



**BAY AREA TOLL AUTHORITY**  
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**SPECIAL**  
**BAY AREA TOLL AUTHORITY (BATA) MEETING**

**1:00 P.M., Wednesday, May 29, 2013**

Joseph P. Bort MetroCenter  
Lawrence D. Dahms Auditorium  
101 8<sup>th</sup> Street, 1<sup>st</sup> Floor  
Oakland, CA 94607

**AMY REIN WORTH, CHAIR**  
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**DAVE CORTESE, VICE CHAIR**  
*Santa Clara County*

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*Cities of San Mateo County*

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*U.S. Department of Housing  
and Urban Development*

**TOM BATES**  
*Cities of Alameda County*

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*City and County of San Francisco*

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*Napa County and Cities*

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*U.S. Department of Transportation*

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**MARK LUCE**  
*Association of Bay Area Governments*

**JAKE MACKENZIE**  
*Sonoma County and Cities*

**JOE PIRZYNSKI**  
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*State Business, Transportation  
and Housing Agency*

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*Solano County and Cities*

**ADRIENNE J. TISSIER**  
*San Mateo County*

**SCOTT WIENER**  
*San Francisco Mayor's Appointee*

**STEVE HEMINGER**  
*Executive Director*

**ANDREW B. FREMIER**  
*Deputy Executive Director*

*The Bay Area Toll Authority (BATA) considers matters related to the Toll Bridge Accounts, Toll Bridge Seismic Retrofit Program and the Regional Measure 1 (RM 1) Bridge Improvement Program.*

This meeting is scheduled to be audiocast live on MTC's Web site: [www.mtc.ca.gov](http://www.mtc.ca.gov)

**AGENDA**

**ACTION**  
**RECOMMENDED\*\***

- |  |                |
|--|----------------|
| 1. Roll Call                                       | Confirm Quorum |
| 2. Pledge of Allegiance                            |                |
| 3. Bay Bridge Anchor Bolts Update (Steve Heminger) | Information    |

*Staff will update the Authority on the testing,  
monitoring and replacement strategy for high-strength  
steel rods on the new Self-Anchored Suspension Span of  
the San Francisco-Oakland Bay Bridge.*

- |   |             |
|---|-------------|
| 4. Public Comment / Adjournment / Next meeting<br>Wednesday, June 26, 2013 at 9:30 a.m.<br><b>Joseph P. Bort MetroCenter</b><br><b>Lawrence D. Dahms Auditorium</b><br><b>101 8th Street, 1st Floor</b><br><b>Oakland, CA 94607</b> | Information |
|---|-------------|

## Special BATA Meeting Agenda

### Page 2

\* Attachment sent to Authority members, key staff and others as appropriate. Copies will be available at the meeting.

\*\* All items on the agenda are subject to action and/or change by the Authority. Actions recommended by staff are subject to change by the Authority.

+ Non-voting Member.

++ Item will be distributed at the meeting.

**Quorum:** A quorum of this Authority shall be a majority of its regular voting members (10).

**Public Comment:** The public is encouraged to comment on agenda items at committee meetings by completing a request-to-speak card (available from staff) and passing it to the committee secretary. Public comment may be limited by any of the procedures set forth in Section 3.09 of MTC's Procedures Manual (Resolution No. 1058, Revised) if, in the chair's judgment, it is necessary to maintain the orderly flow of business.

**Meeting Conduct:** If this meeting is willfully interrupted or disrupted by one or more persons rendering orderly conduct of the meeting unfeasible, the Chair may order the removal of individuals who are willfully disrupting the meeting. Such individuals may be arrested. If order cannot be restored by such removal, the members of the committee may direct that the meeting room be cleared (except for representatives of the press or other news media not participating in the disturbance), and the session may continue.

**Record of Meeting:** BATA meetings are recorded. Copies of recordings are available at nominal charge, or recordings may be listened to at MTC offices by appointment. Audiocasts are maintained on MTC's Web site for public review for at least one year.

**Accessibility and Title VI:** MTC provides services/accommodations upon request to persons with disabilities and individuals who are limited-English proficient who wish to address Commission matters. For accommodations or translations assistance, please call 510.817.5757 or 510.817.5769 for TDD/TTY. We require three working days' notice to accommodate your request.

**可及性和法令第六章:** MTC 根據要求向希望來委員會討論有關事宜的殘疾人士及英語有限者提供服務/方便。需要便利設施或翻譯協助者，請致電 510.817.5757 或 510.817.5769 TDD / TTY。我們要求您在三個工作日內告知，以滿足您的要求。

**Acceso y el Título VI:** La MTC puede proveer asistencia/facilitar la comunicación a las personas discapacitadas y los individuos con conocimiento limitado del inglés quienes quieran dirigirse a la Autoridad. Para solicitar asistencia, por favor llame al número 510.817.5757 o al 510.817.5769 para TDD/TTY. Requerimos que solicite asistencia con tres días hábiles de anticipación para poderle proveer asistencia.

# Briefing on Bay Bridge Bolts - May 29, 2013



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SEISMIC SAFETY PROJECT

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# Developments and Progress

- Bolt Testing Regime and Schedule is Set
  - Important tests will be completed in the coming weeks on status of all bolts
  - Go/No Go determination of Labor Day opening will be made based on results by July 10, 2013
  - Facts about Bolts and Bridge Safety will drive opening decision



# Developments and Progress

- Retrofit Solution Well Underway
  - Fabricator is XKT Engineering, Inc.
  - Work will be done locally (Mare Island)
  - Press Access to Fabrication In Progress
  - Schedule of Retrofit Completion Being Finalized





# Developments and Progress

- Labor Day Opening Is Still The Goal, But Test Results And Retrofit Schedule Will Determine
  - Three-Day Weekend Best for Final Work and Opening
  - Caltrans Has Done This Before (3 Closures; Most Recently Labor Day 2009)
  - Go/No Go Recommendation on July 10, 2013



# Three Key Questions

1. What caused the E2 anchor bolts manufactured in 2008 to fail?
2. What retrofit strategy should be used to replace the 2008 anchor bolts?
3. What should be done about other bolts on the SAS?



# **1. What caused the E2 anchor bolts manufactured in 2008 to fail?**





# Metallurgical Report on 2008 Bolts, Dated May 7, 2013

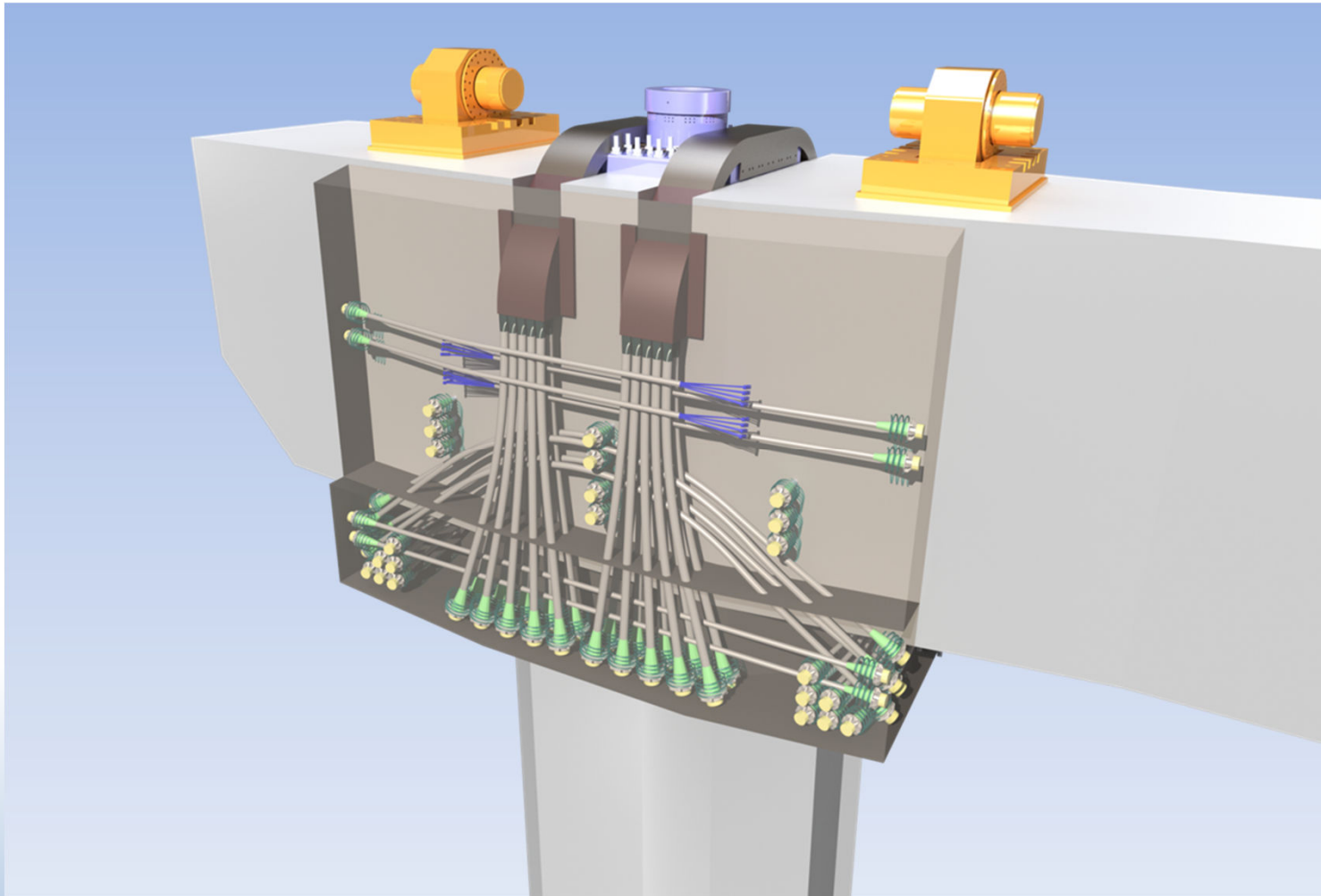
- The root cause of the failures is attributed to higher than normal susceptibility of the steel to hydrogen embrittlement.
- The metallurgical condition of the 2008 bolts was found to be less than ideal with large differences in hardness from center to edge, and high local hardness near the surface. The material also exhibited low toughness and marginal ductility.
- The combination of all of these factors caused the 2008 anchor rods to fail due to hydrogen embrittlement.



## **2. What retrofit strategy should be used to replace the 2008 anchor bolts?**



# Steel Saddle Retrofit Option



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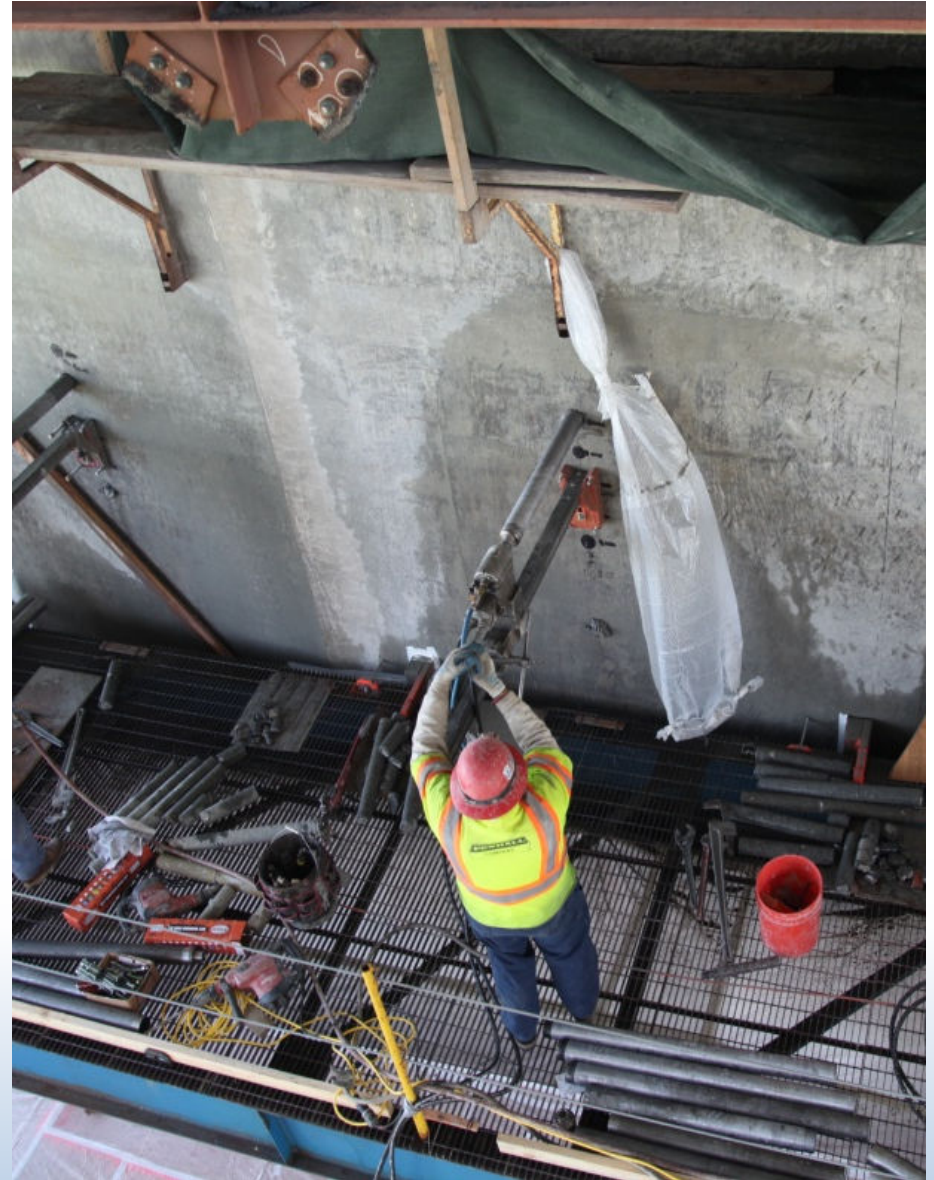
# Construction Progress on Retrofit

- Design moving to shop drawing phase.
- Concrete removal and coring of E2 has begun.
- Material procurement ongoing.





