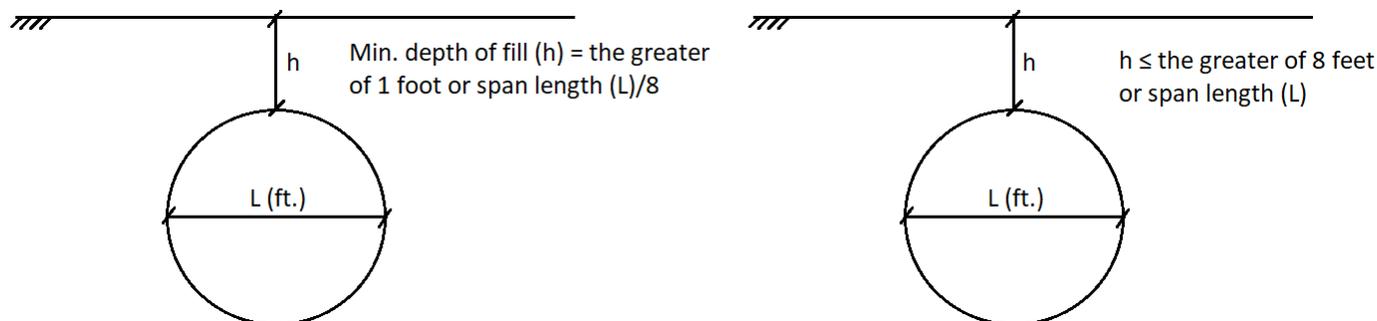


METAL CULVERT LOAD RATING GUIDANCE

Load rating metal culverts includes many complexities, and in addition generally has less available resources than common bridge types (for example cannot be load rated in AASHTOWare BrR). MnDOT State Aid Bridge Office has developed this guide meant to aid the load rater in rating metal culverts. The load rater is ultimately responsible for the load rating result. Whatever means or methods are used, the load rater must always review and consider all load rating variables as well as the condition of the structure to make sure that the load rating determined is representative of a particular structure.

This guidance is provided for various general conditions indicated. The MnDOT LRFR metal culvert spreadsheet is to be used whenever possible and the guidance provides assistance in the application of it. Also required is close inspection of the culvert to accurately determine defects and the current condition, and to obtain and/or verify measurements. Required measurements include, but are not limited to: overall dimensions, corrugations and metal thickness, deformations and distortions, and cover over the culvert. Although not absolutely required, measuring equipment such as a laser scanner is extremely helpful in measuring distortions, deformations, and cover over the culvert.

METAL CULVERTS WHERE THE DEPTH OF FILL DOES NOT EXCEED THE GREATER OF 8 FEET OR THE SPAN LENGTH AND WHERE THE DEPTH OF FILL EXCEEDS THE GREATER OF 1 FOOT OR THE SPAN LENGTH (L)/8

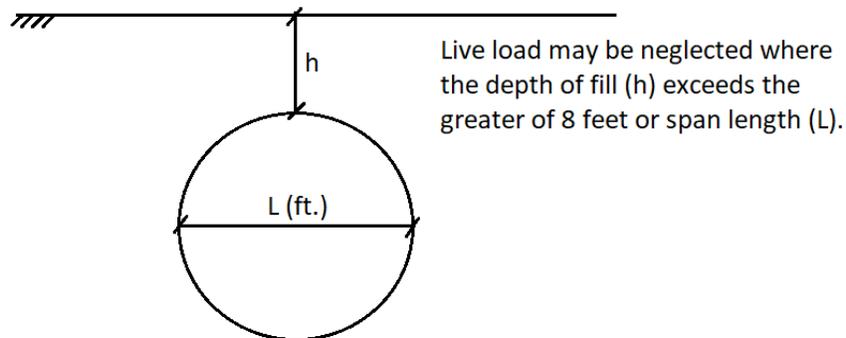


- The physical condition of the culvert must be verified by load rating engineer.
- If the MnDOT LRFR spreadsheet indicates an operating rating factor of greater than 1.30 for the design vehicle, enter 1.0 for the design load inventory rating factor and 1.30 for the design load operating rating factor on the RC-CL form.
- If the MnDOT LRFR spreadsheet indicates an operating rating factor of greater than 1.30 for any of the posting vehicles, emergency vehicles, overweight permit vehicles or annual permit vehicles, enter 1.30 for the operating rating factor on the RC-CL form.
- Fully document the loading conditions used for the load rating in the load rating report. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used in the analysis in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report.
- For a metal culvert with a NBI condition rating of 5 as designated in the bridge inspection report, consideration should be given to using a condition factor of 0.95 based on the location and type of deterioration observed.
- If deformation or deterioration is present, completely define the condition of the section and record the measurements on the RC-CL form.
- For a metal culvert with a NBI condition rating of 4 or less as designated in the bridge inspection report, record the culvert rating on the PIR form based on the analysis with the MnDOT LRFR metal culvert spreadsheet and engineering judgment. Consideration should be given to using a condition factor of 0.85 (or the measured section loss) within the MnDOT LRFR metal culvert spreadsheet. If load posting is required, the posting level

should reflect the condition of the structure. If overweight permit vehicles are not allowed on the bridge, use code "X" for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used in the analysis in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report

METAL CULVERTS WHERE THE DEPTH OF FILL IS GREATER THAN 8 FEET AND SPAN LENGTH (L).

