**TBPOC MEETING MINUTES**
April 17, 2013, 9:00 AM – 1200 PM  
Mission Bay Office, 325 Burma Road, Oakland, CA

**Attendees:**  
TBPOC Members: Steve Heminger (Chair), Andre Boutros, and Malcolm Dougherty  
PMT Members: Tony Anziano, Andrew Fremier, and Stephen Maller  
Participants: Rosme Aguilar, Ade Akinsanya, Bill Casey, Clive Endress, Rich Foley, John Goodwin, Andrew Gordon, Ted Hall, Peter Lee, Brian Maroney, Steve Matty, Dina Noel, Will Shuck, Trish Stoops, Ken Terpstra, and Mazen Wahbeh  
Guests: ABF: Brian Petersen, Peter Vander Waart, Bob Kick; TY Lin/M&N: Marwan Nader; IBECA: Salim Brahim; CMF: Conrad Christensen

Convened: 9:00 AM

<table>
<thead>
<tr>
<th>Items</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-2 BOLTS WORKSHOP</td>
<td></td>
</tr>
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</table>
| 1. What fix should be installed? –  
| 2. Should 2010 bolts be replaced?  
| 3. What caused 2008 bolts to fail?  
BATA Commission Meeting: 4/28/13 | |

1. What fix should be installed?  
Currently there are 3 design alternatives underway (please refer to attached handouts provided in the meeting):  
A. **Option A** - Replace bolts, same as original design - Status: Design at 65%.  
This option would replace anchor rods and would require removal of shear keys; cut and removal of anchor rods in stages. Then re-installing shear keys, install rod extensions in stages, and grouting. Because of constructability

- TBPOC instructed the team to eliminate Option A, and continue developing Options BD1, BD2, and C to 65% design, continue providing design status update to TBPOC on a weekly basis. Design JV targeted that 65% design on Option BD and C to be completed by end of April.  
- Team advised TBPOC of implementation cost of either of
and damage to shear keys risk issues, Team suggested to eliminate this option

### Items

B. **Option BD - Steel Collars**, new design implementation of adding metal frame grillage around housing to hold it down - **Status: Design at 45%**. Does not require removal of shear keys and anchor bolts, potentially fast construction, however would require more coring and PT placement. Team is pursuing 2 alternatives within this option, design performance are same for both alternatives, schedule time may vary:

a. **BD1** - Requires more upfront fabrication, and less time in construction (requires welding during fabrication and also on site during assembly)

b. **BD2** - Less fabrication time and more work during construction, concept includes stacked plates of different size plates clamped together. Construction could start right after milling of plates, with only some plates requires fabrication (no welding required during fabrication or on site during assembly).

C. **Option C – Pre-Stressed Collars**, new design implementation of post tensioning strands - **Status: Design at 30%**. This option has more concrete work and less steel. The main steel element is fabrication of saddle and post tensioning tie-down. Option C requires unique saddle system and extension of concrete cap construction, not as developed as Option BD.

2. **Should 2010 bolts be replaced?**

   Salim Brahim, metallurgist working for ABF (also Chairman of ASTM International

<table>
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<th>Items</th>
<th>Action</th>
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<tbody>
<tr>
<td>the selected retrofit options would be around $10M (the amount does not include replacement of 2010 rods). Scope, cost and schedule in development as design progresses.</td>
<td></td>
</tr>
<tr>
<td>• TBPOC indicated that Department has authorization to go ahead with fabrication of what is needed for Options BD, and C (it was noted that some of material fabricated for Option BD could be used for Option C, also some material ordered for BD2 could be used for the fabrication of BD1), for amount of up to $4.3M which includes some upfront work, detailing, material placement and book for fabrication shop space (the amount was authorized per 4/11/12 TBPOC conference call meeting).</td>
<td></td>
</tr>
<tr>
<td>• TBPOC advised the team to start the lab test on a selected number of bolts (to be decided by the team) as</td>
<td></td>
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</table>
**Items**

F116 Fasteners Committee), briefed TBPOC that the performance of the 2010 bolts appears thus far to have better uniformity and toughness than 2008. He also indicated that he could not fully answer this question until 2010 bolts have completed the metallurgic examination for the selected bolts (total of 10), this examination would determine the mechanical and physical properties.

ABF has completed the In-Situ tensioning of 192 bolts (the 2010 bolts) on 4/9/13, after the 30-day waiting period by May 9th, extended lab test to start on 10 bolts. It was estimated final reports on the extended lab test result would not be available until about one month later (around 6/10/2013).

