| 2. | Review BSIR and note any field observations that correspond to the analytical results. | | |
| 3. | Adjust distributions factors using AASHTO 1994 Guide Specs for LFR or calculate lever rule where code equations may not apply. | | |
| 4. | Remove pedestrian load from Overload analysis. | | |
| 5. | Increase shy distance for Overload analysis on bridges with wide shoulders where fascias are controlling. | | |
| 6. | For models analyzed using AASHTO Engine, re-analyze using Wyoming Brass Engine (if available). | | |
| 7. | For structures analyzed per LFR, analyze with LRFR method. | | |
| 8. | For prestressed concrete members not meeting current AASHTO shear requirements, use 1979 Interim Code where applicable. | | |
| 9. | For steel members not meeting steel servicibility requirements, ignore servicibility where applicable. | | |
| 10. | For steel members not meeting strength limit state requirements, allow plastic analysis where applicable. | | |
| 11. | Evaluate whether analysis in another software (QA/QC) may improve results, and request approval to perform QA/QC analysis where applicable. | | |

If steps 1-11 produce desirable results, note the applied steps on the assumption or summary form as applicable, finalize and submit the load rating along with completed checklist. Otherwise follow steps on page 2:

1 of 2

**MDOT Load Rating Advanced Analysis Steps Checklist (Cont'd)**

| | | | | | |
|---|---|---|---|---|---|
| CS/STRNO | B01 of 11111 | COMP. BY | ABC | DATE | 10/1/2012 |
| DESCRIPTION | Pleasant Road Over Raging River | CHECK BY | DEF | DATE | 10/9/2012 |
| | | CONSULTANT | Joe Consultant | TASK #: | 42 |

| | Item to Review | Impact on Analysis | Comments |
|---|---|---|---|
| 12. | For steel members, identify whether steel samples are warranted. Note required yield strength. | | |
| 13. | For steel members, explore whether the addition of stiffeners will produce a desirable rating. Explain proposed location of stiffeners and resulting rating. | | |
| 14. | For steel members failing in negative moment regions, determine whether addition of cross frames will produce a desirable rating. Explain proposed location of cross frames and resulting rating. | | |
| 15. | For concrete members, identify whether concrete cores are warranted. Note required compressive strength. | | |

If steps 12-15 produce desirable results, email Virtis Model (.xml), Draft Summary and Assumption form, and completed checklist to the Load Rating Specialist Engineer along with your recommendation of how to proceed.

**Summary:**

**Recommendations:**