

SCDOT LOAD RATING CULVERT GUIDANCE

March 27, 2020

The intent of this document is to provide guidance for load rating reinforced concrete box culverts (RCBCs) using BrR 6.8.4 in situations not currently covered by the Load Rating Guidance Document (LRGD). ***Sound engineering judgement shall be exercised in applying these guidelines.***

General

If a culvert shows no signs of distress and has been carrying normal traffic for an appreciable period of time, various modifications can be made to the model to achieve ratings consistent with the observed condition of the culvert. It is permissible to add reinforcing and/or increase material strengths to obtain LFR or LRFR ratings > 1.0 for all legal vehicles (as long as warranted by the observed culvert condition). ***Add clear note(s) to the Remarks section of the LRSF*** stating the culvert condition as the basis for the rating and clearly document any deviations from the material strengths and/or reinforcing shown on the plans.

Condition Specific Cases for Rating Factors Well Below Observed Field Condition

Case I

Constraints:

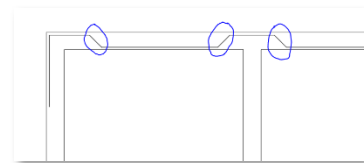
- Single-span with fill $< 8'$ or
- Multiple-span w/ fill $<$ distance between faces of end walls
- Carrying normal traffic for an appreciable period of time
- Showing no signs of distress or deterioration per latest inspection report

1. If BrR returns a rating factor of 0.00 controlled at the exterior walls:

- a) If the controlling rating location is on the outside face near the corners, increase the vertical length of the corner bar a maximum of two inches to ensure the rating is not due to rounding errors or clear cover.
- b) If the controlling rating location is on the inside face near midspan, increase wall reinforcing in 20% increments (in accordance with the LRGD 17.2.1(#1)) and/or increase the material strengths until all legal load rating factors are > 1.0 .

2. If BrR returns a rating factor of 0.00 controlled at the top or bottom slabs:

- a) If the controlling rating location is near the walls/supports ($< 30\%$ of span or $> 70\%$ of span) near the transition region of truss bars (see illustration), ensure there is no gap between top and bottom “truss” bars.
- b) If the ratings are still unsatisfactory, refer to the *General* guidelines above (for obtaining BrR ratings consistent with the observed culvert condition).



SCDOT LOAD RATING CULVERT GUIDANCE

March 27, 2020

3. If BrR returns ratings below 1.00 and the controlling location is on the inside face of exterior walls, i.e. near midspan, increase the exterior wall reinforcing in 20% increments or increase the material strengths until the legal ratings are > 1.0 (controlled by the exterior walls) or the rating is no longer controlled by the exterior walls.

In all scenarios of Case I above, code NBI items 64 and 66 as the final HL-93 LRFR rating factor in the modified BrR model (unless it results in ratings of 0, in which case items 64 and 66 are coded as 1.0). Add clear note(s) to the Remarks section of the Load Rating Summary (LRS) form to document all deviations from the culvert plans which were employed to attain beneficial ratings.

Case II

Constraints:

- Single-span with fill > 8' or
- Multiple-span w/ fill > distance between faces of end walls
- Carrying normal traffic for an appreciable period
- Showing no signs of distress or deterioration per latest inspection report

Follow the guidance provided in LRGD Section 17.2.1(#3) and/or increase material strengths until all legal ratings are > 1.0. If the HL-93 LRFR ratings in the modified BrR model are < 1.0, code NBI items 64 and 66 as 1.0 regardless.

In all cases where NBI items 64 & 66 are coded 1.0, add clear note(s) to the Remarks section of the LRSF stating the reason for such coding (i.e., LFR ratings pass, fill > 8', etc.).

For all cases where LRFR ratings (in the final revised BrR model) are 0.0, the signed/sealed LRFR form shall still be submitted. Use "N/A" in Section 3 of the form and add clear note(s) to the Remarks section documenting the coding of items 64 & 66 and pointing out (if applicable) the passing LFR ratings.

SCDOT LOAD RATING CULVERT GUIDANCE

March 27, 2020

BrR Limitations

- BrR version 6.8.4 does not properly account for the area of hooked bars and they are not included in the spec checking. Therefore, hooked bars shall be input as straight bars in BrR. The length of the straight bar can be taken as the “straight length” of the hooked bar. Alternatively, the straight bar can be set to fully developed on both ends and the length shall be taken as ‘the length of the hooked bar’ (Lh) minus two times the ‘development length of the hooked bar’ (Ld) [Equation: $L = L_h - 2(L_d)$].
- For truss bars that begin at the corner and slope down at midspan, in addition to inputting the bars as straight length bars with fully developed ends, a straight, fully developed bar equal to the horizontal dimension of the bend may be input midway between the top and bottom straight bars (highlighted yellow in **Figure 1**).

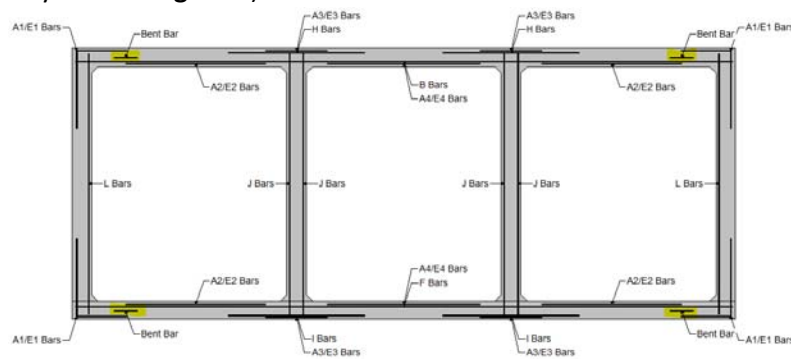


Figure 1 – Modeling Truss Bars in BrR