The Chair asked if in the event the 192 bolts (S3, S4, and B1-B4) needed to be replaced; can construction of retrofit work (S1 & S2) and re-installation of 192 bolts be performed at the same time. ABF indicated that the existing truss working platform for the retrofit work would be in the way of re-installing some of the 192 bolts and the 2 operations could not be performed at the same time due to work space limitations and physical interferences.

<table>
<thead>
<tr>
<th>Action</th>
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<tbody>
<tr>
<td>soon as possible.</td>
</tr>
</tbody>
</table>

- Report to TBPOC after workshop.
- Team to meet in the afternoon on 4/17/13 to follow up discussion of whether the same bolts will be reordered for the 10 replacement bolts, or if supplemental requirements would be specified.

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3. **What Caused 2008 bolts to fail?**

Salim Brahimi indicated that the following combination of factors caused this failure:

- High-end hardness
- Low-end ductility (toughness)
- Incomplete transformation of the metal, and
- High stress along with some
<table>
<thead>
<tr>
<th>Items</th>
<th>Action</th>
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<tbody>
<tr>
<td>presence of hydrogen</td>
<td>Salim stated the material met specification; however, additional requirements could have been given to manufacturer. Salim indicated that the lab result shows hydrogen in the metal. At this point, one could not determine whether this resulted due to manufacturing or due to environment (water in the pier cap).</td>
</tr>
</tbody>
</table>

Adjourned: 12:00 PM

**TBPOC MEETING MINUTES**
April 17, 2013, 9:00 AM – 12:00 PM

**APPROVED BY:**

**STEVE HEMINGER,** TBPOC Chair  
Executive Director, Bay Area Toll Authority  
6/6/13

**ANDRE BOUTROS,**  
Executive Director, California Transportation Commission  
6/6/2013

**MALCOLM DOUGHERTY**  
Director, California Department of Transportation  
6/6/2013
## E2 SHEAR KEY (S1 & S2) RETROFIT ALTERNATIVES

<table>
<thead>
<tr>
<th>ID Tag</th>
<th>ID Text Label</th>
<th>Image</th>
<th>Major Steps</th>
<th>Major Pros</th>
<th>Major Cons</th>
</tr>
</thead>
</table>
| A      | Replace Bolts | ![Image](image1.png) | 1) Procure Material (Bolts)  
2) Develop and construct mockups  
3) Remove bolts and slide out shear keys  
4) Remove grout and cut anchor bolts at bottom  
5) Prepare holes and install new bolts  
6) Install shear keys  
7) Grout  
8) Tension | No formal design required  
- If all went well, potentially the fastest and cheapest |  
- High degree of construction uncertainty, requiring construction related R&D  
- Requires shear keys to be removed and reinstalled  
- Requires significant mock-ups (expect design iterations) |
| BD     | Steel Collars | ![Image](image2.png) | 1) Procure material (PT strands/ steel plate/ bolts)  
2) Fabricate steel frame  
3) Tap holes in existing lower housing and prepare surface  
4) Core existing concrete and cast supplemental concrete  
5) Install steel frame  
6) Grout  
7) Tension | More developed  
- Potentially simplest but a lot of work  
- Potentially fastest  
- Shear keys do not need to be removed |  
Potentially most costly  
- More coring and PT placement required  
- Most steel fabrication |
| C      | Prestressed Collars | ![Image](image3.png) | 1) Procure material (PT strands/ steel plate)  
2) Fabricate steel frame/ saddle  
3) Core existing concrete and cast supplemental concrete  
4) Install steel frame/ saddle  
5) Grout  
6) Tension | Potentially cheapest  
- Potentially fastest  
- Shear keys do not need to be removed |  
Not as developed as BD  
- Requires unique saddle system |
Alternative C
E2 SHEAR KEY - PT OPTION

