HOW TO USE THE C-RAIL-R GUIDE DRAWING

Amy Smith, P.E.
Bridge Division
July 18, 2013
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Introduction

- Why?
  - Anticipated statewide increase in rail upgrades
  - 31” MBGF implemented
- Provides details for common retrofits
- Can be used for several superstructure types
# Bridge Division Webinar - July 18, 2013 - “How to Use the C-Rail-R Guide Drawing”

## Introduction

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<tr>
<th>Rev Date</th>
<th>Std Name</th>
<th>Description</th>
<th>File Name</th>
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<tr>
<td></td>
<td></td>
<td><strong>RAILING STANDARDS</strong></td>
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<td><strong>TRAFFIC RAILS</strong></td>
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<td>07-13</td>
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<td>Index Sh of Railing Standards</td>
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<td>07-12</td>
<td>T1F</td>
<td>STL Post w/Alum Tube &amp; Opt Drains (33” tall)</td>
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<td>STL Post w/Sti Tube &amp; Opt Drains (32” tall)</td>
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<td>07-12</td>
<td>T221</td>
<td>Concrete Parapet (32” tall)</td>
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<td>07-12</td>
<td>T223</td>
<td>Conc Bm &amp; Post w/6” Openings (32” tall)</td>
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<td>T401</td>
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<td>07-12</td>
<td>T402</td>
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<td>T411</td>
<td>Conc Traf Rail w/Windows (Tx Classic) (32” tall)</td>
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<td>07-12</td>
<td>T551</td>
<td>Concrete Safety F-Shape (32” tall)</td>
<td>rlstd09.dgn</td>
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<tr>
<td>07-12</td>
<td>T552</td>
<td>T551 w/Multiple Drain Slots (32” tall)</td>
<td>rlstd10.dgn</td>
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<td>07-12</td>
<td>T66</td>
<td>Conc Bm, Post &amp; Curb w/5.25” Max Open (32” tall)</td>
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<td>07-12</td>
<td>T77</td>
<td>Steel Post w/Two Elliptical Pipes (33” tall)</td>
<td>rlstd13.dgn</td>
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<td>07-12</td>
<td>SSTW</td>
<td>Conc Single Slope Traffic Rail (36” tall)</td>
<td>rlstd14.dgn</td>
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<td>07-12</td>
<td>T80HT</td>
<td>Conc &amp; Steel Heavy Truck Traffic Rail (50” tall)</td>
<td>rlstd15.dgn</td>
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<td>07-12</td>
<td>T80SS</td>
<td>Conc Single Sip Hvy Truck Traffic Rail (42” tall)</td>
<td>rlstd16.dgn</td>
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</table>

|          |          | **COMBINATION RAILS**                             |               |
| 07-12    | C1W      | Steel Post w/Sti Tube & Opt Curb Drain (42” tall) | rlstd17.dgn   |
| 07-12    | C221     | T221 w/Steel Pipe Rail (42” tall)                 | rlstd18.dgn   |
| 07-12    | C223     | T223 w/Steel Pipe Rail (42” tall)                 | rlstd19.dgn   |
| 07-12    | C402     | T402 w/Steel Pipe Rail (42” tall)                 | rlstd20.dgn   |
| 07-12    | C411     | Comb Rail w/Windows (Tx Classic) (42” tall)       | rlstd21.dgn   |
| 07-12    | C412     | Conc Comb Rail w/Windows (TL-4) (42” tall)        | rlstd33.dgn   |

|          |          | **MISCELLANEOUS RAILS**                           |               |
| 05-11    | C-RAIL-R | Retrofit Guide for Concrete Rails                 | rlstd22.dgn   |
| 11-12    | T131RC   | Retrofit Guide for Curbed Structures              | rlstd34.dgn   |
| 04-09    | T2/T201TR| Guide for T2/T201 (Retrofit Thre-Beam Transition)  | rlstd52.dgn   |
| 04-09    | T202TR   | Guide for T202 (Retrofit Thre-Beam Transition)     | rlstd26.dgn   |
| 05-11    | TRF      | Traffic Rail Foundation                           | rlstd27.dgn   |
| 04-09    | PR1      | Pedestrian Rail,Steel Pipe (42” tall)             | rlstd28.dgn   |
| 05-11    | PR2      | Pedestrian Rail,Steel Pipe on Parapet (42” tall)  | rlstd29.dgn   |
| 04-09    | PR3      | Pedestrian Rail,Steel and Conc (43.75” tall)      | rlstd30.dgn   |
| 04-09    | PR3-HD   | Handrail Details for PR3 Pedestrian Rail           | rlstd31.dgn   |
| 04-09    | CLF-RO   | 8 Ft Chain Link Fence for Railroad Overpass       | rlstd32.dgn   |
Introduction
Introduction

Retrofit Rail Sections on Slabs Using Anchor Bolts

Retrofit Rail Sections on CG (Pan Form) Spans

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Testing

- **0-4823 Adhesive Anchors for Retrofit/Repair of Bridge Rails**
  - Tested T501 and T203 on a bridge deck
    - (now T551 & T223)
  - Statically test conventional anchorage (CIP)
  - Dynamically test conventional anchorage (CIP)
  - Develop an adhesive anchorage and dynamically test