- Fabricator is XKT Engineering, Inc.
- Work will be done locally (Mare Island)
- Schedule of Retrofit Completion Being Finalized



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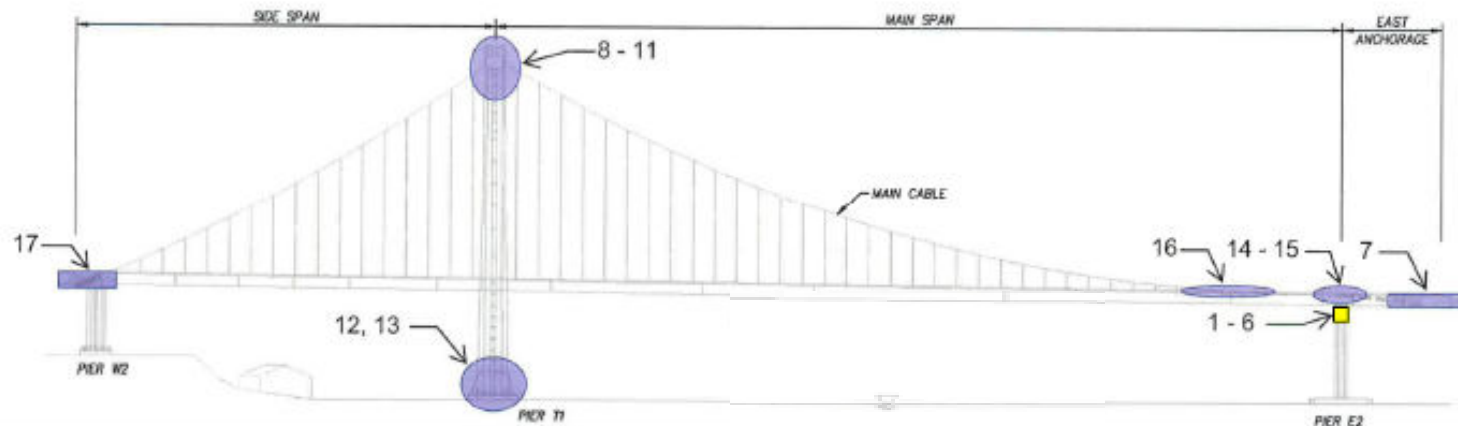
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### **3. What should be done about other bolts on SAS?**

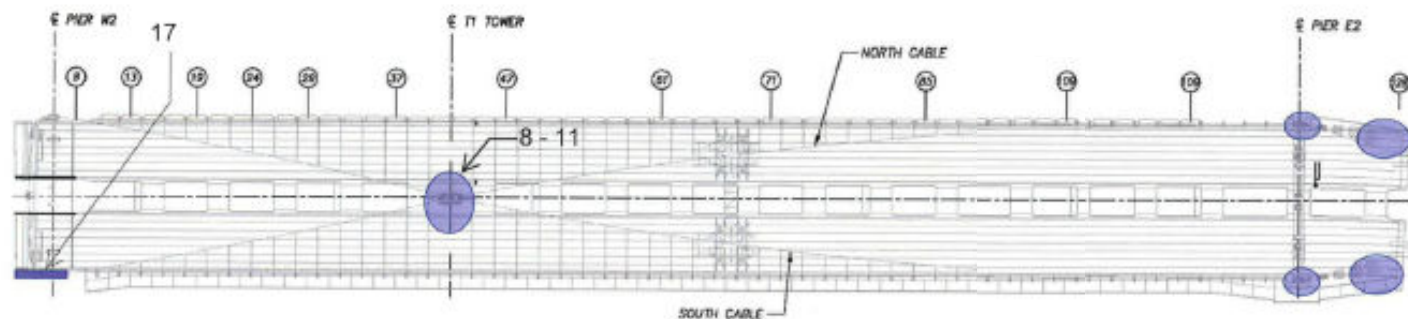




# ASTM A354 Grade BD Rods Across SFOBB-SAS

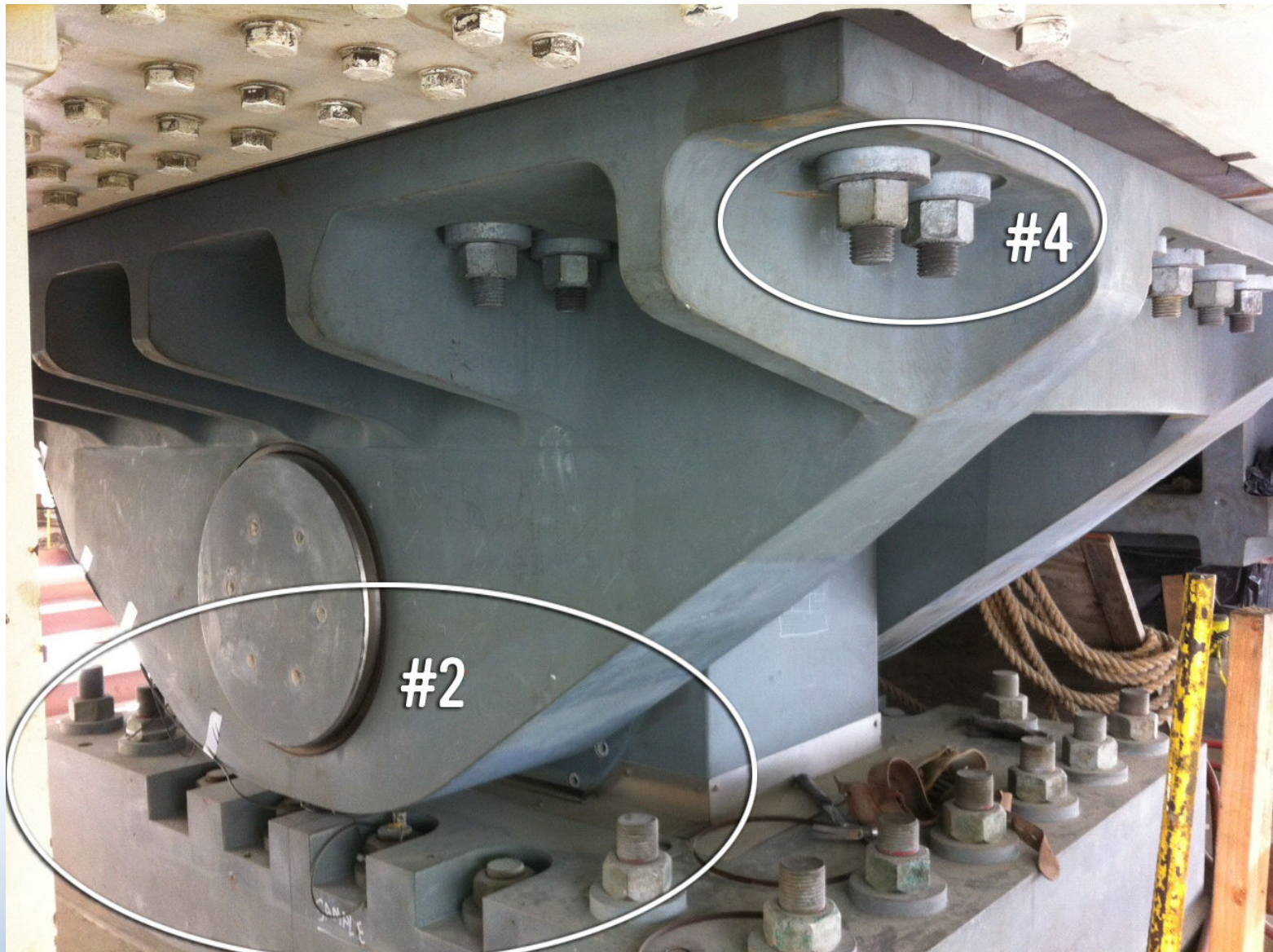


ELEVATION  
LOOKING NORTH



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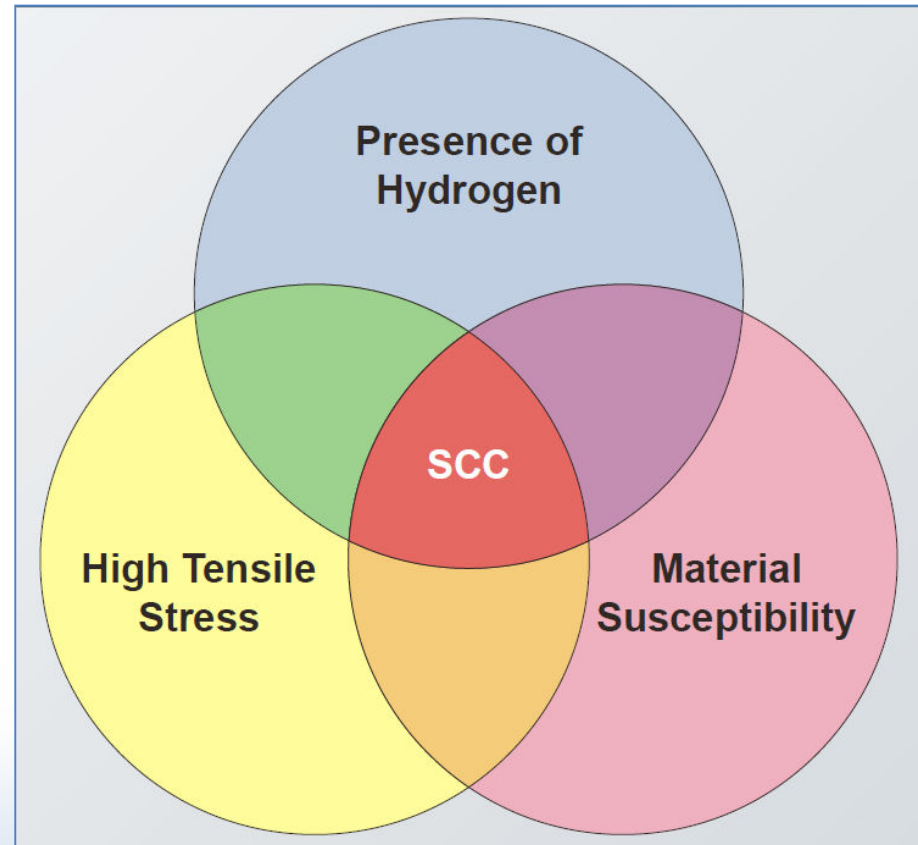


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# Stress Corrosion

- Based on regular inspection and ongoing testing, remaining bolts continue to perform as designed.
- Longer term concern is whether remaining bolts under high tension might be subject to stress corrosion cracking.
- Long term stress corrosion susceptibility is a function of the size and hardness of material, and level of tensioning.



# A354 BD Galvanized Bolts

Location	Item No.	Description	Quantity Installed	Diameter (in)	Tension (fraction of Fu)	Average Hardness
E2	1	2008 Shear Keys Bolts	96	3	0.7	37
	2	2010 Shear Keys and Bearing Bolts	192	3	0.7	34
	3	Upper Shear Key OBG Connections	320	3	0.7	35
	4	Upper Bearing OBG Connections	224	2	0.7	35
	5	Bearing Assembly Bolts for Bushings	96	1	0.6	36
	6	Bearing Assembly Bolts for Retaining Rings	336	1	0.4	35
Anchorage	7	PWS Anchor Rods	274	3.5	0.4	35
Top of Tower	8	Saddle Tie Rods	25	4	0.4	35
	9	Saddle Segment Splices	108	3	0.5	37
	10	Saddle to Grillage Anchor Bolts	90	3	0.1	34
	11	Outrigger Boom	4	3	0.1	39
Bottom of Tower	12	Anchor Rods 3"	388	3	0.5	34
	13	Anchor Rods 4"	36	4	0.4	33
East Saddles	14	East Saddle Anchor Rods	32	2	0.1	37
	15	East Saddle Tie Rods	18	3	0.1	33
East Cable	16	Cable Bands	24	3	0.2	36
W2	17	Bikepath Anchor Rods	43	1	TBD	36
Total			2306			





# What to do with other bolts on SAS?

1. Replace before seismic safety opening
2. Replace after seismic safety opening
3. Modify by
  - Dehumidifying
  - Reducing tension
  - Additional Corrosion Protection
4. Acceptance, ongoing monitoring and maintenance



# Purpose of Testing

- Collection of factual data on actual rods to guide decisions now and into the future
- All tests will provide data on the materials susceptibility to hardness and toughness
- Provides the capacity of the rods to continue carrying load in an extremely aggressive environment






# Self Anchored Suspension Span A354 BD Test Plan

Location	Item No.	Description	I (In-Situ Test)	II (Partial Specimen Lab Test)	III (Full Specimen Lab Test)
E2	1	2008 Shear Keys Bolts	TBD	TBD	TBD
	2	2010 Shear Keys and Bearing Bolts	164	-	4
	3	Upper Shear Key OBG Connections	320	12	4
	4	Upper Bearing OBG Connections	224	7	2
	5	Bearing Assembly Bolts for Bushings	-	-	-
	6	Bearing Assembly Bolts for Retaining Rings	-	-	-
Anchorage	7	PWS Anchor Rods	270	43	1
Top of Tower	8	Saddle Tie Rods	25	2	1
	9	Saddle Segment Splices	20	2	-
	10	Saddle to Grillage Anchor Bolts	-	-	-
	11	Outrigger Boom	-	-	1
Bottom of Tower	12	Anchor Rods 3"	194	8	1
	13	Anchor Rods 4"	36	4	-
East Saddles	14	East Saddle Anchor Rods	16	2	1
	15	East Saddle Tie Rods	9	1	-
East Cable	16	Cable Bands	12		-
W2	17	Bikepath Anchor Rods	9	1	-



# Schedule for Tests I, II, and III

Test		May 2013					Jun 2013				
I	In Situ Testing										
II	Partial Specimen Lab Testing										
III	Full Specimen Lab Testing										

- Ongoing in-situ and laboratory testing on other bolts will provide necessary information for bridge opening decision.



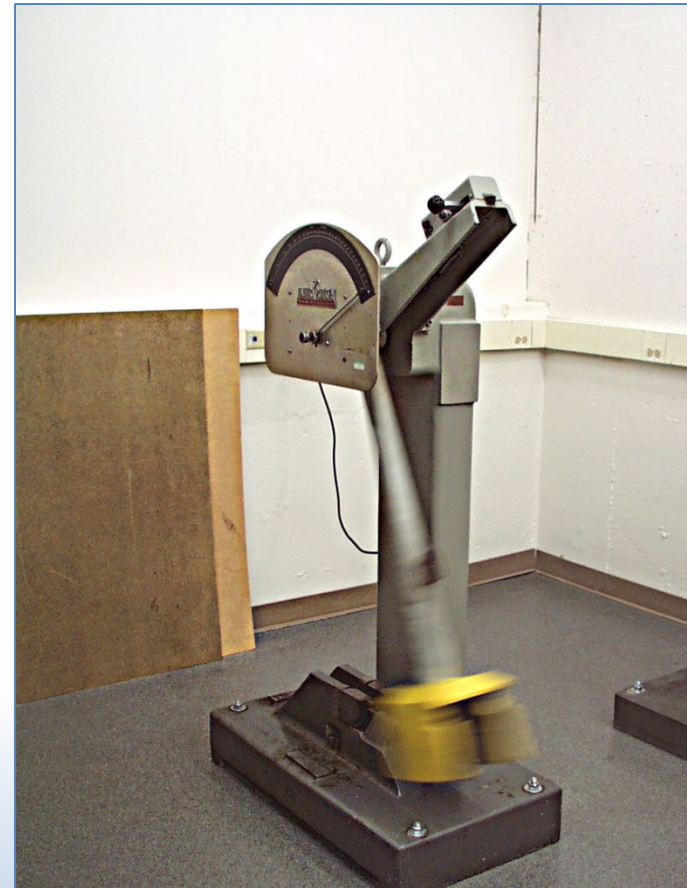
# I. In-situ Testing (Hardness Tests)



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## II. Partial Specimen Lab Testing



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# III. Full Specimen Lab Testing



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## IV. Stress Corrosion (Townsend) Test

- The Townsend test is an accelerated test being prepared to determine the longer term susceptibility of the material to stress corrosion.
- Full sized bolts will be soaked in a controlled concentrated salt solution while tensioned progressively over a number of days until failure.