SECTION A-A

VIEW B-B

DETAIL A

DETAIL B

ALTERNATIVE C

Date: 2015-04-15

15 APR 2013

DRAFT In-Progress

Not for Construction
<table>
<thead>
<tr>
<th>Location and Item</th>
<th>Component Description</th>
<th>Rod (no head) or Bolt (with head)</th>
<th>Supplier</th>
<th>Diameter (in)</th>
<th>Overall Length (ft)</th>
<th>Overall Length (mm)</th>
<th>Quantity Installed</th>
<th>De-Humidified Zone?</th>
<th>Tighten Method</th>
<th>Final Tension</th>
<th>Date Tension or Loading Complete</th>
<th>Date Re-Inspected</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E2 Shear Key - Connect to Concrete - Above Columns Under OBG [B1, S2]</td>
<td>rod</td>
<td>Dyson</td>
<td>3</td>
<td>17.2</td>
<td>5235</td>
<td>60</td>
<td>L</td>
<td>96</td>
<td>No</td>
<td>Tension</td>
<td>0.7</td>
<td>3/6/2013</td>
</tr>
<tr>
<td>2</td>
<td>E2 Shear Key - Connect to Concrete - Above Bent Cap, Under Crossbeam [S3, S4]</td>
<td>rod</td>
<td>Dyson</td>
<td>3</td>
<td>21.9</td>
<td>6676</td>
<td>96</td>
<td></td>
<td>192</td>
<td>No</td>
<td>Tension</td>
<td>0.7</td>
<td>4/1/2013</td>
</tr>
<tr>
<td>3</td>
<td>E2 Bearing - Connect to Concrete - Under OBG [B1, B2, B3, B4]</td>
<td>rod</td>
<td>Dyson</td>
<td>3</td>
<td>22.6</td>
<td>6902</td>
<td>64</td>
<td></td>
<td></td>
<td></td>
<td>Tension</td>
<td>0.7</td>
<td>4/9/2013</td>
</tr>
<tr>
<td>4</td>
<td>E2 Bearing - Connect to OBG [S1, S2]</td>
<td>rod</td>
<td>Dyson</td>
<td>3</td>
<td>4.4</td>
<td>1337</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
<td>Tension</td>
<td>0.7</td>
<td>9/12/2012</td>
</tr>
<tr>
<td>5</td>
<td>E2 Bearing Assembly Bolts (Spherical Bushing Halves)</td>
<td>rod</td>
<td>Dyson for Lubrite for Hochang</td>
<td>1</td>
<td>2.4</td>
<td>733</td>
<td>96</td>
<td>No</td>
<td>Tension</td>
<td>0.61</td>
<td>July 2009</td>
<td>not accessible</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>E2 Bearing Assembly Bolts (Retaining Rings)</td>
<td>Rod</td>
<td>Dyson for Hochang</td>
<td>1</td>
<td>0.2</td>
<td>55</td>
<td>336</td>
<td>No</td>
<td>Tension</td>
<td>0.61</td>
<td>January 2010</td>
<td>4/6/2013</td>
<td>(for 32 accessible bolts)</td>
</tr>
<tr>
<td>7</td>
<td>PWS Anchor Rods - PWS Socket to Anchorage</td>
<td>Rod</td>
<td>Dyson</td>
<td>3-1/2</td>
<td>27.9 to 31.8</td>
<td>8500 to 9700</td>
<td>274</td>
<td>Yes</td>
<td>Load Transfer</td>
<td>0.26</td>
<td>9/26/2012</td>
<td>4/6/2013</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Tower Saddle Tie Rods</td>
<td>Rod</td>
<td>Dyson</td>
<td>4</td>
<td>6.0 to 17.5</td>
<td>1840 to 5325</td>
<td>25</td>
<td>Yes</td>
<td>Tension</td>
<td>0.41</td>
<td>7/14/2012</td>
<td>4/6/2013</td>
<td>Tensioned to 0.5 kFy</td>
</tr>
<tr>
<td>9</td>
<td>Turned Rods at Tower Saddle Segment Splices</td>
<td>Rod</td>
<td>Dyson</td>
<td>3-1/16</td>
<td>1.5</td>
<td>463</td>
<td>100</td>
<td></td>
<td></td>
<td>Tension</td>
<td>0.45</td>
<td>4/6/2011</td>
<td>4/6/2013</td>
</tr>
<tr>
<td>10</td>
<td>Tower Saddle to Grillage Anchor Bolts</td>
<td>Hex Bolt</td>
<td>Dyson</td>
<td>3</td>
<td>1.2</td>
<td>360</td>
<td>90</td>
<td>Head Yes, Nut No</td>
<td>Tension</td>
<td>0.48</td>
<td>ongoing</td>
<td>3/25/2013</td>
<td>4/6/2013</td>
</tr>
<tr>
<td>11</td>
<td>Tower Outrigger Boom (for Maintenance) at Top of Tower</td>
<td>Hex Bolt</td>
<td>Dyson</td>
<td>3</td>
<td>2.1</td>
<td>630</td>
<td>4</td>
<td>No</td>
<td>Snug</td>
<td>0.1</td>
<td>July 2012</td>