(AASHTO LRFD Bridge Design Specs 3.6.1.2.6a - For single-span culverts, the effects of live load may be neglected where the depth of fill is more than 8.0 ft. and exceeds the span length; for multiple span culverts, the effects may be neglected where the depth of fill exceeds the distance between inside faces of end walls.)



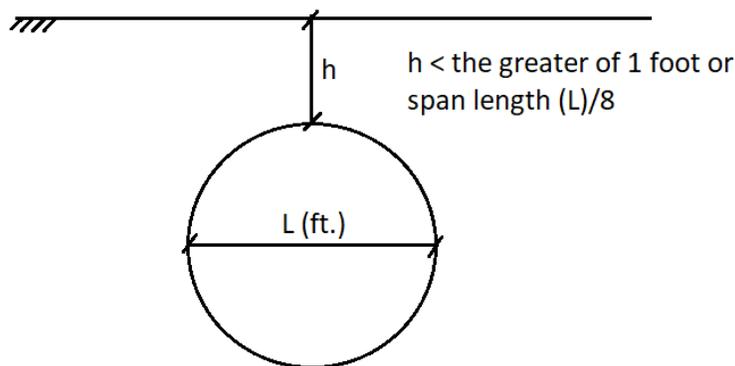
- The physical condition of the culvert must be verified by the load rating engineer.
- For a metal culvert that is in fair (NBI rating of "5") condition or better (smooth curvature in barrel shape, no deformation, tight seams and joints, minor to moderate corrosion, etc.) has a fill depth (cover) that exceeds 8 feet and the span length and the structural capacity of the culvert can support the permanent loads based on analysis with the MnDOT LRFR metal culvert spreadsheet, report the culvert rating on the PIR form. If the load rating engineer concludes that no restrictions are necessary, consider using a maximum of 1.0 for the design load inventory rating factor and 1.30 for the design load operating rating factor. The load rating engineer may adjust the design load rating factors stated above based on engineering judgment. Note, the adjusted design load rating factors should not necessarily result in load posting of the bridge. If the bridge is not load posted, list the overweight permit codes as A: 1, B: 1, C: 1, otherwise use code "X". When filling out the form, please check other for the type of analysis use and record "Cover exceeds 8 feet and span length, checked with MnDOT LRFR metal culvert spreadsheet" under the asterisk for the description. See screenshot below as an example. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used in the analysis in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report.

Data for Basis of Report (Check all that apply)		NBI Condition Ratings	
<input checked="" type="checkbox"/> Bridge Inventory File <input type="checkbox"/> Previous Bridge Rating and Load Posting Report <input type="checkbox"/> Bridge Plans <input type="checkbox"/> New <input type="checkbox"/> Overlay <input type="checkbox"/> Repair/Reconstruction <input type="checkbox"/> Other Dead Load Modifications		Deck _____ Superstructure _____ Substructure _____ Culvert <u>7</u> ADTT <u>25</u>	
<input checked="" type="checkbox"/> Bridge Inspected by <u>XXXXXXXX</u> Date <u>XX-XX-XXXX</u> <input type="checkbox"/> Damaged Component _____ <input type="checkbox"/> Deteriorated Component _____			
Types of Analysis: <input type="checkbox"/> Manual <input type="checkbox"/> AASHTOWare BrR, V. _____ <input type="checkbox"/> Computer* <input checked="" type="checkbox"/> Other*			
* <u>Cover exceeds 8 ft. and span length, checked with MnDOT LRFR metal culvert spreadsheet</u>			
Method of Rating (Check appropriate box)		Design Load _____ Design Method _____	
<input type="checkbox"/> Load Factor (LFR) <input type="checkbox"/> Assigned LFR <input type="checkbox"/> Allowable Stress (ASR) <input checked="" type="checkbox"/> Assigned LRFR <input type="checkbox"/> Load & Resistance Factor (LRFR) <input type="checkbox"/> Load Testing <input type="checkbox"/> Field Eval./Doc. Engineering Judgment			
Summary of Rating and Load Posting Analysis			
Load Posting		Bridge Rating	
Required <input type="checkbox"/> Not Required <input checked="" type="checkbox"/>		Inventory Operating	
Sign _____ TONS _____		HS <input type="checkbox"/> HS <input type="checkbox"/> RF <input checked="" type="checkbox"/> <u>1.0</u> RF <input checked="" type="checkbox"/> <u>1.20</u>	
R12-1a <input type="checkbox"/> _____ R12-5a <input type="checkbox"/> _____ R12-5 <input type="checkbox"/> M3 M3S2-40 M3S3 R12-X11 <input type="checkbox"/> _____ 45 R11-2a <input type="checkbox"/> _____		Overweight Permit Codes A <u>i</u> B <u>i</u> C <u>i</u>	
BRIDGE CLOSED			