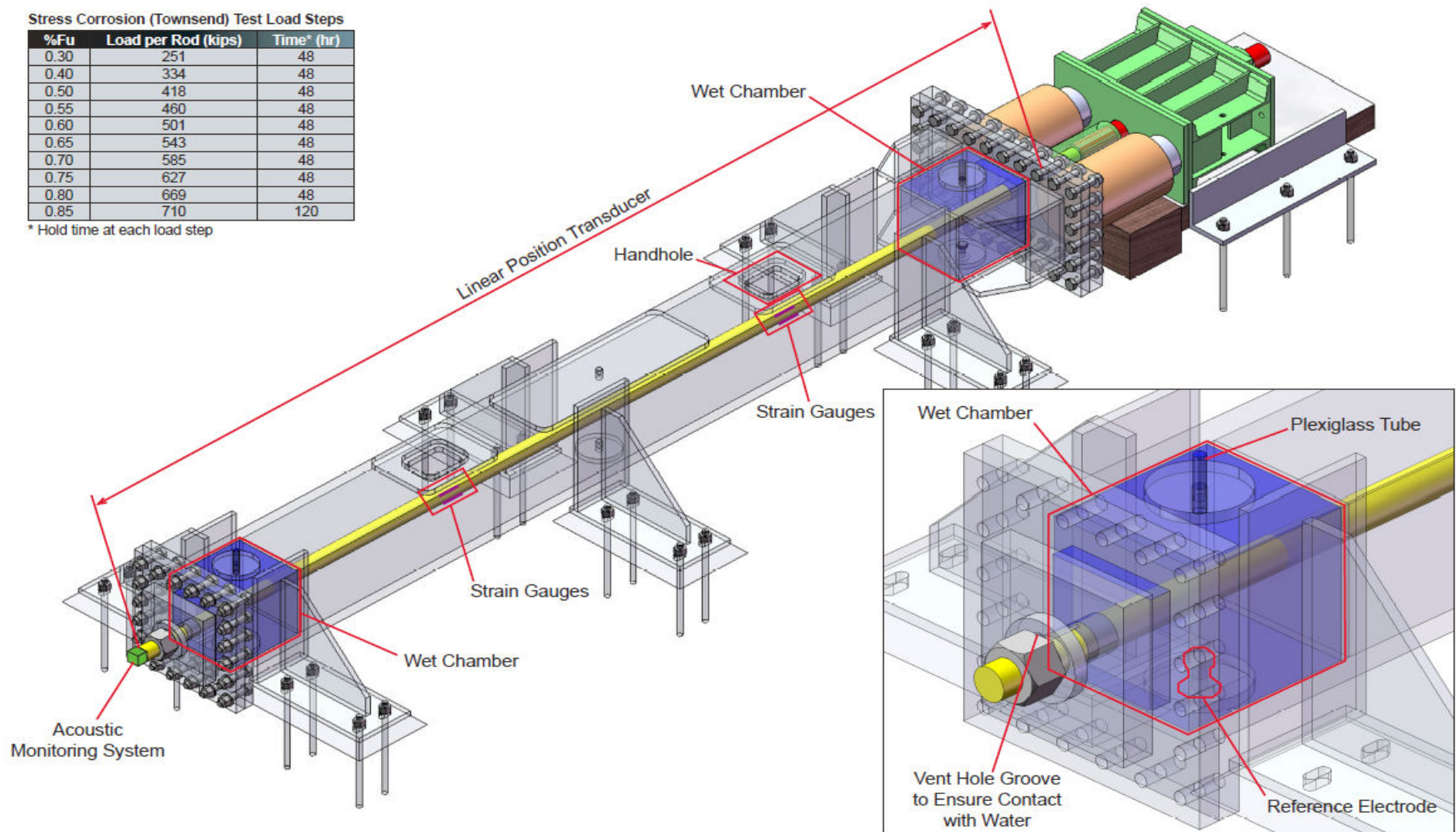


# Test Set-up for Stress Corrosion (Townsend) Test

Stress Corrosion (Townsend) Test Load Steps

%Fu	Load per Rod (kips)	Time* (hr)
0.30	251	48
0.40	334	48
0.50	418	48
0.55	460	48
0.60	501	48
0.65	543	48
0.70	585	48
0.75	627	48
0.80	669	48
0.85	710	120

\* Hold time at each load step




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# Construction Challenges

Challenge	
<p>1. Electroslag Welding at Tower Base</p> <ul style="list-style-type: none"><li>• Inspectors have found a number of imperfections in electroslag welds at the base of the tower.</li><li>• Engineers are methodically mapping welds and determining which imperfections must be removed and replaced with quality weld material to ensure that all weld capacities exceed seismic demands for the 1,500 year design motions.</li><li>• The process has been underway for about nine months, and is continuing.</li></ul>	



# Construction Challenges

## Challenge

### 2. Skyway Tendon Corrosion

- On the skyway portion of the bridge, concrete sections are clamped together with internal steel cables known as pre-stressing tendons.
- Grouting of the pre-stressing was delayed, after inspectors learned that pumping grout in one tube could potentially get into another tube, clog it, and prevent a cable from being installed.
- Engineers conducted inspections and discovered grout vents had been broken and not repaired. Rain water entered the vents and partially filled the pre-stressing ducts leading to some steel corrosion. Additional inspections and lab testing were done and it was concluded the steel was within tolerance for successful use.



# Construction Challenges

## Challenge

### 3. Bike Path Connection

- While removing divider rails to make electrical and shimming modifications, Caltrans observed that some bolts securing the rails to the deck had been sheared, likely by thermal movement of the deck.
- The bolted connection was restrained from thermal expansion and contraction by an oversized weld of architectural bolt caps to the base plate.
- To resolve the problem, all divider panel bolts were removed, railings were modified with larger slotted bolt holes in the base plate and bolt caps were eliminated.
- The railing work has been completed, it was estimated that 10% of over 2000 divider bolts may have had this problem.



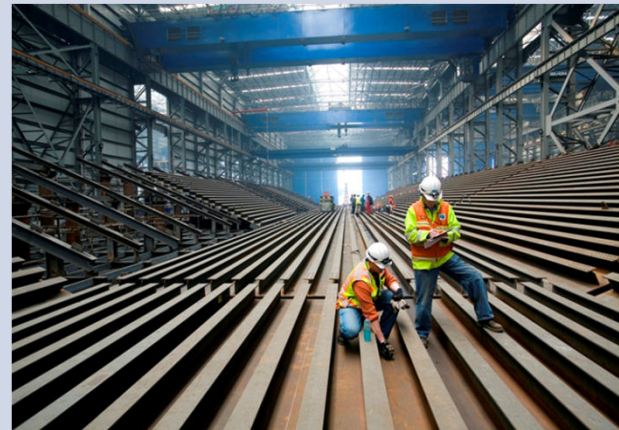


# Construction Challenges

## Challenge

### 4. Roadway Box Welding

- Over the course of the project, weld quality has been raised and reported upon several times.
  - In 2008, inspectors found cracks in welds of deck plates in China. Supplemental testing was instituted and all cracks were repaired.
  - In 2008 to 2010 time period, field welding of deck segments in the Bay was not achieving required tolerances for planar alignment. Analyses were performed and repairs were made.
  - The challenges were reported to the Oversight Committee and in monthly reports.
  - The challenges were vetted by the Seismic Peer Review Panel and documented in a report in March 2011.

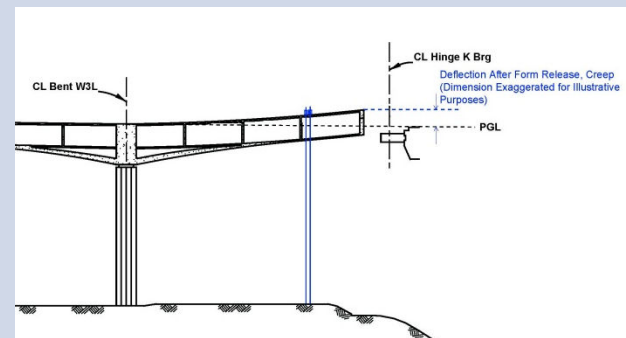


# Construction Challenges

## Challenge

### 5. YBI/SAS Deck Alignment

- The concrete section of the bridge between the Self-Anchored Suspension span and Yerba Buena Island was a few inches higher than the suspension bridge deck. The added elevation was due to the pulling forces of the imbedded pre-stressing tendons.
- Engineers carefully considered several options.
- The steel ballast option was selected as best alternative.

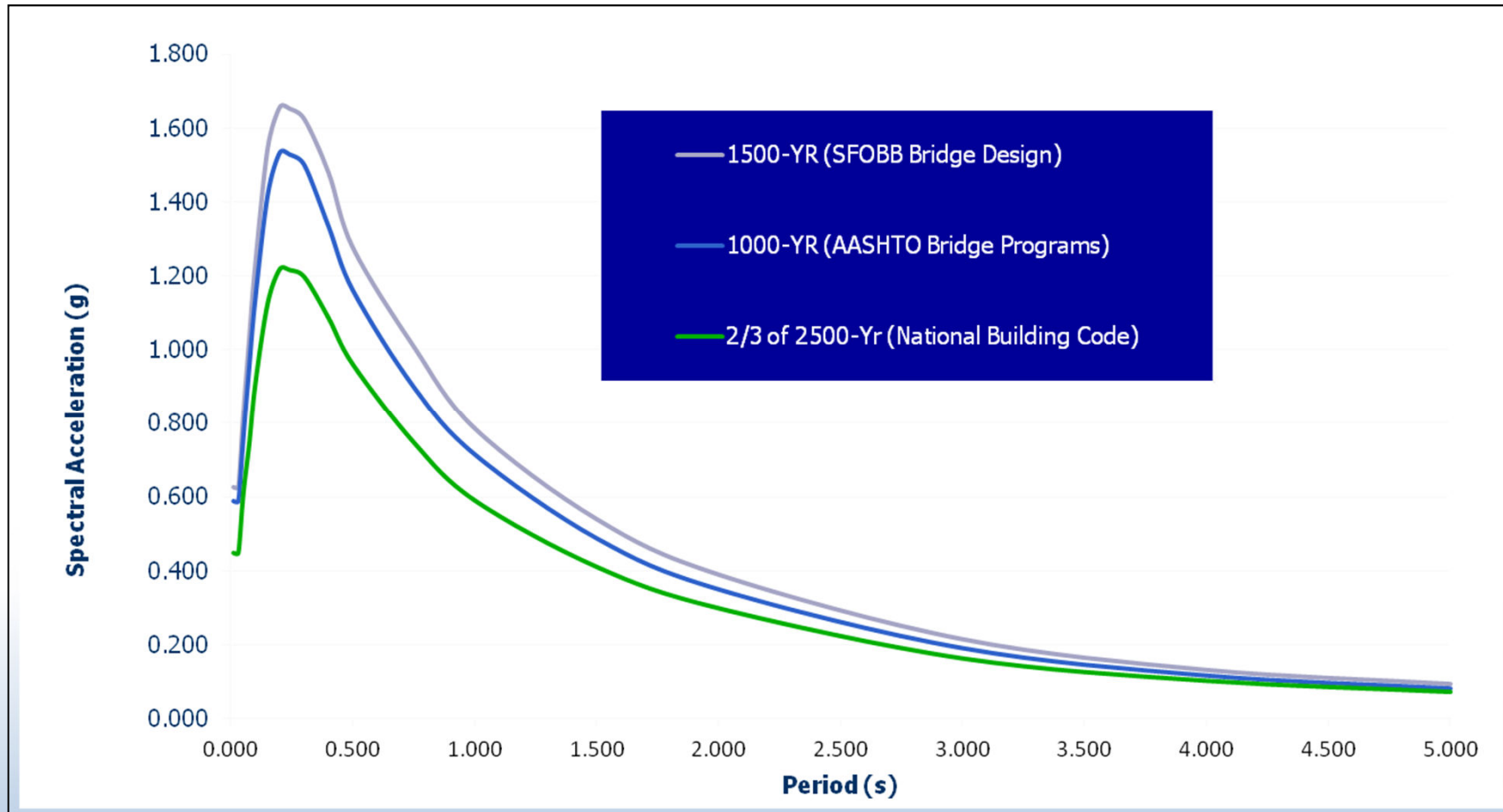


# Seismic Importance and Innovations

- "Important" Bridge - "Lifeline" design criteria
- Seismic Safety Peer Review not only for design criteria but also through design and construction
- Higher level of geotechnical testing
- Higher level of seismic, and other testing in laboratories and in the field
- Shear links in tower
- Seismic hinge pipe beam in deck joints
- SAS - YBI column design and test
- Maintenance and operation manual and tools



# Comparison of Bay Bridge Seismic Criteria with Other Standards



# Tower Shear Links



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# Hinge Pipe Beams



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# Investigative Structure

## 1. Toll Bridge Program Oversight Committee

CALTRANS

BATA

CTC

## 2. Seismic Peer Review Panel

## 3. FHWA



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# Items Expected at July 10 BATA Oversight Meeting

- Completion of written TBPOC investigative report, plus
- Firm schedule for E2 2008 bolt retrofit, plus
- Decision on other bolts on SAS, equals
- Decision on Seismic Safety Opening Date of Bay Bridge.



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# California Legislature

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STATE CAPITOL, ROOM 2209  
SACRAMENTO, CA 95814  
TEL (916) 651-4121  
FAX (916) 445-2209

May 21, 2013

Malcolm Dougherty, Director  
California Department of Transportation  
1120 N Street  
Sacramento, California 95814

Dear Director Dougherty:

This letter is a follow up to the May 14<sup>th</sup> Senate Transportation and Housing Committee hearing. We don't feel satisfied with the answers that were provided. Below we outline a number of follow-up questions to which we'd appreciate timely responses. We understand you and your staff are busy attempting to resolve the steel bolt issues, but we firmly believe, as Mr. Heminger stated in the hearing, that the road to rebuilding the public's confidence in the bridge begins with frankly and honestly telling them what happened and what consequences may result.