### Table 1. Summary of Analytical and Full-Scale Testing.

<table>
<thead>
<tr>
<th>No.</th>
<th>Case</th>
<th>Calculated Conventional Anchored Strength (kips)</th>
<th>Static Strength Conventional Anchored Design (kips)</th>
<th>Dynamic Strength Conventional Anchored Design 50-ms Avg. (kips)</th>
<th>Retrofit Design Strength (Dynamic) 50-ms Avg. (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T501 Mid-span (Avg. 2 Tests)</td>
<td>59.7</td>
<td>70.5</td>
<td>68.0</td>
<td>62.8</td>
</tr>
<tr>
<td>2</td>
<td>T501 End/Joint</td>
<td>36.4</td>
<td>41.0</td>
<td>46.0</td>
<td>50*</td>
</tr>
<tr>
<td>3</td>
<td>T203 End/Joint</td>
<td>23.2</td>
<td>33.0</td>
<td>N/A</td>
<td>39.5</td>
</tr>
<tr>
<td>4</td>
<td>T203 Mid-span (Avg. 2 Tests)</td>
<td>71.0</td>
<td>72.8</td>
<td>71.0</td>
<td>68.3</td>
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</tbody>
</table>
Testing

- 9-1002 MASH Test 3-11 of the SSTR on Pan-formed Bridge Deck
  - 6” slab with 21.25” overhang (typical pan form)
  - Pickup truck at 62 mph
  - Test successful
    - No dynamic or permanent deflection seen
These rail types are on the Guide drawing:

- T221, C221
- T401, T402, C402
- T551, T552
- SSTR
- **What if I want...**
  - T223 or T1F, etc?

- **Contact BRG – be prepared with**
  - Photos (particularly is slab repair also required)
  - Existing plans
  - Form 2488
How to use the details

- **First thing first!**
  - **NOT a standard**
  - Must be marked up
  - Label “MOD”
  - Must be sealed & signed by P.E.

- **Also must include the rail standard itself**
  - C-RAIL-R only provides anchorage details
How to use the details

- Need to know:
  - Type of superstructure/culvert
  - Slab thickness most important variable
  - Is there an existing curb
  - Photos!!!!!

- **Scenario 1**

- You have a slab thickness 7” or more
  - Lucky – easiest to retrofit
  - Want to use T551
  - Rebar doweled and epoxied into slab
  - Use sheets 1 & 2
How to use the details

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Scenario 2

You have a slab thickness 6 1/2”
- Must use the bolt-thru option on sheet 3
- Spacing of anchors in notes 15-18 (not from sheet 1)
- Wingwall still uses epoxy bars

- Less favorable option than epoxy anchors because access beneath bridge is required
How to use the details

Anchor bolt

Secondary epoxy anchor
How to use details

- **Scenario 3**
  - You have a pan-form with overhang
    - Must use the bolt-thru option on sheet 3
    - Spacing of anchors in note 17 (not from sheet 1)
    - Wingwall still uses epoxy bars
  - Only available rails are T551 and SSTR
  - Based on crash testing
  - Has overhang limits
How to use the details

- **Scenario 4**
  - You have a curb
    - DO NOT REMOVE THE CURB
    - Use details from sheet 4
    - There are restrictions for use of these details
      - Rail type
      - Minimum curb size
    - Use same elevation (Sheet 1) for spacing of anchors
    - Wingwall still uses epoxy bars

(Also consider T131RC for retrofit on curb)
How to use the details

- **Notes, notes, notes**
  - Carefully review which notes go with which details
  - Best to strikeout or remove non-applicable notes
  - Epoxy anchors require a particular epoxy – pay attention

- **General Notes**
  - Retrofit details provide a TL-3 rail, regardless of higher rating shown on the individual rail standard
  - Payment Item 450 “Ty xxx (Retrofit)”
  - (will be Item 451 in 2014 Spec book)

- **Your bridge doesn’t match anything on the C-RAIL-R?**
  - Contact BRG
Example retrofit 1

- **T221 on 8.5” slab with epoxy anchors**
Example retrofit 2

- T552 on pan-form with overhang
Example retrofit 2

SECTION OF EXISTING T6 RAILING TO BE REMOVED

SECTION OF T552 Railing Retrofit

SECTION OF T552 Railing Retrofit

SECTION OF T552 Railing Retrofit

SECTION OF T552 Railing Retrofit

Example retrofit 2

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Example retrofit 2

- Pan-form bridge
- Notice overhang is 2’-2.75”
  - Larger than the 1’-9.25” max on Guide
- Move rail 5.5” from edge to satisfy overhang limit
Example retrofit 3

- **T551 with epoxy anchors on slab with curb**
Example retrofit 3

- Compare to Case (D)

From C-RAIL-R
### Summary

<table>
<thead>
<tr>
<th></th>
<th>T221</th>
<th>T401</th>
<th>T551</th>
<th>SSTR</th>
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<tbody>
<tr>
<td></td>
<td>$/lf</td>
<td>$/lf</td>
<td>$/lf</td>
<td>$/lf</td>
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<tr>
<td>Conventional</td>
<td>54</td>
<td>80</td>
<td>39</td>
<td>34</td>
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<tr>
<td>Retrofit</td>
<td>170</td>
<td>167</td>
<td>106</td>
<td>110</td>
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- Retrofit is 2-3x price of conventional install
Summary

- C-RAIL-R has easy retrofits for:
  - Slabs 6.5”+ thick
  - Most pan-form bridges
  - Slabs with curbs
- Details will provide a TL-3 rail (50mph)
- Must be MOD and sealed/signed
- Other situations can be handled
  - BRG needs to evaluate structure for best rail type and anchorage

Questions?
- Amy Smith 512/416-2261
- Jon Ries 512/416-2191