<td>4/6/2013</td>
<td>Act as pins for swinging out and then securing the maintenance outrigger boom at the top of 2 of 4 tower head chimneys. At each boom, one bolt is loaded and other bolt is unloaded in the current boom position. The currently unloaded bolt will be installed snug tight when the boom is swung out for use (future position).</td>
</tr>
<tr>
<td>12</td>
<td>Tower Anchor Rods - Tower at Foating (3&quot; Dia)</td>
<td>Rod</td>
<td>Vulcan Threaded Products for KOS for KFM (04-0120E4)</td>
<td>3</td>
<td>25.6</td>
<td>7789</td>
<td>388</td>
<td>Yes</td>
<td>Tension</td>
<td>0.48</td>
<td>ongoing</td>
<td>daily</td>
<td>Tensioned to 1850 kN = 404.7 kips before and after load transfer</td>
</tr>
<tr>
<td>13</td>
<td>Tower Anchor Rods - Tower at Foating (4&quot; Dia)</td>
<td>Rod</td>
<td>Dyson</td>
<td>4</td>
<td>25.7</td>
<td>7839</td>
<td>36</td>
<td>Yes</td>
<td>Tension</td>
<td>0.37</td>
<td>ongoing</td>
<td>daily</td>
<td>Tensioned to 2530 kN = 568.8 kips before and after load transfer</td>
</tr>
<tr>
<td>14</td>
<td>East Saddle Anchor Rods</td>
<td>Rod</td>
<td>Dyson for JSW</td>
<td>2</td>
<td>2.6</td>
<td>800</td>
<td>32</td>
<td>Yes</td>
<td>Tension</td>
<td>0.45</td>
<td>May 2010</td>
<td>4/7/2013</td>
<td>Specified gap under nut/washer so no load; use jam nuts to secure structural nuts</td>
</tr>
<tr>
<td>15</td>
<td>East Saddle Anchor Rods</td>
<td>Hex Bolt</td>
<td>Dyson</td>
<td>3</td>
<td>4.7</td>
<td>1420</td>
<td>18</td>
<td>Yes</td>
<td>Tension</td>
<td>0.1</td>
<td>4/13/2012</td>
<td>4/7/2013</td>
<td>Snug tightened before load transfer</td>
</tr>
<tr>
<td>16</td>
<td>B214 Cable Bands - Cable Brackets - at East End of Bridge - Strongback Anchor Rods</td>
<td>Rod</td>
<td>Dyson</td>
<td>3</td>
<td>10.3 to 11.1</td>
<td>3129 to 3372</td>
<td>24</td>
<td>No</td>
<td>Tension</td>
<td>0.16</td>
<td>2/8/2013</td>
<td>4/7/2013</td>
<td>Neoprene between strongback and cable band is in the grip</td>
</tr>
<tr>
<td>17</td>
<td>W2 Bikepath Anchor Rods</td>
<td>Rod</td>
<td>Dyson</td>
<td>1.5</td>
<td>460</td>
<td>43</td>
<td>No</td>
<td>Tension</td>
<td>0.7</td>
<td>N/A</td>
<td>N/A</td>
<td>Not Determined Yet</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Notes:**
- Connect 2 halves of the spherical bushing assembly housing together at Lubrite; rods are internal to bearings and all rods are not accessible after bearing assembly at Hochang (December 2009 & January 2010); rods tensioned to 0.7 kFy.
- Bottles thread into drill and tap holes to attach retaining rings that secure the Lubrite spherical bushing assembly in the tower housing; bolts are mechanically galvanized, not hot dip galvanized; bolts are internal to bearings and not accessible after bearing assembly at Hochang, except for a small number of bolts in limited areas -> 32 of 326 bolts are accessible.
- Loctite 25 and Shear Keys Connect 2 halves of the spherical bushing assembly housing together at Lubrite; rods are internal to bearings and all rods are not accessible after bearing assembly at Hochang (December 2009 & January 2010); rods tensioned to 0.7 kFy.
- Act as pins for swinging out and then securing the maintenance outrigger boom at the top of 2 of 4 tower head chimneys. At each boom, one bolt is loaded and other bolt is unloaded in the current boom position. The currently unloaded bolt will be installed snug tight when the boom is swung out for use (future position).