Our specific questions include:

1. Our understanding is that Caltrans made the decision to use high-strength, galvanized steel fasteners during the design phase of the project in consultation with internal and external metal and corrosion experts. In the hearing, you pledged to make available details concerning the decision-making process by the May 29<sup>th</sup> Special Bay Area Toll Authority Meeting.
  - a. Who was the Engineer of Record that ultimately agreed to the design deviation allowing the use of high-strength, galvanized steel fasteners on the Bay Bridge?
  - b. Who was consulted, and what contribution did each person involved provide concerning this deviation?
  - c. What reviews were conducted, who was involved in the review process, and at what point in the overall design phase was this decision made?
2. In the hearing, you referred to a "Design Engineering Team" that made design deviation decisions and specifically suggested that among the members of that team were corrosion experts.

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MAY 22 2013

DIRECTOR'S OFFICE

- a. Who are the members of the Design Engineering Team today, and who has historically been part of this team? Please provide names, titles, and qualifications for each as well as at what times they participated.
  - b. Please outline and describe every deviation from state, national, and international standards and specifications approved by the Design Engineering Team.
  - c. When and where did the Design Engineering Team meet? Were there regularly scheduled meetings, or was it on an “as needed” basis? If possible, please provide any agendas, minutes, notes, staff notes, electronic communications and correspondence related to these team meetings.
  - d. Who was the corrosion expert described in the hearing? Did he or she ever communicate any concerns regarding the design of the bridge or the use of high-strength, galvanized bolts? Please provide any documentation related to his or her concerns.
3. Caltrans specifications for the high-strength bolts and rods required them to be “blasted” instead of “pickled” when galvanized to address the potential for hydrogen embrittlement. Recent media reports suggest that the more than 424 anchor rods at the bottom of the tower were “pickled” when galvanized, despite Caltrans specifications. Experts suggest that this type of galvanization process increases the potential for hydrogen embrittlement, particularly given the tension of these rods. Our understanding is that these anchor rods are embedded in the base of the tower.
  - a. Are you able to access these tower rods to test their hardness and determine their susceptibility to hydrogen embrittlement?
  - b. Can you test the tension level of each rod to better estimate its susceptibility to hydrogen embrittlement?
  - c. If you determine that they are susceptible to hydrogen embrittlement, what alternatives do you have to address the problem?
  - d. Do you have some idea of how many of these anchor rods could suddenly fail without jeopardizing the safety of the bridge?
4. Your presentation stated that the 274 bolts that anchor each strand of the main cable are made of galvanized, high-strength steel and are tensioned to 40 percent. The critical stress curve in your presentation describes, and experts suggest, that hydrogen embrittlement is a concern at roughly 40 percent tension and grows when tensions are 50 percent or greater.
  - a. Are you able to access the main cable anchor bolts to test their hardness and determine their susceptibility to hydrogen embrittlement?
  - b. Can you test the tension level of each bolt to better estimate its susceptibility to hydrogen embrittlement?
  - c. If you determine that these bolts are susceptible to hydrogen embrittlement, what alternatives do you have to address the problem?
  - d. Do you have some idea of how many of these anchor bolts could suddenly fail without jeopardizing the safety of the bridge?
5. Experts suggest that, even if high-strength, galvanized bolts don’t fail in the first week or two after tensioning, there is still a risk they could fail in the coming months or years.



- a. Is the threat of hydrogen embrittlement susceptibility of the Bay Bridge's galvanized, high-strength bolts time-sensitive? In other words, is there a set period of time that, once reached, minimizes the likelihood of the bolts failing sometime in the future?
- b. If you conclude that the hydrogen embrittlement susceptibility does not increase over time, upon what evidence do you base this conclusion?

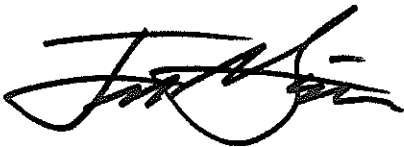
In addition, the San Francisco Chronicle reported today that Mr. John Fisher and Mr. Robert Reis have both expressed concerns throughout the design process regarding the use of galvanized, high-strength steel bolts and rods. Please provide us with any reports, notes, correspondences or electronic communications that communicate their concerns.

We would appreciate written responses as soon as possible; by May 31<sup>st</sup> at the latest. We hope to have answers to each question or an update on when you expect the answers to be available. Please let me know if you have any questions.

Sincerely,



**MARK DeSAULNIER**  
Chair



**TED GAINES**  
Vice Chair

CHAIR AMY REIN WORTH: All right, good afternoon. Okay. Thank you for your help. Good afternoon. My name is Amy Rein Worth. I am Chair of the Bay Area Toll Authority and it is my pleasure to welcome you to this special meeting of the Bay Area Toll Authority for Wednesday, May 29<sup>th</sup>.

First of all, I'd like to request the secretary to call the roll.

SECRETARY: Good afternoon, Commissioners. Chair Amy Rein Worth is present. Vice Chair Dave Cortese. Commissioner Aguirre?

COMMISSIONER ALICIA AGUIRRE: Present.

SECRETARY: Commissioner Azumbrado? Commissioner Bates? Commissioner Campos? Commissioner Dodd? Commissioner Giacomini? Commissioner Glover? Commissioner Haggerty? Commissioner Halsted?

COMMISSIONER ANNE W. HALSTED: Here.

SECRETARY: Thank you. Commissioner Kinsey? Commissioner Licardo? Commissioner Luce? Commissioner Mackenzie?

COMMISSIONER JAKE MACKENZIE: Present.

SECRETARY: Commissioner Pirzynski?

COMMISSIONER JOE PIRZYNSKI: Here.

SECRETARY: Commissioner Quan?

COMMISSIONER JEAN QUAN: Present.

SECRETARY: Present, thank you. Commissioner Sartipi? Commissioner Spering? Commissioner Tissier? Commissioner Wiener? You have a quorum, Madam Chair.

CHAIR REIN WORTH: Thank you very much. I think we're hearing a high-pitched sound. I don't know where that's coming from, but if... we got it? Thank you. All right, thank you. Now I'd like to invite you all to join together in the Pledge of Allegiance.

[Pledge of Allegiance]

Thank you. I'd like to announce that our meeting is being broadcast on the MTC website, and request that all speakers speak clearly into the microphone so that you can be recorded by our microphones.

I'd like to also remind the public that we look forward to your comments on these items that are on the agenda, and invite you to fill out a speaker card that is in the back of the room and bring it over to the clerk over here on this side of the room, and we will... I will call you when we get to that appropriate time.

So with that, then, we'd like to proceed with Item 3, which is the Bay Bridge anchor bolts update, and I'd like to turn to our Executive Director Steve Heminger for that report.

STEVE HEMINGER: Thank you, Madam Chair, and good afternoon, commissioners. I'm joined, as I have been for the last few briefings, by my colleagues on the Toll Bridge Program Oversight Committee, Andre Boutros and Malcolm Dougherty. We're also joined by our project management team over at the far table, Andy Fremier and Tony Anziano... Stephen Maller, I think, is serving on jury duty, and Brian Maroney is joining them, and we'll have a speak in part a little bit later on in the presentation.

We're here to give you a briefing on the bolts. And I have to start with news that... I don't think there's any way to sugarcoat it, and that is we're going to need a little more time. We had hoped to have some decisions that we could present to you today, but for various reasons that I'll describe we are not quite there yet. We absolutely want to do this right and not be rushed, and we also want to try to maintain our schedule for Labor Day, but we are not going to compromise on accuracy, on comprehensiveness, and on

safety to meet any date. So that is why we are presenting you an update today and not final decisions, but I do think we've got quite a bit of information for you that will get you up to speed on what we've been doing, and also, I think, we can give you a much better sense now of what the final boarding process will look like as we're heading toward final decisions. Next slide.

And maybe we could center the middle one a little... maybe we can't. It's just up there on the ceiling. So look to my left and right; don't worry, the titles aren't all that important.

So what have we been up to? What sort of progress do we have to report? One of the major items that we do need to complete before we make a decision about opening the bridge is a lot of testing. Malcolm is going to describe that in detail today, but we've got a lot of testing underway now and testing that will also be accelerating over the next few weeks, and that test information is going to be vital as we make decisions not only about the 2008 bolts that have failed—we've already made that decision, we're not counting on them at all, and we're going to replace their clamping capacity with a retrofit system that you'll hear about more from Andre—but all the remaining bolts on the bridge, we want to assure ourselves that they are shipshape and that we can open the bridge with them in the shape they are in, and then if necessary do things to them—and we'll describe that, as well, later on—that might be necessary.

We have been driving, as you know, at Labor Day 2013 for over two years now, in terms of trying to focus our attention on delivering this bridge to the public. We have been pushing that date. Clearly, with the developments that we have before us... and I believe one of you, perhaps, asked for a drop-dead date on Labor Day... it might have been Commissioner Quan... a couple of meetings ago, and here's that date, July 10<sup>th</sup>, 2013. That is a meeting of the Oversight Committee of this board, and we believe that is the last date when we can really decide to go for Labor Day. We have a lot of work to do. As you know, when we do these closures of the bridge, a lot of traffic to alert, a lot of arrangements with BART and other providers, to make sure we can get people around the Bay Area, and we think responsibly that date is the last date at which we can say we are going forth. And so



what we need is a lot of information, a lot of moving pieces now to come together by that date, so that we can move forward in that fashion. We think that is entirely possible to do, but it requires a lot of information to be assembled, a lot of work to be complete, and we'll give you in this presentation exactly what that looks like, and we'd be happy to answer our questions as we move along. But one thing, as I said at the outset that we want to make sure that everybody knows is that it'll be the facts about the bolts and bridge safety that will drive the opening decision, not whether it's Labor Day or Columbus Day or any other day of the year. Next slide.

The retrofit solution—again, I'm summarizing here; Andre will give you more detail—is well under way. You've probably seen some pictures of the work on the pier in the newspaper already. The fabricator is located locally in Mare Island so they'll be handy and nearby. We are working on some access for the press to get out to the fabrication facility, so they can see what's going on, help us track the progress. One reason we could not today give you a better sense of Labor Day is that the design for the retrofit has just recently settled into, I think, final shape, and until you really have a design that's final, and you've got shop drawings that tell you how you're going to accomplish that design, you really can't put a firm schedule in place, and we did not want to present you or the public with a schedule that was subject to a large degree of variability. So we are awaiting a schedule from the contractor that will be based on much better information, so that we can then forecast with that schedule whether Labor Day is a possibility or not. We think it likely will be, but, again, the retrofit decision, the retrofit schedule, rather, and the bolt review, are critical path items to open the bridge, and if we don't have the retrofit done we're not opening the bridge. Next slide.

As I said at the outset, Labor Day is still the goal, but the test results and the retrofit schedule will determine whether we meet that goal or have to meet another goal. And just as a refresher, Labor Day is not some arbitrary date. It's a three-day weekend, obviously, that's one thing it is, but it's also a time during the year when we've still got traffic down before school picks up. It's also a history of very good weather. We've had very good success... in fact, Caltrans has done this sort of operation three times already. Probably the most complicated one was when they cut out a section of the bridge and

moved in the S-curve. And so we know how to do this, we know how to do it with the transit operators and public information, to make sure we inconvenience the public as little as possible. And again, as I indicated earlier, the go/no-go decision on that will be on July 10<sup>th</sup>, just a few weeks from now.

We have been organizing our presentations to you in the form of three questions. If you'll recall the first, 'What caused the 2008 bolts to fail?' 'What retrofit strategy should we use to replace that lost clamping capacity?' And, 'What should we do about the other bolts?' We're going to follow that same order today, and I think it's fair to say the third item will get most of the air time, as it should.

So the first one we consider a closed matter, and the next slide just shows you the reports, the report that we released at your last meeting in summary form, the fact that the failures were due to hydrogen embrittlement, and that resulted from a combination of factors, as you recall—the presence of hydrogen, susceptible material, and also the tension that was brought to bear on those bolts, and that report is readily available to the public, as well.

And so I think at that point we need to move on to the second question, which is where I turn the presentation over to my colleague, Andre Boutros

ANDRE BOUTROS: Madam Chair, Commissioners, good afternoon. So we presented the selected alternative at the last hearing, and we had settled on the steel saddle as the preferred option to get to the clamping forces that the bolts had initially been designed to.

So what you're looking at here is really a rendering of what that system would look like. Again, just for orientation purposes, the yellow elements are the bearing assemblies, the sheer key is that bluish color element in the middle of the picture, and the saddle is the gray areas connected to the cables that you see here anchored all the way down. Below the concrete cap there will be an extension of that cap to a certain extent, and the cables will be wrapped around the cap to get that confinement and that anchorage force that would have been provided by the bolt design that was in the initial contract plans.

This design, even though, you know, it's in the shop drawing phase right now, has actually been implemented in the field to a certain extent. The contractor has already begun chipping concrete and coring through the concrete to put those cables through that concrete system that is in place. Shop drawings are already in the preparation stages. They're being developed by the contractor. They'll be shared with the fabricator. The fabricator will use those shop drawings to fabricate that assembly system that will be placed on top of the sheer key plate. The fabricator, as Steve mentioned, is a local company that is on Mare Island. The work will be done locally here, and we're hoping that there will be some availability to view some of that work in place as it is being done.

The schedule for the retrofit is really being developed right now, it's being finalized, and it takes a lot input from fabricators as well as the constructors that will be putting that system together. So since the shop drawings are being prepared, that's really the stage where that schedule will be laid out to see how long the fabrication will take, when that material becomes available to the field for placement in the field, and how long the contractor will take to put that system in place. So we are determined to bring you back a schedule at the July meeting to let you know whether that work will be done in time for the planned opening of Labor Day.

And that's really what I wanted to cover today, and I'm going to pass it back to Steve here to cover the remainder of the bolts on the SAS.

HEMINGER: Thank you, Andre. Again, the third question is about the remaining bolts. And, again, we've mixed up the order a bit. You're used to hearing from Malcolm first, but you'll hear from him third today because he's covering all the testing information, which is quite considerable. Next slide.

As a reminder, there are lots of bolts. The grade of these bolts is 354 Grade BD. I apologize to all the engineers who insist on calling these things rods. Some of them are rods, some are bolts, some are anchor bolts, so I'll just say bolts. And they are at various locations across the steel portion of the new bridge, the SAS. You'll see the blue here. The west pier on the far left, the

top and the bottom of the tower, in the saddle, and also in the tower foundation, and then also in the anchorage to the east, as well as the east pier, where we've had the most visibility, obviously, with the failures.

Just to give you a better sense of what these bolts look like and where they are, this is on the east pier, one of the rocker bearings, and what you see are the lower bolts, not on this one, but some of which have failed on the sheer keys. So the lower bolts you see in the lower part of this picture, labeled number two, and the upper bolts that connect the devices, the sheer keys and bearings, up to the deck that's above it, the orthotropic box skirter.