- For a metal culvert rating that is in fair (NBI rating of "5") condition or better (smooth curvature in barrel shape, no deformation, tight seams and joints, minor to moderate corrosion, etc.), has a fill depth (cover) that exceeds 8 feet and span length, but the structural capacity of the culvert cannot support the permanent loads based on analysis with the MnDOT LRFR metal culvert spreadsheet, report the culvert rating on the PIR form. Please contact Moises Dimaculangan. It may be recommended to use another analysis program such as CANDE Software to validate the spreadsheet results. The CANDE results may help us adjust the following guidance. Based on engineering judgment, use a design load operating rating factor of less than 1.0 and a design load inventory rating factor value of less than the operating rating factor (e.g. RF Inventory: 0.80, RF Operating: 0.9). Also, based on engineering judgment, consider assigning it with a low load restriction. It should be recommended to the bridge owner to closely monitor the bridge until it can be replaced. Because overweight permit vehicles are not allowed on the bridge, use code "X" for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used for the load rating in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report.
- For a metal culvert that is in poor (NBI rating of "4") condition or less (deformation, section loss, joints and seams separation, cracks, etc...), has a fill depth (cover) that exceeds 8 feet and the span length, and the structural capacity of the culvert can support the permanent loads based on analysis with the MnDOT LRFR metal culvert spreadsheet, report the culvert rating on the PIR form. Completely define the deformation or deterioration of the section and record the measurements on the PIR form. Based on engineering judgment, use a design load operating rating value less than 1.0 and a design load inventory rating factor value less than the operating rating factor (e.g. RF Inventory: 0.4, RF Operating: 0.6). Also, based on engineering judgment, consider recommending posting the bridge with a very low load restriction. It should be recommended to the bridge owner to closely monitor the bridge until it can be replaced. Overweight permit vehicles are not allowed on the bridge, therefore use code X for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used for the load rating in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report.
- For a metal culvert that is in poor (NBI rating of "4") condition or less (deformation, section loss, joints and seams separation, cracks, etc...), has a fill depth (cover) greater than 8 feet, and the structural capacity of the culvert cannot support the permanent loads based on analysis with the MnDOT LRFR metal culvert spreadsheet, report the culvert on the PIR form. Completely define the deformation or deterioration of the section and record the measurements on the PIR form. Based on engineering judgment, use a design load operating rating value much less than 1.0 and a design load inventory rating factor value less than the operating rating factor (e.g. RF

Inventory: 0.2, RF Operating: 0.4). Also, based on engineering judgment, consider recommending closing the bridge until it is replaced. Otherwise post the bridge with a very low load restriction. It should be recommended to the bridge owner to closely monitor the bridge until it can be replaced. Overweight permit vehicles are not allowed on the bridge, therefore use code X for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used for the load rating in the load rating report. Finally, attach a copy of the MnDOT LRFR metal culvert spreadsheet analysis to the load rating report.

METAL CULVERTS WITH THE DEPTH OF FILL LESS THAN THE GREATER OF 1 FOOT OR SPAN LENGTH (L)/8.



- The physical condition of the culvert must be verified by the load rating engineer.
- For a metal culvert that is in fair (NBI rating of “5”) condition or better (smooth curvature in barrel shape, no deformation, tight seams and joints, minor to moderate corrosion, etc.), and the minimum cover is less than the greater of 1 foot or span length (L)/8, report the culvert on the PIR form. We strongly recommend load posting the bridge. Based on engineering judgment, use a design load operating rating value less than 1.0 and a design load inventory rating factor value less than the operating rating factor (e.g. RF Inventory: 0.7, RF Operating: 0.9). Also, based on engineering judgment, the posting level should reflect the condition of the structure (e.g. deformation, section loss, etc...), along with considering span length, ADTT, etc. Overweight permit vehicles are not allowed on the bridge, therefore use code “X” for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used for the load rating in the load rating report. Use caution when the MnDOT LRFR metal culvert spreadsheet is utilized and data from the spreadsheet is for information only.
- For a metal culvert that is in poor (NBI rating of “4”) condition or less (deformation, section loss, joints and seams separation, etc...), and the minimum cover is less than the greater of 1 foot or span length (L)/8, report the culvert on the PIR form. Completely define the deformation or deterioration of the section and record the measurement on the PIR form. We strongly recommend posting the bridge with a very low load restriction or close the bridge. Based on engineering judgment, use a design load operating rating value much less than 1.0 and a design load inventory rating factor value less than the operating rating factor (e.g. RF Inventory: 0.2, RF Operating: 0.4). Also, based on engineering judgment, the posting level should reflect the condition of the

structure (e.g deformation, section loss, joints and seams separation, etc...), along with considering span length, ADTT, etc. If load posted, it should be recommended to the bridge owner to closely monitor the bridge until it can be replaced. Overweight permit vehicles are not allowed on the bridge, therefore use code "X" for the A, B, C trucks that are on the front sheet of the form. Fully document the culvert conditions (include sketches, narrative descriptions, and photographs) used for the load rating in the load rating report. Use caution when the MnDOT LRFR metal culvert spreadsheet is utilize and data from the spreadsheet is for information only.