BrR FOR BRIDGE MAINTENANCE & REHABILITATION

Larry Evans, PE
Ryan Sherman, PE, SE
FORSGREN ASSOCIATES, INC.

- Founded in Eastern Idaho in 1962
- Primary Clients are State and Local Government Entities
- Began Bridge Load Rating in 1995
Began working together on Bridge Load Ratings using BrR in 2009

Load Rated 1,700 Bridges using BrR
TYPICAL LOAD RATING PROCESS

- Assigned Bridge to Load Rate
- Develop Load Rating
  - Follow MBE and State Guidelines
  - Assign Conservative Assumptions
- Present Load Rating Results
- DONE!
WHAT ABOUT THE IMPACT OF LOAD RATING RESULTS?

- Bridge Closures
- Bridge Posting
- Is there Significant Negative Impact to Owner/Traveling Public?
LAFARGEHOLCIM CEMENT PLANT, MORGAN COUNTY, UT
USE BrR TO MANAGE THE LOAD POSTING IMPACTS

- Goal is to remove/increase load posting
- Refine load rating model (when possible)
  - Review assumptions (material properties, supplemental loads, etc.)
  - Compare LRFR and LFR results
  - Use 3D FEM
  - Can impact be lowered?
  - Live Load Placement
- Quickly look at multiple strengthening options
- Utilize existing BrR model for rehab designs
ROCKVILLE TRUSS, ROCKVILLE, UT

- 220 ft Steel through truss bridge built in 1924
- Only access from Rockville to farms and residences south of the Virgin River
- Detour Length of over 40 miles
- Bridge Closure would have a severe impact
- Initial rating of 0
ROCKVILLE TRUSS, ROCKVILLE, UT
ROCKVILLE TRUSS, ROCKVILLE, UT

- Looked for alternatives to refine the load rating
- Obtained additional field measurements allowed a reduction in the wearing surface thickness
- Analyzed vehicles in the middle 12 ft
- Low ratings from multiple bridge components = strengthening would be a major task
- Model revisions allowed the bridge to remain open with load posting
16TH AVENUE OVERPASS, NAMPA, ID

- 766-foot, 11-span steel girder bridge over UPRR
- 4 different bridge segments
- Near downtown and important truck routes
- Rated low requiring load posting
16th Avenue Overpass, Nampa, ID

- Low rating was only in spans 7 and 10
- Controlling point was at a dramatic flange change
- No other low ratings
- Refining load rating didn’t increase load posting
BrR Spec Check showed the bottom flange in compression after the transition to the 8"x1/2" flange.

With the current diaphragm spacing of 22.75 ft the unbraced length was too long.

Looked at several options including:

- Cover plate
- Longitudinal stiffener near bottom flange
- Additional diaphragms near flange transitions
16th Avenue Overpass, Nampa, ID

- Chose to add diaphragms near each flange transitions
- This option was the least expensive and easiest to construct in the field
- The City was able to remove the posting and open the bridge to full legal loads
2100 S RD BRIDGE OVER I-84

- Low volume 3-span continuous steel girder bridge over I-84 in agricultural area
- Rated low during initial BrR load rating requiring load posting
- Low rating was only in span 2 near the bottom flange transitions
- Looked to refine analysis
<table>
<thead>
<tr>
<th>Rating Vehicle</th>
<th>Original Analysis</th>
<th>3D FEM</th>
<th>3D FEM w/ 25 mph Impact</th>
<th>Add Cover Plate at Bottom Flange to Diaphragm</th>
<th>Additional Diaphragm (between support &amp; first diaphragm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-20</td>
<td>0.608</td>
<td>0.756</td>
<td>0.769</td>
<td>1.157</td>
<td>1.203</td>
</tr>
<tr>
<td>Idaho - Type 3</td>
<td>1.016</td>
<td>1.243</td>
<td>1.261</td>
<td>1.976</td>
<td>2.041</td>
</tr>
<tr>
<td>Idaho - Type 3S2</td>
<td>0.773</td>
<td>0.936</td>
<td>0.950</td>
<td>1.369</td>
<td>1.414</td>
</tr>
<tr>
<td>Idaho - Type 3-3</td>
<td>0.767</td>
<td>0.928</td>
<td>0.942</td>
<td>1.353</td>
<td>1.398</td>
</tr>
<tr>
<td>Idaho - 121k</td>
<td>0.585</td>
<td>0.701</td>
<td>0.711</td>
<td>0.938</td>
<td>0.97</td>
</tr>
<tr>
<td>NRL</td>
<td>0.735</td>
<td>0.887</td>
<td>0.900</td>
<td>1.278</td>
<td>1.320</td>
</tr>
<tr>
<td>Posting Requirement</td>
<td>9.5 Ton Max Axle Weight</td>
<td>10 Ton Max Axle Weight</td>
<td>10 Ton Max Axle Weight</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
4th Street Bridge, Caldwell, ID

- 34-foot single span bridge constructed in 1935
- 5 salvaged railroad cars with 4 members per car
- 9" concrete deck with steel channel members embedded 3" into deck
- Initially rated as non-composite girders
- Ratings of 0 for exterior channels of each frame
4TH STREET BRIDGE, CALDWELL, ID

- Closing the bridge would have significant impact
- Adjacent to the City Police Station
- Truck Route for adjacent businesses
- No change in structure condition from inspection reports over past 10 years
4TH STREET BRIDGE, CALDWELL, ID

- Refined analysis
  - Analyzed as composite superstructure: Rating = 0
  - Modeled each frame as 1 and 2 composite girders
  - Max Axle Weight of 2.2 Tons
- Looked at adding cover plates
- Concluded that it is time to replace this structure
USING BrR FOR BRIDGE REPAIRS
MOODY RD BRIDGE, MADISON COUNTY, ID

- RCT bridge built in 1959
- Severe concrete deterioration at edge of deck and curb
- Used BrR to verify bridge capacity warranted repair
MOODY RD BRIDGE, MADISON COUNTY, ID

- Updated BrR model to analyze repairs
- New deck overhang, curbs, and rail
PACKSADDLE RD BRIDGE, TETON COUNTY, ID

- 3-Span RCT bridge built in 1956
- Scour concerns, concrete deterioration at pier caps and substandard rails
- Currently load restricted
- Developed BrR model to evaluate rehabilitation vs. replacement
PACKSADDLE RD BRIDGE, TETON COUNTY, ID

- Used BrR to analyze different deck geometry
- Replaced 5” concrete deck with 8” deck
- Widened the deck 1’-8” and updated curb and rail
- Removed load restrictions without replacing the entire structure
CONCLUSION

- Refine the BrR model for low ratings that cause severe impacts
- BrR is an efficient tool for analyzing rehabilitation/strengthening options
- BrR allows the use of existing load rating files to analyze repair/rehabilitation options quickly