Here's another set of bolts in the cable anchorage. This is the anchorage for the main cable, which, unlike a traditional suspension bridge, this anchorage is actually inside the bridge, it's not on land, and it's at the east end of the bridge. And what you see here are the anchor rods for that section of the bridge, some of them in place, some of them just laying on the steel, as you see, being installed. Right now that space where the worker is, and where those rods are lying down is actually called the splay chamber, which sounds a little bit medieval, but what it is, is where the cable splays out and is anchored into the deck. So here is another clearly critical location where these bolts are performing the function of holding down the main cable. And here we are in the tower foundation, which has gotten a bit of airplay in the media coverage, and you can see here the bolts being tensioned, you can see some over on the right with that circle 12 that have been installed, and those on the left being installed, and this is deep within the foundation of the suspension tower, which is 500 feet tall.

As a reminder, we have done a lot of regular inspection, not only before the bolts broke but after they did, and we spent obviously a lot of extra time after they did inspecting the remaining bolts that are on the bridge. And based on that inspection, as well as the ongoing testing that we are doing, not only on the site but in the laboratory, the remaining bolts, again, with the exception of the 2008 bolts, but the remaining bolts continue to perform as designed, no other observed problems or failures.

What we are concerned about primarily now, then, is perhaps not a similar failure to the 2008 bolts in terms of a near-term hydrogen embrittlement



phenomenon, but the longer-term concern of whether the remaining bolts, especially those that are under high tension, might be subject to a phenomenon known as stress corrosion cracking. And it's similar, and in fact some experts might dispute the way I'm describing it to you, but if you look at the chart on the right, what you will see is the elements that you need for stress corrosion cracking to develop, and you need all three. And the one at the top, hydrogen, we've got in abundance, and so that's to some extent controllable, if you can dehumidify the environment, but there is a lot of hydrogen around a bridge over water, especially one in a foggy place like this, so that's part of the challenge you've got. The factors you can control, especially, are the bottom two. What level of tension the particular bolt is under, as well as whether the bolt, the material it's made of, the steel, is susceptible, and that especially has to do with how hard the steel is, especially at the surface of the steel. Next slide.

This roster I think you have seen, of all the bolts on the bridge. And, again, I think the important point to emphasize is that although we've got some 2,300 bolts, they are not all alike. In fact, they are quite different from each other in many respects. But what we are looking for, again, as you look across these various categories of bolts at various locations, is especially the last two columns of data. What tension are they under and what is their hardness? Now, what we're showing you here for the hardness information is averages that we developed during the quality control process. What Malcolm will describe is a testing procedure that is going to give us much greater specificity about that hardness, not only in the site but also within the bolt itself, from center to edge, and it's especially the edge that we're concerned about. But even just as you glance through this information, and let's just use item number one, which is the bolts that fail as sort of the comparison point, what you see there is a fairly high level of tension—this, again, is on a scale of 0 to 1.0—and an average hardness—and the range that is acceptable under national standard is 31 to 39—you see a fairly high hardness, as well. So that clearly raises a concern in terms of stress corrosion, cracking, and, in fact, in the case of those bolts, because of the imperfections that were noted in the metallurgical report, actually led to their failure through a hydrogen embrittlement procedure.

As you look down the list, you will see that on the east pier most of the bolts are under that same tension level, so we're spending a lot of attention on the east pier in terms of testing, but you'll also see in terms of hardness that the 2010 lower bolts—that's item number two—have the same tension level but a considerably lower hardness level, which is obviously leading a candidate to explain why one set failed and the other set didn't. As you look down the list, you will see generally lower tension levels, and that's obviously good news. What we don't know, and what the testing will help us determine is how low do you want it to be? And obviously you need it to be high enough to perform the function that the bolt is performing, but also as low as you can get away with to reduce the potential for stress corrosion cracking. And, likewise, when you look down at the list of average hardnesses, you will see many bolts that are below the 37 hardness, the average hardness, for the bolts that failed, but you'll see some that are at it, or higher than it. And, again, that is where we are going to pay a lot of attention in the testing. Next slide.

So the final slide I'll present in this section before turning it to Malcolm is what might we do in terms of mitigating this susceptibility to stress corrosion and cracking? Well, obviously, number one, in terms of the bolts that failed, we have to replace them before we open the bridge, and that is a process that's underway. It's equally plausible that it would make sense to replace some of the other bolts after we open the bridge, and it would make sense to do so if they are especially susceptible to stress corrosion cracking, and it would make sense to do so relatively early in the life of that bridge before that issue develops, and it tends to develop sometimes over decades.

We also have some other tricks up our sleeve that we might be able to do for some of the bolts, for example, by dehumidifying their location, which helps reduce the hydrogen, which is one of the three factors you need present for the stress corrosion cracking to occur. Another factor you could reduce, potentially, with some of the bolts, not all of them, is to reduce the tension level that they're under, which is another way of reducing that potential for cracking.

And, finally, there are other stress... excuse me... there are other corrosion protection materials and processes that we might employ in addition to the

galvanizing that is on all of these bolts today, as a way of protecting them against cracking and corrosion.

Finally, I think an option that's available for many of the bolts, in all likelihood, is that we accept them in the shape they are in, that they are under either low enough tension or the hardness testing that we do on a rigorous basis convinces us that we should accept them as fit for purpose, and as serving their purpose over the long-term life of the bridge. We will monitor and maintain them like we would any element of the bridge, but we would not do anything in terms of a remediation strategy, because it might not, for many of the bolts, be necessary.

The way we will decide which of the bolts fall into which of these categories is the testing regime that Malcolm will describe.

MALCOLM DOUGHERTY: Thank you, Steve, as well as Andre, Madam Chair, as well as Commissioners. I appreciate the opportunity to be here and provide you an update. I think we have made significant progress. We've determined the cause of the failure of the 2008 bolts, and we've provided documentation of the reasoning behind that. We've worked diligently, as described by Andre, to find a fix to replace the functionality of those bolts. And I want to commend the entire team, not only the Caltrans team, the TBPOC team members, but also our contractor and our consultants that are involved in this effort. It has very much been a collaborative effort to reach a solution to replace the functionality of the 2008 bolts, which became problematic. We're thoroughly evaluating the remaining bolts on the bridge to determine if we have any concerns from a safety standpoint, and if we do, what do we need to do? And, again, as Steve articulated, this will be a data-driven decision with safety as the controlling factor. One thing to keep in mind: All the other bolts on the bridge are performing, they are tensioned up to their required tension, which is described in the chart that was shown earlier, but that's not enough to convince us that these bolts are satisfactory to remain in place for service, and that's what I'd like to elaborate on, is the amount of testing that we are doing today... are doing now and moving forward.

This is another chart, it looks very similar to the one that was up there before. It, again, shows a roster of the bolts. You'll notice the item number, second column from the left, and that's how we kind of prioritized them. The pictures that appeared in your PowerPoint earlier also have numbers in the circles, and that actually correlates to this roster of bolts for cross-referencing. There are three different types of testing that we are conducting to the A354 BD bolts. This is what we described as a summary of the test plan. Just about all the bolts in the first testing column will be put through in-situ testing, which means we will test those bolts specifically for hardness in the field. We will be able to go out there and do that with different machinery, and I will show you a picture of that, but just about every bolt on the bridge in this category will be tested for hardness in-situ. We will then take samples from those bolts, and then we will have specimen lab tests, which means you take a half-inch diameter portion of the rod and subject it to different tests. This shows the audience that we will be doing that, too. We will then also be doing full-scale lab testing where we extract a rod or bolt from the bridge and then conduct it to full-scale lab testing such that we can analyze all the information that we need to analyze. Really, what we are doing here I think Steve articulated very well, the stresses that we know that each of these bolts and rods are under, we're assuming a certain amount of presence of hydrogen, the third component is the material susceptibility, and this test will provide us data to try to make that determination about susceptibility, but one thing to keep in mind, again, is that all these bolts are in the field, and have been in the field, and tensioned up, and are performing for some time.

This slide shows a rough schedule as to when we will complete these tests, the in-situ tests out in the field, the specimen tests, as well as the full-scale test. You will notice that the timeline takes us to about the third week of July, and that information will contribute greatly to us making a data-driven decision regarding the safety of the bridge, to whether or not it can be opened on Labor Day, depending on the outcome of that information and what it provides us as far as the condition and susceptibility of these bolts.

These are some of the picture of the in-situ testing, the hardness test. We actually go out and test... Steve talked about the significance of hardness on these bolts. We can do that test out in the field, and it allows us to do that

test on nearly every bolt that is in this category. This is a practical specimen lab test, where we take a portion, or a sampling, out of the rods in the field, and we can subject them to much more destructive testing such as elongation and strength, if you will. And then the last portion is where we take a full segment of a rod and subject it to tensioning tests to see how strong it is in the lab. And, again, all this information will feed into our decision-making.... making us smarter about the condition of these bolts. Thus far we have completed a significant amount of testing and collected a significant amount of data, and it is showing a differential between these bolts, the other bolts, and the 2008 bolts, which failed because of hydrogen embrittlement.

Steve talked about the long-term stress corrosion. So there's an additional test that we're doing to try to determine the susceptibility of all these rods to long-term corrosion and what concerns we may or may not have regarding that factor. The Townsend Test is an accelerated test being prepared to determine that longer-term susceptibility. It will essentially subject full-scale rods to a decades' worth of corrosive weather simulated, while we do full-sized bolts tensioning to see how they react over time. This is to determine whether or not we have a concern of the performance of these bolts over decades, decades from now. This is a very involved test that we are subjecting these additional rods to. This is a blueprint or a detail of what this Townsend Test rig, if you will, looks like. It took a design to develop it. It will take time to actually fabricate and build it. And then it is a test that lasts for approximately 25 days, and it involves a saltwater bath to, again, simulate that long-term corrosive environment so that we can see how the metal reacts to that, to see whether or not we have any susceptibility concerns for the long-term, if you will.

With that, I'd like to summarize just briefly, that we are testing the full audience of bolts to a multitude of tests, to ensure that we have a level of confidence to move forward in one fashion or another. All data thus far is showing us a clear distinction between those bolts and the 2008 bolts. But that's partly why we have to defer this decision to July 10<sup>th</sup>, is we have to complete all that testing, so we have all that data in hand and can make a completely informed decision as to how we go forward. But, again, the



initial test, the in-situ, the lab test, will be completed by the latter part of June.

In addition we are conducting the long-term corrosion test that would be completed in July. And that test, again, is not necessarily akin to the decision for opening but potentially what the disposition of these bolts are over time, and it may lead us to a position where we need to replace bolts after seismic safety opening if the bolts and the test reveal to us that they will perform at opening.

All test methods, data, and decisions will be reviewed by our expert peer review panel and by the Federal Highway Administration before the Toll Bridge Program Oversight Committee will provide a report, and any decisions will be based primarily on... focused on public safety. We are well on our way to resolve the issue that came up with the 2008 bolts, as well as well on our way in evaluating the performance of the other bolts, as was described today.

There are a few other items that we would like to provide you with an update on today, and this is when I'm going to invite Brian Maroney, the Toll Bridge Program Chief Bridge Engineer, to describe other challenges that we have encountered on the bridge and that we have overcome, either in the past or are currently tackling. so at this time I'd like to introduce Brian Maroney.

**BRIAN MARONEY:** Good afternoon, Commissioners. The POC has asked me to share with you some experiences that are challenging on this job, and a few things that I think the team has done extremely well on.

So what I'd like to do is kind of introduce you to the challenges. First of all, it's been my experience in design and construction, most of the time I'd say, you know, something like 80% of the time you get what... you actually get better than what you want. You order concrete that's 3,000 pounds per square inch, and the contractor actually delivers you something like 5,000 PSI, or you order 14-millimeter-thick steel, and the contractor will actually give you 15- or 16-, because they don't want to take the risk of having it delivered. And we will make them rip it out, and they know that, so you

always get... you usually get a little bit more, so that's usually about what happens about 80% of the time. Then about, I'd say about 15% of the time, maybe, you get exactly what you ordered, nothing more, nothing less, that's what you get. That leaves like 5%. Then what happens is in that 5% you have to sharpen your pencil. It's not exactly what you wanted, let's look at it, and you go back to your design calcs. And our design calcs might say, 'Okay, I needed 8-1/2 bars by calculations.' Well, you can't buy 8-1/2 bars, so what you do is you round it up to 9, and then it goes out in the plans and out in construction, and you go, 'Oh, I got 9 bars, I don't have 8-1/2.' And if something happens to part of one of those bars, you can go back to your calculations and go, 'Hey, we're fine, we got plenty, we rounded up.' And that happens sometimes. Then about something less than 1% of the time we get something we don't want, and we actually have to tear it out, replace it, repair it, or go buy another one. And it's that last 1% I think the POC has asked me to tell you about in some of our construction challenges. So what... if I can refer to some of the slides here, I'll use these to kind of guide you through some examples of some of the construction challenges.

First one, electroslag welding at the tower base: So if I can describe to you... I'm very sure you've all actually been out to see the bridge, and you're familiar with the basics of the bridge, but the center of the bridge, the self-anchored suspension bridge, single-tower structure, but it's actually four towers, they're right next to each other, architecturally it looks like one but there are four elements, and they're separated and then connected by linking beams. At the very bottom of that 500-foot tower, about 30-foot-high pieces of steel, and there's about 20 of them that connect, about 20 welds that connect the bottom. They're not used for self-weight, they're not used for truck traffic, they're only used during a large seismic event. And right now they're all welded up, and we found a number of flaws in those welds. Now, there is lots of steel, but there are some flaws inside this weld material. Now, you might say, 'Well, hold it, if you're only using it for seismic isn't it important to get everything just right for seismic?' In a large seismic event we believe what would happen is some of those indications, some of those flaws, what they would do is they would grow in a seismic event. So we're still convinced, I'm convinced, that it's still appropriate to move the public on to a new bridge, even with some of these flaws still in place.

But through the construction inspection and materials inspection folks, we have found a number of indications, and some indications we've already... some indications we've already communicated to the contractor they need to be taken out and removed, and the contractor's proceeding doing that. Others... and so it's very, very clear... others, it's very, very clear that they're imperfections, but they do not impact the performance of the bridge, so they're acceptable. It's not necessary to dig them out. And then there are some in the middle, some in-between those two limits... and what we're doing is we're evaluating those, we're using finer-field electronic equipment to map those out, and we're actually going to be doing some testing on a sample piece to be able to actually test a piece of the steel with those indications or those imperfections in them, and deform them just the way they would be deformed in a very large earthquake. And we're not actually going to put through one earthquake, one big design-level event. We're going to actually put it through three. And the idea is if it can perform through those multiple large earthquakes, we're going to consider, we're going to consider it being fit for purpose.

Now why would we ever want to do that? And the reason for that is, is because these large steel towers, they're very close together, and they're strong, they're stiff, they're rigid, and when you put a steel element in-between them, and you weld them, what you're doing is you're melting steel, melted, it's liquid steel, and as it cools that liquid steel shrinks, and what it does is it pulls the towers together. And what it does is that steel potentially can actually work itself thermally back and forth, and you can actually sometimes do more damage while you're trying to repair something than evaluating and saying, 'This is fine, fit for purpose.'

