Portable Timber Bridge Systems for Temporary Stream Crossings

STEVE TAYLOR, MIKE RITTER, CHRISTIAN BRODBECK
STREAM CROSSING CHALLENGE

- Forest road stream crossings are focal points for introducing sediment into streams.
  - Construction, use, and removal activities can introduce significant sediment loads.
  - Road approaches bring sediment to the stream.
  - Low-impact and cost-effective stream crossing methods are needed.
- Temporary bridges are also needed by construction activities.
STREAM CROSSING WATER QUALITY IMPACTS

- Portable bridges can be installed and removed with negligible sediment loads to forest streams.
- Sediment introduction during use of portable bridges can be minimal – even during use of off-highway vehicle bridges by log skidders.
  - Majority of sediment introduced during storm events
  - Majority of sediment is generated from road approaches
PORTABLE BRIDGE DESIGN CONSIDERATIONS

- **Safety**
  - Structural adequacy / design vehicle
  - Appropriate management of risks

- **Serviceability and Performance**
  - Deflection limitations
  - Ease of installation
  - Durability

- **Cost**
  - Initial
  - Life-cycle
# BRIDGE CLASS DESIGN CRITERIA

<table>
<thead>
<tr>
<th></th>
<th>Sub-Low Volume</th>
<th>Low Volume</th>
<th>High Volume</th>
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<tbody>
<tr>
<td><strong>Design Life</strong></td>
<td>5 years</td>
<td>10 years</td>
<td>25 years</td>
</tr>
<tr>
<td><strong>Traffic Type</strong></td>
<td>Off-highway vehicles</td>
<td>Trucks</td>
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<tr>
<td><strong>ADT</strong></td>
<td>50</td>
<td>100</td>
<td>unlimited</td>
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<tr>
<td><strong>Design Speed</strong></td>
<td>8 kph</td>
<td>8 kph</td>
<td>40 kph</td>
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<tr>
<td><strong>Load type</strong></td>
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<tr>
<td><strong>Load application period</strong></td>
<td>6 months</td>
<td>24 months</td>
<td>36 months</td>
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<tr>
<td><strong>Deflection limit</strong></td>
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<td>none</td>
<td>AASHTO or reduced</td>
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## DESIGN LOADS

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<thead>
<tr>
<th>Vehicle Weight (lbs)</th>
<th>15000 - 20000</th>
<th>20000 - 25000</th>
<th>25000 - 30000</th>
<th>30000 - 35000</th>
<th>35000 - 40000</th>
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<tbody>
<tr>
<td>Bridge Span (ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
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<td>HS 25-44</td>
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DESIGN LOADS – DYNAMIC EFFECTS

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<th>Dynamic Amplification Factor</th>
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<td>Mean</td>
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<tr>
<td>90th Percentile</td>
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<tr>
<td>95th Percentile</td>
<td>1.64</td>
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Smooth Approach  8 kph

Rough Approach  8 kph

[Graphs showing deflection vs. time for smooth and rough approaches.]
PORTABLE BRIDGE EXAMPLES

Longitudinal deck superstructures

- Traditional glued-laminated timber deck
- Off-highway vehicle glued-laminated timber panels
- T-section glued-laminated timber deck
TRADITIONAL GLULAM DECK
TRADITIONAL GLULAM DECK COST

+ initial bridge cost = $ 15,500
+ installation cost per site = $ 1,000
+ total cost for 10 sites = $ 25,500
+ average cost per site = $ 2,550
GLULAM DECK FOR OFF-HIGHWAY VEHICLES
OFF-HIGHWAY VEHICLE BRIDGE COST

+ initial bridge cost = $8,000
+ installation cost per site = $165
+ total cost for 50 sites = $16,250
+ average cost per site = $325
T-SECTION GLULAM DECK
T-SECTION BRIDGE COST

+ initial bridge cost ....................... $17,000
+ spread footer cost ....................... $600
+ installation and removal cost .......... $1,000

+ Total Cost for 10 sites................. $27,600

Cost per site $
DISCUSSION

- Bridges performed well overall.
  - Bridges successfully carried design loads and overloads.
  - Repeated installation/removal brings additional wear on components.
  - High initial cost limits acceptance for engineered bridges.

- Bolt-laminated and stress-laminated deck designs available.
  - Repeated handling may be problematic for hardware.
Portable timber bridges are excellent options for temporary stream crossings.

- Portable bridge systems can reduce water quality impacts at the road stream crossing.
- Longitudinal deck designs are most appropriate for portable applications.
- Glulam decks have performed well in service. Repeated use results in considerable wear.
- While glulam decks have high initial costs, the average cost per site is competitive with other stream crossing options.