So that's the iteration that we're doing it, that we're going through. So, again, we're still focused on the seismic performance that we need for the 1,500 years, and the process has been underway for probably about nine months. We've made good progress, and I really don't see a problem with us not making through this. We've got a good team. The contractor is working with us, our materials people. And then of course as I do this the peer review panel is coming out to look over my shoulders June 7<sup>th</sup>. This is the kind of thing that I will be updating the external peer review panel on.

So the second one we'd like to move to, skyway tendon corrosion, that's its label...

WOMAN: [...unintelligible...].

MARONEY: Sure, of course...

WOMAN: [...unintelligible...].

MARONEY: Do you mean on the electrosag? I would say a small percentage.

WOMAN: [...unintelligible...].

MARONEY: Gosh, I don't want to pick a number off the top of my head.

CHAIR REIN WORTH: I just wanted to say I know we're going to have a lot of questions, so if the commissioners wouldn't mind holding questions until the presentation is over then we'll go through everything, thanks.

WOMAN: [...unintelligible...].

MARONEY: Okay, you know, what I can do... what I can do is I want to share with you one of the challenges of throwing out a number like that, if I was to do that. The steel—30-foot-tall, about four inches thick—and when you start talking about 30 feet high, four inches thick, you're going to have some indications in every single weld, not one well can ever be perfect. So if you say does every well have an indication in it, I would say yes, every well has an indication in it. But it's a continuum, so you have to say... if you're talking about all of the weld, the entire volume of weld, then it would be very small, you know, very small, just literally a small number of percentages, very small, but there's still a lot of indications.

Okay, moving on to skyway tendon corrosion. Okay, on the skyway portion of the bridge, there are hundreds of multi-hundred-ton segments. They're 4-, 5-, 600 tons, and they're clamped together with pre-stressing. Pre-stressing

is extremely important for a post-tensioned box girder bridge, and that's what this is, so this is a very important part of this bridge. And while in construction it was discovered that while the contractor was trying to get all the tendons in, all the pre-stressing tendons in, and then grout them up, some of the grout vents that stick up out into the deck... they're plastic pipes, they're plastic tubes, and what they do is they allow for air to escape from the pre-stressing ducts. Pre-stressing ducts are like pipes, like big pipes, four inches, six inches in diameter, and they run all through the bridge. And then inside those ducts are steel... pieces of very high-strength steel, pre-stressing tendons. So there's lots of void. It's not solid steel. There are like steel cables that go through there, and once the steel is inserted... placed, and it's stressed up, clamped, then we pump grout in from one side, and we fill up that tube. And when the tube goes high you can potentially trap an air pocket in there, and you don't want that. So every time that pipe, or that pre-stressing duct goes high, we'd put a little pipe that goes up to the top of the deck, and during grouting we'd take the cap off so air can escape, so we get really good grouting all the way through that pipe. Well, they stick out, and they might stick out something like a few inches, and you can see right here... this is what one of these look like... this is the deck on the skyway, you're looking down on it. And this is one of those plastic vent pipes right there, and what happened was, during construction, while we were waiting to get all of the pre-stressing ducts stressed and grouted up, these... some of these were probably run over by cars. Somehow they were broken, and while they were broken they weren't maintained, and water got in, rainwater, probably, perhaps sprinkling water, while the deck is being cured, but nevertheless water got into these ducts, and, you know, that's a serious issue. We took it very, very seriously. I want to let you know, the first thing I did, I mobilized our corrosion engineers, I communicated to the FHWA California chief engineer—at that time, it was Nancy Bob—I communicated to her what we had found. They brought in their own corrosion engineers from the east coast, and there was a team put together. We actually developed new technology, never used before at Caltrans. In fact, because of this Caltrans was the first department of transportation in the United States to use a bore scope. It's the same kind of technology that perhaps when you have a knee surgery, and a doctor will put a probe inside your leg, and will actually do work on your knee. They also have cameras that they can use magnifying lenses on, they can take



videos, etc. So what we did is we actually opened up the bridge and inserted this probe, and we collected and took perhaps more than 5-... well, I know more than 5,000 enhanced photographs, and we made that available to the corrosion team that was reviewing this, and actually some samples of the tendons were actually taken out of the bridge, we actually removed an entire tendon.

And then samples were made available to our corrosion engineers here in California with the California Department of Transportation, as well as we sent samples with the FHWA corrosion engineers, and they... what they did is they evaluated the amount of degradation that had developed of the worst of everything that we had seen. And then at the same time I asked my design team, 'Now I want you to evaluate, go back to your design calcs and open up your calcs and tell me how much you really have.' And in design you meet whatever the code says, and sometimes... you don't just design a bridge for the truck that you're designing for. There are load factors, so what you do is you take the weight of a truck and then you up it a little bit, and that's a requirement of the Code. And you don't get to count all of the material strengths. It's called a capacity reduction factor. So if you have like 5,000 psi concrete you don't get to count on all that 5,000, because there are human factors involved in construction—quality of the material, quality of the work, workmanship, etc. So the code requires you to have a certain factor of safety and that was never compromised. However, in this case the design team put about 10% extra pre-stressing above and beyond what the Code requires you to have. So we had, in this case, about 10% extra above and beyond what the code required. Now what the corrosion engineers gave us, based on their investigation, less than 2% of the strands had been corroded to less than 10%. So you're talking about like .02, 2%, times less than 10%, so you're talking about a fraction of 1%, yet we have an extra 10%. So this is one of those cases where, 'Holy smokes...' and this is probably the moment I was most frustrated on this job, when we ran into this, and I was very concerned, and I was ready to put in extra tendons. I was ready to take down segments. I was ready to do whatever we needed to do. And I was pleased when the two teams, the design team, evaluated and sharpened their pencil, and we went back and looked at what we had, and we used the corrosion engineers from both the California Department of Transportation and FHWA, and then we also twice... I had two presentations

to the external independent peer review panel, once while we were doing the testing, so they could look over our shoulders, give us advice, if they wanted to, in the middle of what we were doing, and then at the end, when we made... as we were making our evaluation.

The next one, bike path connection, and I think this is something that you might be reading about right now in the newspaper, and I want to highlight... and I'm going to use the images, and I know some people are on one side, and some people are on the other side. I'll try to bounce back and forth. I'm going to start over here. This top image, what you're looking at is a section of the bike path, and there's a line right there that you can see, and that's a thermal expansion joint. The bike path is made of many, many steel boxes, they're about 30 feet long, so every 30 feet there's a little thermal expansion joint, and just like when you walk down a sidewalk, you see the lines in the sidewalk, that's to allow for thermal expansion. Things get hot, they expand, things get cold, they get short. And if you try to fight Mother Nature you will lose. That behavior is going to happen. And in bridges, all parts of bridges, we have to allow for that. So that's what that is. Now part of the bicycle hand railing, bicycle/pedestrian hand railing, spans... oh, thank you. That's even better. Part of that bicycle pedestrian hand railing spans that thermal expansion joint, and this was designed... every other one of these was designed to be able to slide. There's a slotted hole with a bolt in it, so that slot allows for that thermal expansion to work. Well, right here there's a nice little architectural detail, it's like a cap that goes over the top of the bolt, that little cap right there goes over the top of the bolt, and it was supposed to have just a little tack weld on it. Well, it got a big tack weld on it, and it melted through the cap, and it actually ended up connecting onto the head of the bolt, and it restrained the freedom that that hand railing needed to have, and then the bolts sheered, some of the bolts sheered. And so I want to communicate, it's not... this is not a bolt material problem. This was about a detail where somebody was thinking, 'I'm going to get a really good weld, you know, I'm going to put double or triple in.' And what they did is they put enough in. Now, what we've done over on the left side of this same drawing, you can see there's a new detail here, so what we've done is we've gone through, where needed, and we're taking these things off, and we're changing the detail—we no longer are going to have that cap, so that weld that causes the problem, it's not going to be

there—and we've also opened up the slot to be even larger to make sure we have plenty of extra, and we're going through and doing that at those locations.

Okay, the next one, if I can move to, is roadway box welding. Well, that really refers to... we've got a lot of steel in this bridge, even the skyway has a steel nose, steel orthotropic box, one on both sides, but this just talks a little bit about... there are basically... welding has taken place not only at ZPMC in Shanghai, China, where the orthotropic box was fabricated, and the tower was, too, but we've also done welding here. So just to get a sense of it, there was some... we had some challenges. Actually, we've had challenges, you know, in just about... it's always hard to build a bridge, and when we were welding... let's just talk about the boxes, the boxes when we were in China... we had some welds that we were not happy with. And the first thing you do is you evaluate them a little tighter, and I'll just share with you, sometimes we completely reject it—not just the weld, I mean, we rejected the whole deck plate, everything. Other times we would evaluate that yes, it is repairable, and we allowed folks to dig them out and repair them, and sometimes that wasn't once. Sometimes it was dug out, repaired, and it's like, 'Try again. It still doesn't pass. You know, try again, it doesn't pass,' etc., until we were satisfied that, yes, it's going to be just fine.

Now, there was a lot of excitement about welds in China, and I can tell you that really is unfounded, because in China I was quite surprised when I went over there, and there I'm looking at a brand new Lincoln arc welder, the best welder you can buy here in the United States, and they don't have one, they have two, so... and they follow our welding code, because we took our welding code over there, American Welding Society, AWS D15. D15 is the bridge code, D11 is the building code. And the bridge code has fatigue involved, because trucks go over things over and over and over again, so we actually have a higher criteria. Now, there was a lot of excitement about it, so what we did is we actually generated a very large report that documents the percentages of rejection rates, etc., and obviously what we learned when we organized it all and put it into one report... and by the way, we did have the chair of AWS D15 Bridge Code review it. We had the chair of D11 review it. We had several outside specialists review that package, and then we presented it to the peer review, and they actually sent the report back to

the TBPOC. One of the things that is interesting there is, in China the welds were so automated. There was so much machinery, modern machinery, the human error element was pretty much removed. All those things that were done automatically with the machine, you set up the gantry welders, sometimes six welds going on all at the same time, very high level of quality, very low rejection rate. Now, where somebody has to weld on their back overhead, now those are hard, and sometimes you have to do those two or three times. And we did see rejection rates on welds where they were very hard to do, and, again, that's all documented. There's a very significant report if you need it.

There was another challenge in welding. Here in the United States the boxes, they came in, they weighed several... well, they weighed well over a thousand tons, as the steel pieces were lifted up, and then they were set up on the temporary works out in the bay. And remember these boxes are 25 meters wide, each box, eastbound and westbound, they're both, so that's like 75 feet wide, and the top of the deck, the top of the deck varies, you know, it's on the order of like 12- to 14 millimeters. That's how thin it is. Now, AWS Welding Code requires that that weld plate to be within 2 millimeters, everywhere. So 75 feet across and the thickness of these, before you can weld them, they have to be within 2 millimeters. Now, there were some challenges in the beginning. The first time you do something it's pretty hard, and we had to do a lot of forcing, we call them dogs. And we put them into place before we could weld; there was a lot of measurements. Not only did the contractor have their own inspectors checking the geometry before we went to the welds, then we had our own inspectors, our own people going out. So we had two layers of inspection, one the contractors, and then one ours, and they had to agree before they were allowed... okay, thanks... and in almost all cases out in the middle of the deck, where the tires worked the deck, we had everything. Now, there were a couple of spots out in the corner, over by the shoulders, where we didn't quite get to that 2 millimeters, but in some cases we judge, 'You know what? it's not worth it to start tearing up the middle of the bridge and reworking that over in the deck on the corners, where you're not going to see millions of truck cycles, you're just not going to see it. It's better to take out any misfit you have across 75 feet in those locations.' And again, all that's documented. So those are the kinds of things that we do.

And then the last one, I guess I'll share with you, is what we call YBI SAS deck alignment. And I'm going to ask you to consider if you're on the west end of a self-anchored suspension bridge, so you're on the steel section, you're over land on Yerba Buena Island. So you're at the west end of the SAS. Now, the island structure, the concrete island structure, reaches out to the SAS, and I'll use the image down at the bottom right here. This is the self-anchored suspension bridge right here. This is the easternmost column on the Yerba Buena Island transition structure. This is very, very tall. This arm, we call it a cantilever arm because it reaches out like a diving board, reaches out 175 feet, 175 feet, and it has lots and lots of pre-stressing, lots of pre-stressing tendons through here. And when you pre-stress it up sometimes this cantilever, sometimes this cantilever structure will start to move upward. Kind of like if you're riding a horse and you pull on the reins hard, the horse's head comes up, okay? Well, same thing right here. Now what we did is... and that's a problem... now, we analytically predicted it in our calculations, we saw that, but then we need to be able to predict this and manage it literally to fractions of an inch. So what we did is we had a combination of tie-downs, but we also put ballast, we actually put weight inside this cantilever to manage the elevation. So the top of that Yerba Buena Island deck where the cars go matches up just perfectly right here with the top of the SAS. Now some people go, 'Gee whiz, you put ballast in? You actually weighted it down?' Yes, and that's the way it was in the original plans. Now, we did have to up the weight a little bit, we did, but we always had planned to do that, and we monitoring it, surveying it continuously, because we wanted it to match just right when we got across it. Okay, next one, Andy?

Okay, and then I've also been asked to share with you some of the things that I think are innovations and things that are very special. And I think... I'm going to run down this pretty quickly, but the first thing I want to share with you is that this bridge, we have maintained what the Governor's Board of Inquiry wrote in this book. For the first time ever in the United States there was a desire in earthquake country to have a bridge be recognized as an important bridge. The building world was ahead of the bridge world at that time, a fire station, a police station, a school, those are recognized as buildings that should... a hospital... we should invest a little more into,



because of the value and the purpose that they serve. Well, the Governor's Board of Inquiry, chaired by George Housener, who's really like the father of earthquake engineering, they recommended make the Bay Bridge an important bridge. Now the standard across California, and the standard across the United States is after an earthquake, no-collapse is all we're shooting for, and as bridge engineers we associate no-collapse with no loss of life. So if we have to tear down a bridge after an event, as long as it didn't fall down and nobody died, that's success, that's standard, and that's over 99% of the bridges. A very few bridges in California have this label. The new Benicia Bridge has this label. The Bay Bridge has this label. Richmond San Rafael does not have this label. It's a no-collapse. So I want to share with you probably the first seismic innovation was Governor's Board of Inquiry, elected officials, you know, folks like yourself, said, 'This bridge needs to be a little better. We need to invest more in it.' And we followed that. And I've been on this job since... well, really, 1995, so I can tell you we actually have maintained that.

The second thing I want to highlight is seismic safety peer review. Normally, in the past, Caltrans has really only done seismic safety peer review on design criteria. That is, put down your criteria, write it down, it goes through a peer review panel, and that's pretty much it. Well, on this job, I've asked for financial support, and my boss, Tony Anziano and the POC and others have supported me financially in having this peer review panel not only watch over just the paperwork criteria, but also the actual design, the analysis, the decision-making, and go into construction. This is the first bridge... and, of course, Tony and I and the rest of the members of the POC were also involved in Antioch and Dumbarton... these were the first bridges where we actually took peer review with us all the way to construction. So I think that's a real first and I think at times that will continue. We did an unprecedented, unprecedented amount of geotechnical work, and I think that really paid off. Up and down the state of California most claims are due to work underground, in the foundations. Anytime you go underground, you have historically a lot of claims, a lot of surprises in construction. We have not had one claim even in the skyway foundations, in the water, etc., just fantastic.

Shear links in the tower... oh, excuse me, high level of seismic and other testing in laboratories: On the Bay Bridge, Tony and the POC and other members financially supported me in actually going into laboratories, like University of California, San Diego, Davis, Berkeley, University of Nevada, Reno. They actually allowed me to build columns, build pieces of superstructure deck, build shear links and take them in the laboratory and prove that our analytical calculations are correct, that we could actually verify that these things are tough and they're buildable. And if you go to many other structures in the state, in fact, just about all structures in the state, you will not find that. You will find regular, generic research associated. Here we proved... we proved a lot of things with that testing.

The shear links in the tower are another example. Actually, an added member, an added member on the bridge for one purpose, one purpose only, seismic. That is... that's the first time that that has happened on a bridge in California. Now, others are starting to copy us, but we were the first on this, so it's a real innovation. And it actually, believe it or not, it came from the retrofit work. And the retrofit, while we were working on the retrofitted east spans and the west spans, I was exploring scenarios of how I could modify that bridge to function well and I started adding extra members. So, believe it or not, the retrofit work on the east and west spans actually helped us on the new bridge. The seismic hinged pipe beams in the deck joints, fantastic. And, actually, I think, Andy Fremier has a video that he can run.

ANDREW FREMIER: Brian, why don't you go through the next slide and then we'll talk about those two I think afterwards and move on through the presentation.

MARONEY: Okay, very good. I'll talk a little bit about the hinged pipe beam when the video is shown.

And then the SAS YBI column design test: Again, I want to share with you the self-anchored suspension bridge, very exciting architecturally, right? It's asymmetric, very long forward span, short back span, and the short back span is on rock, and the forward long span is on soil. So imagine in an earthquake, you have the short stiff column vibrating high frequency and then you have this really long flexible column doing this on the other side.

And what it does it they're not compatible. They twist each other and they don't share well. In the beginning, the very first designs, distribution on the shear, distribution of the work that those columns had to do was about 90% to the short, stiff one and about 10% to the tall, flexible ones. We actually did something really amazing. We went down into the ground 15 meters on Yerba Buena Island and cut a hole to make that what appears to be a short column now a long column. And if you go out there, even though from faraway it looks like all the other columns, but if you get up close, you'll find that they're not connected. The columns at W2, they're not connected. So we did some very clever things to actually make sure that those are more compatible, and we actually got it down from 90/10% distribution to a 60/40, which is really fantastic. Now, that is a fundamental property in my mind. And we didn't just do it analytically, we just didn't do it with our calculations, we actually went down to UC San Diego and built a model of W2 in the lab and worked it back and forth. And I can tell you that column can comfortably go double what the motions are. The next slide is... I want to share with you...

MAN: Just close with this one.

MARONEY: Okay, thanks. The next slide I want to share with you is these are one way to describe earthquake motions, these three curves. And I'll make it real simple here. The green curve, the lowest one, that's 2,500-year return period motions multiplied times two-thirds. If you... and that means about a 500-year return period motion. If you were to build a brand new building in San Francisco, a brand new building in Oakland, that's what you would design to, that green one. So that's... that's about a 500-year return period, or 2,500-year return period multiplied times two-thirds.

The next curve up, that's the 1,000-year return period motion. That's the standard in AASHTO. And the top one, the top one, that's the Bay Bridge. That's the 1,500-year motions. And I'll also have to tell you these are not just linear. That little bit right there, that cost money. Those 1,500-year... that up-ing from 1,000 to 1,500, it cost us dollars. So I do want to share with you the ground motions. And, actually, Norm Abrahamson—this is the guy who did our ground motions—he's also the person who, you know, develops ground motions for things like Yucca Mountain where the world

keeps all the worst stuff in the world. He actually told the LAO review group a couple of weeks ago that this project defined new state-of-the-art, seismic ground motions. Okay with that, Andy?

FREMIER: Thanks, Brian. Andrew Fremier, Deputy Executive Director of the Bay Area Toll Authority. The next two slides that are really videos that we have links on our web page and so we'll just pass through those. I think I'll... we can make them available to anybody that wants to take a look afterwards and talk about them. Obviously, Dr. Maroney has got a lot of information that we're happy to share, but I think I'll give it back to Steve at this point.

HEMINGER: Thank you, Andy. And, Commissioners, I appreciate your patience here in the homestretch here. And I will say that anybody who complains about indifferent public employees, I'd like to introduce them to Brian Maroney, because he is possessed by his work. And I think that clearly comes through.

I want to talk a little bit just briefly here on this slide about public confidence, because I think that is a great part of our challenge right now, and maybe we can have the lights back on, as well. And I could see some of your faces in part of Brian's presentation, you know, and I'll try to summarize part of what I saw. You know, 'Why are you telling me about more problems?' you know, 'Aren't the bolts enough?' And, look, maybe we shouldn't have. Sometimes you're damned if you do, damned if you don't. I will say one reason we did is we wanted you to hear about these issues from us first and not elsewhere. And another is because a project of this scale is so big and complicated that you encountered a lot of challenges. That's not the important part. The important thing is how you meet those challenges. And I think Brian described well how we have met them. And we have documented meeting those challenges exhaustively. This is the report that he was referring to about the welds on the deck, the decks that were manufactured in China. This is the report on the issues that have been raised about the foundation of the tower. This is the report on the stress corrosion issue that... stress corrosion... excuse me, the corrosion issue we had on the skyway. There are a lot more of these. Now, there are certainly matters for debate and many experts have different opinions, but we have

consulted with some of the leading lights in the field on all these subjects, many of them work for Caltrans and work for our team because they are building a bridge that attracts hundreds of visitors from around the world on... every couple of months because they're learning from what this bridge is doing.

So that's one point I wanted to make. It's not that we don't have challenges. It's not that the challenges are unimportant. It's not that we're trying to minimize them. But, again, I think we ask you to hold us to account and to hold us to the standard of, 'What have you done to deal with them?'

And, also, we heard I think recently plenty of calls from quarters. We've heard it throughout the history of the project that what we need here is an independent investigation, and I agree with that. And we've got one underway. And I think this slide tries to make that case, and I will keep trying to make this case. Just bring in three guys from somewhere else in the world, who know nothing about this project, is not necessarily a recipe for success, and then you'll be opening the bridge not this Labor Day, but maybe a couple ones from now. What we have underway, as authorized by state law with this committee, is three agencies working this issue. One of them is Caltrans, but two of them are not, and it's pretty easy to count among the three of us on this committee. Secondly, we have an independent peer review panel, three members of the National Academy of Engineering. You are not going to find better people anywhere on the world who are going to review the issues that we need reviewed for this bolt question. And, finally, as you know, we have asked out of an abundance of caution and to try to assure absolute independence, because all of us have been working on this bridge, that's true—we have asked the Federal Highway Administration to come in and look over our shoulder and they've agreed to do so. We think that is the definition of an independent investigation, and that is what is underway.

So let me conclude the presentation with the final slide, which is what you should expect and, again, hold us to for July 10<sup>th</sup>. We need three things to come together in order to say on July 10<sup>th</sup> that we think we can go for Labor Day 2013 as an opening. One of them is we need our written investigative report completed. We are working on it. It's not done yet. We want to



share a draft with the Federal Highway Administration, so they review it and agree with it, or, if not, tell us what they think is wrong so we can fix it. And that is step 1. Step 2, as we've indicated earlier, we need a firm schedule for the retrofit of the 2008 bolts that says we can make Labor Day. If the schedule doesn't say we can make Labor Day, we're not going to make Labor Day in all likelihood. And, thirdly, we need a decision on the remaining bolts on the bridge. And as Malcolm indicates, we've got a lot of testing underway. I think he misspoke just in terms of July versus June. That testing is going to be done in June. The long-term stress corrosion test will go past that point, but that test is looking at long-term stress corrosion. It's not giving us information that we need about opening the bridge. The other tests will do that. And those tests we forecast will be ready by late June. If they're late, then we're not doing Labor Day either.

So it's all three of those things that have to come together. That's why this slide is written as an equation. It's  $1+2+3$ . And if that comes together, we will be back to you forecasting an opening date on Labor Day. If any one of them does not, we will come back to you with the fact that we will have to take a delay and choose another date to open this bridge. Again, as I said earlier, the safety of the public, the status of these bolts on the bridge will determine when we open it and nothing else.

Again, I apologize for the length of our presentation, but we had a lot of information to convey to you. And we'd be happy, any of us, to try to address your questions.

CHAIR REIN WORTH: First of all, I just... I really want to thank all of you for that really in-depth, thoughtful presentation and for everybody for coming to this special meeting today. I think it was really helpful for both us, the Commission, and the public to hear a detailed discussion of not only where we are right now, but issues that we've dealt with in the past and will be, you know, continuing to address, so thank you very much for that. And I concur with the Executive Director's comments about the commitment to this project.

I did want to just... I know our commissioners will have some questions. And if I might just ask a couple of clarifying questions and then take

commissioners' questions, and I also have some public comments that we will take also. So, if you'd like to make a public comment, please complete a speaker card.

First of all, I just wanted to ask, I know that in addition to our commission being very engaged in this, obviously, the California Transportation Commission is also a public body that's monitoring this very closely. And I just wanted to ask Mr. Boutros, the Executive Director, if you wanted to offer what... might be so kind just to offer any additional comments in terms of the perspective of the Commission?

ANDRE BOUTROS: Thank you, Madam Chair. As Steve mentioned, we are three organizations that make up the body of the TBPOC. We are independent of each other, luckily. My commission is very concerned, to say the least, about what they're hearing in the media and what they're learning about some of these issues that we're talking about here. My commission is really... is focused and connected and they keep track of me, in particular, to make sure that whatever decisions or whatever recommendations we are making are in the best interest of the public. My commission really takes the role of oversight very seriously. And they will accept nothing but the most safe bridge that was promised to the public, that was intended in the original design. So I hope that answers that question, and I'll be happy to elaborate further if you...

CHAIR REIN WORTH: Oh, thank you. And, again, we appreciate the ability to collectively work together both with the commission and the state legislature, and this commission to address these issues and to open a safe... high-quality, safe bridge.

And I just had another... one other final question for Malcolm. You mentioned that you're still working on the testing of the... both the bolts have failed, as well as the other anchor bolts that we're considering, the 2010 bolts, as well as the tower bridge bolts. We have received several independent reports from the public, which I know have been forwarded on to you. And will those... that information, is that part of... can you talk a little bit more about how those reports, again, from engineers in the field, from University of California professors, from people who are, you know,

experts in this field and they've raised some issues relative to both testing as well as the... you know how it's important to be comprehensive in terms of looking at all the factors to really determine completely the cause of the failure of the bolts as well, as what to do with the remaining anchor bolts. So I wonder if you might be able to kind of convey to us what your process is to incorporate and, you know, evaluate and engage those individuals at a substantive level in terms of the information that they're bringing forward?

DOUGHERTY: Sure, I'll have a couple of comments and then also invite Tony and/or Brian to add on if there's anything they would like to add to. Just one clarification as far as the existing testing and the ongoing testing, I think we're done testing the 2008s. I think we've pretty much exhausted that exercise and summarized that. And the testing on the 2010 bolts at E2, as well as all the other bolts is ongoing. We have some of that data back. And if I did misspeak earlier, we are targeting the testing for those... Other than the long-term wet test, we are targeting about the third week of June, so that we will have data in hand to make any decisions.

We have received input from other experts. And what we have done typically is try to reach out to those experts to see whether or not they want to engage in a further conversation with additional information that we may have at the pier. And we have invited some of them for further conversations, not necessarily 100% of those, but I think we have done some outreach to engage further at a more detailed conversation, and I think that there has been some healthy input. And where we thought that it would be beneficial not only for them to be engaged, we've reached out and tried to set up meetings. I don't know that we've been successful in setting some of those meetings up, but we have reached out to several individuals who have opined.

TONY ANZIANO: Certainly, I'd be happy to add to that, Chair Worth, Commissioners. Tony Anziano with the State of California Department of Transportation. There have certainly been a lot of opinions rendered on this topic. There were two individuals, however, who took the time to put together fairly detailed reports and analyses. Mr. Chung, who's a retired metallurgist from Bechtel, and also Professor Devine, who's a metallurgist at UC Berkeley. And I think, at an absolute minimum, given the fact

they've put that amount of thought and attention into the problem is something that is worthy of our attention and consideration. And in both instances, we've had an opportunity to invite both out to the project, have a conversation about their reports, get some input from them with respect to their views, let them know what we are doing in terms of our testing program, trying to get some sense if they thought we were on the right track, and I think in both instances they thought that we did. Fairly recently, I think, within the last week, we've received comments from both with respect to the metallurgical report that was prepared on the 2008 rods, and that information will be forwarded on to our metallurgical team. I think it's valuable information that they should have access to.

CHAIR REIN WORTH: Thank you very much. So now I'd like to take any of commissioner comments... or, excuse me, commissioner questions. Commissioner Aguirre?

COMMISSIONER ALICIA AGUIRRE: One of the things I'm really glad to hear about this report is the safety before even any bridge opening. I think we all agreed that that was our number one concern. And I asked this question the last time that we had a similar presentation. We know that the 2008 bolts are a problem, but that's a five-year... is it a problem because they're five years old? And what about the 2010 bolts, will they be a problem when they've reached that five-year, as well? And I know they're being tested, but will we come back in two years and say, 'We tested them, but because of age factor...' Is age factor considered at all within the issues that we've had?

DOUGHERTY [?]: Certainly, the expectation is... And this is not an expectation that was met on the 2008 bolts. There was a design life for these bolts. And the testing that we do to ensure that we got the product that we want from a metallurgic standpoint, as well as meeting the strength requirements of those bolts are for long-term. The testing that we are doing today should give us enough information to tell us about those bolts for the life of those bolts. Whether or not that's going to meet our expectations for the life of those bolts or not is what the conclusion we will reach one way or the other. But the information we are gathering about the properties of that

metal will tell us one way or another whether they're going to meet our expectations for the life of those bolts.

COMMISSIONER AGUIRRE: Thank you.

CHAIR REIN WORTH: Okay, great. Thank you. Commissioner Quan?

COMMISSIONER JEAN QUAN: Thank you. Thank you for the report, and I understand the passion that you try to develop really high standards. But I have to say that when I looked at this list and I was glad that you were addressed some additional issues, but when I compared them to what was in the *Sacramento Bee* and what was in front of the DeSaulnier Committee, that there are several issues that were not addressed and I hope that when you come back on July 10<sup>th</sup>, or whenever the date is that we get reports on it, specifically, according to the *Bee*, the Legs [?] analyst is doing a report and expects to have a report on June 30<sup>th</sup> on the cement used in the foundation. And so I'm wondering whether or not you think that's going to be an issue. I suspect they think it's an issue, since you're doing a report on it. Again, I'm a new commissioner, so maybe you've addressed that in previous years.

Also, specifically, Professor Devine at UC, and the *Bee* say that thousands of the tendon bars could be corroded, and so I specifically want a response to his feeling that you used the wrong test, the wrong standard and that it's not safe. He's the major guy with the degree out there who has put that out, and I'd like to have a direct response to that... on that.

We also have on the *Bee* list the welding issues on the span, which I don't see in this list, but would like to see that addressed and specifically to look at... and I'm curious about the issue... maybe Caltrans in a separate way could explain. I guess there was criticism about the Committee, there was criticism from the *Bee* that some of the information, questions on the welding problem haven't been made public, haven't been addressed, did not seem to be addressed in this presentation.

What I'm concerned about is... and I'm not an engineer, none of us are engineers, we keep saying that... but that although they're high standards, if

the work wasn't implemented correctly, we may not meet those standards, and, therefore, we may not get a 150-year bridge. We might get a 50-year bridge. It sounds like, particularly because of the corrosion issues and the water issues that our maintenance costs are going to be much higher, just doing this replacement. And so I'd like to get an assessment. If you add all these things up, do we still have a 150-year bridge? Did we get what we paid for? And if not, how much more the maintenance will be, because of the corrosion and the other issues, and what's that going to cost the Authority, the joint authorities, over the life of the bridge, and have we budgeted for that? Is there some ability and liability to get some of these repairs paid for?

So... and then I want to thank the staff for at least setting a date, two months, ahead of Labor Day that at least we'll know, we'll be able to tell the community, be able to tell people who have blocks of hotel rooms blocked-out what the story is. You know, I think we all agree, even if it takes us another year, we'd rather have the bridge be safe. I don't think the Governor will be very happy, but I think we really need to do this in a way that's safe.

But my bigger questions are it seems like there's issue after issue, there's now at least a dozen issues. Maybe you disagree with the *Bee's* list, but I'd like to hear a response to each of their items. They've done a really good job, I think, following this issue. And so I don't want to hear just these four or five issues that seems to be going from what's presented here. I want to hear a response to the issues that the Legislature is looking at and the issue that the other media groups have raised, because I'm not going to be able to make a good decision on July 10<sup>th</sup>, unless I also hear the answers on the cement and on the broader issues on the tendons that weren't raised today and the issue on the welds. Thank you.

HEMINGER: Commissioner, we'd be happy to bring back any information you want on any subject. And, believe me, there's lots of stuff that we could have covered today, but we didn't.

I will say on the foundation question, which was largely something that grew out of the employee at Caltrans who's since been fired, who was



falsifying test results on other bridges, not on this one, but he did work on this one and that led, you know, one thing to another, we did do a very exhaustive review of that, so did our independent Peer Review Panel. That's the report that I mentioned earlier. We're happy for the Leg [?] analyst, or anybody else who wants to take a look at it, to take a look at it, because we think the results are unequivocal that the foundation is fine.

On the tendon corrosion, I think I'll let Brian address that a little further today. On the welds, at least on the steel portion of the bridge, that's the other report I mentioned earlier. It got I think some press attention a couple of years ago when we were still in China doing the fabrication. I don't know that it's got a lot since then. But, again, we're happy to talk to anybody and brief anybody and have anybody review the information we've put together. Again, our independent Peer Review Panel, as well as some other fabrication experts put together I think a very exhaustive review of where we ended up and I have full confidence in that.

I will also say, as your representative on this committee, it is not acceptable to me to say, 'Well, look, it's going to be okay. It might cost you more on maintenance, but let us open the bridge.' We're not buying that. We did not spend \$6 billion for a bridge that has a lot of maintenance trouble. So we are going to make sure when we open this bridge, and we have made sure, I believe, on all of these issues, that we're not just settling for something that's okay structurally, but is going to be a big maintenance headache. We want to make sure we get our money's worth for this bridge, because we paid through the nose for it. And I think we have met that standard in all these cases.

Now, I would like to ask Brian Maroney, perhaps, or perhaps Malcolm to address the skyway issue a little more details.

DOUGHERTY [?]: Well, I'll intercept it. I'll intercept it on the way over to Brian, and he can elaborate on some of the criticism on the report that was written and the analysis on the tendons. But I was going to echo, or at least insert what Steve started to talk about as far as the 150-year life. Any issues that have come up, we have analyzed and come up with a solution that will replenish that 150-year design. That's what we came up with, with

the retrofit for the 2008 bolts and we do not anticipate with any of the resolution of these issues of having any additional higher maintenance costs than we had expected for the bridge going through. There will be a significant amount of maintenance effort on this bridge because it is a very important bridge, but I think that's typical for any of our bridges. But we have always tried to preserve the 150-year design life and are not accepting any maintenance liabilities going into the project.

MARONEY: I'm going to try to limit my response.

MAN: We appreciate it.

CHAIR REIN WORTH: But keep the enthusiasm.

MARONEY: Okay. Well, I guess I heard two things. Let's just start with the electroslag welding. And I want to be very clear, we're in the middle of building the base of that. We don't even have, you know, all the skirt completely on yet and we don't have the dehumidifier turned on. And, you know, it's partially... it's welded up, and one weld is completely cleared, and the other ones we're working through. Some welds get them out, fix them, and if you have to do it twice or three times, do it. Others, the imperfections are so small, forget it. Even by code, no problem, don't worry about it. And then there's another little group where we're sharpening our pencil, using higher technology... or higher and better... higher quality equipment and better technology to characterize those imperfections and then we divide those up, get them out or they're acceptable. We're actually doing physical tests not only on practice weld samples, but also we're taking a piece out and taking it to a laboratory and testing it. So the electroslag welding, we're working through one weld, and, again, we've got miles and miles and miles and miles and miles of welds.

To officially, or, you know, very directly answer your question, 'Tell me how many?' Okay, I can't say a percentage, because that's... it's a non-engineering characterization of such a situation. Every single... one weld is completely cleared. Every weld, they're like 30-feet tall, they're about 4 inches thick, so there's a lot of weld here. A lot of it... we've got... we've got some numbers, some few hundred of indications. We've got hundreds

of indications and they're spread out all over everywhere. And some we'll be turning into it's an unacceptable flaw. An indication is what we'd label it, when we first see it. So an indication is what we first call it and then we decide is it a crack in... like a planer crack and you have to remove it? And if it's a very small flaw that doesn't have any impact on its performance, it's accepted, and you can find that in the code. So I hope I answered that question very directly.

With the respect to pre-stressing tendons, again, what we did is when we discovered it we first understood how it got there, so that means we knew what we were doing. We did identify, absolutely, some corrosion and that's got an impact. And we evaluated that and we compared it to the capacity, the overdesign, if you will, and we determined that it was acceptable. However, we also brought in external people, specialists in that. We actually reached out to the private sector, also specialists from Florida. As you know, Florida, just like California, we have a lot of expertise here in earthquakes because we've suffered from earthquakes. We have to know a lot about earthquakes. In Florida, they've suffered from pre-stressing corrosion, so they have to be expert at it, so we reached out to them to come and help us evaluate. Let's take all the knowledge that they have.

Now, with respect to... and then external, independent people looking over my shoulders. And FHWA, we feel we've evaluated correctly. However, as Mr. Anziano pointed out, we're always... I'm an engineer. I love an extra check. I never mind anybody coming over and looking at anything at all over my shoulder. And anytime anybody wants to come in, they're welcome to review things. In fact, the LAO Review, they came in to look at the foundations, but we actually invited them. They didn't even know about it. We told them, 'Hey, why don't you come over and look at the tower, look at what we're doing. Why don't you...' We actually told them about this information. So I think we're being really open and I welcome all input. In fact, we are bringing in Mr. Devine's report, and this is the kind of thing that we do pass on to our specialists, the corrosion engineers, and we say, 'Well, here's a new perspective, or a different idea. Let's be open to it, let's consider it, and what do you think?' And that's actually what some of my team is doing right now.

So I hope that responds... and, again, I'll be happy to bring a full presentation on both of those subjects next time, if you wish.

CHAIR REIN WORTH: Thank you. Commissioner Pirzynski and then Commissioner Campos.

COMMISSIONER JOE PIRZYNSKI: Thank you, Madam Chair. To reiterate, none of us are engineers, thank God. The idea that anyone can actually build a bridge is kind of magical thinking for me. My field is psychotherapy. And I'd like to kind of approach that part now. Every time you come to present, I get a more significant level of confidence in where we're going. But in your presentation today, it was mentioned that we have a public confidence issue that has been building. And my concern is that as I become more confident given the technical evaluation in, you know, the level of expertise, the orientation towards safety, I don't see these as words. I see these as actions. I see these as actual dedicated orientation on the part of the team. My concern is as we go downstream how do we build public confidence? How do we return public confidence in the... in our ability to present a safe bridge to the public that will be using this, given the fact that we have now this disconnect between the engineering, the types of fixes that have occurred to address some of the difficulties that have presented themselves, so that when we do open our public says, 'I feel good about crossing that bridge.' I'll tell you right now, I feel good about crossing that bridge. I am feeling very good about what I hear. I'm feeling very confident. But my concern is, then, our public's level of confidence as we approach whatever date it is that we're going to open the bridge. And we've done such a good job of planning and forecasting, I'm curious how we're going to attack that particular problem that now exists with the bridge?

HEMINGER: Commissioner, if I could start, and I got a similar question when the three of us testified before the Senate Transportation Committee in Sacramento. And I think the first step is to acknowledge where we made mistakes and where we should have done things differently and where, as we did today, we tried to do, we met challenges in the fabrication or construction of the bridge and we had to fix things. I think that level of transparency and accountability is important to folks and I think there is always room for improvement when it comes to that. And we do have an

investigation of these bolts that's underway—it wasn't an act of God that these bolts failed—and we are trying to track down with good factual evidence why the decision was made to select these particular bolts, why the decision was made to protect them from corrosion in a certain way, how were they manufactured, what led to these failures. We know what happened. We need to know why. And that report has to carry with it credibility, I think, as step 1.

I think step 2, and I'm reassured myself to hear you say you're becoming reassured. I think you all, as well as the press who are here... I mean, you are both, I think, surrogates for the public at large. You represent them, you communicate with them, and I think that's another reason why we felt even though we had to call special meetings and drag you out when you're not supposed to be here, we thought it was important to try to keep you as up-to-date as possible, to give you a chance to question, to probe and so on.

I do think, unfortunately, our single, biggest challenge is that, you know, we all live here in earthquake country and no one wants to deal with that on a daily basis. And no one wants to deal with the fact that they're driving over a bridge today that in a major earthquake could fail, but that is a true statement. And, you know, I don't think we ought to be in the business of trying to scare people or trying to cause then needless anxiety, but I think what has guided this commission, and I think where this commission has acquitted itself well since 1997 when we got into this, is that that has always been our guiding star. And I hope it remains so and that we open this bridge when it's safe and not a moment too soon and not a moment too late either.

CHAIR REIN WORTH: Thank you.

COMMISSIONER PIRZYNSKI: Thank you.

DOUGHERTY [?]: If I could build on that, I would certainly liken myself to the comments that Steve offered up, but when it comes to the technical issues and was asked earlier, this is only a representative group of the challenges that we've undertaken and overcome on a project of this size, or any project. But, certainly, as we tackle this issue, as well as the other issues, I think we need to make sure that we're being transparent in the

outcome of the tests that we do, share the actual undertaking of those tests with the media so people can see what we are doing, share the oversight that is being done of what we are doing, and then be transparent with the reports that are written and the appropriate narrative that goes along with that. I think that's what we've been able to provide to you here in this forum. And we need to figure out how to get that to the general audience, so that they can understand the level of detail that is going into and thoughtfulness, and engineering to resolve any issues that we do encounter, and I think that's one of the other challenges that we need to overcome.

CHAIR REIN WORTH: Thank you. Commissioner Campos.

COMMISSIONER DAVID CAMPOS: Thank you, Madam Chair. I want to thank the staff for their presentation and it was certainly very reassuring in a way to see Mr. Maroney talk about the bridge and the passion and the excitement with which someone can look at a bridge. I think that's... it's great to see. Again, I want to thank the staff for all the work that's gone into this, and I'm certainly very appreciative not only of the staff here at MTC and have a great deal of confidence in our executive director, but also want to thank the CTC and Caltrans.

But in our role as Oversight, I do think that we have some questions that we have to ask, and it's not anything directed at a staff or an individual, but I think it's part of the process of reassuring the public. And so my question that I have in terms of process to the POC, as Mr. Maroney talked about it, is in the presentation, you have I think five construction challenges that were identified. Each one of them, individually, is a very complicated issue that raises a number of questions and a number of technical issues that come with them. And so the first question is more of a request. I think it would be better for us, certainly for me—I can only speak for myself—but for the public, as well, that these kinds of presentations be given to us in advance so that if you're going to talk about such a meaty subject as each one of these five issues that we have the opportunity, at least I have the opportunity as a commissioner to review what you're going to talk about so that I know what questions, if any, to ask. You know, I have a pretty simple mind, so it takes me a while to really get my arms around something as complicated. So, you know, what you said about each one of these items sounds good to



me, and I want to trust what staff is... and I don't, you know, usually quote Ronald Reagan, but you know he used to say, 'Trust, but verify.' So I just want it verified. I think having information in advance is part of that verification. So I'm wondering if going forward, if we could have that?

HEMINGER: Commissioner, that's a fair point. And, as you know, that's our sort of standard practice around here. This has been a challenge, I have to be candid, just because there is so much information and we're presenting it to you real-time. What we have in front of us is one more meeting, and we will endeavor to meet that standard. We do have with respect to our investigation not just three agencies involved but four with the Federal Highway Administration. And so we've just got a lot of things to corral into one moment, but we will endeavor to try to get to you something before that meeting, so you have a chance, as you say, to review it and prepare for questions instead of doing them on the fly.

COMMISSIONER CAMPOS: Now... thank you. You talked about the steel saddle retrofit option and how you're finalizing that design. Have you checked with the Federal Highway Administration about what their thoughts are in terms of that approach, that solution, and are they in agreement that that's the best solution here?

HEMINGER: We did not check with them. We, in fact, had a conversation about that. And the letter we sent them, which I think we gave to you in and released to the public at the last meeting, was really asking for their review of not our decision on replacing the 2008 bolts or what we're replacing it with, but what are we doing with the remaining bolts? We did have on the retrofit selection our independent Peer Review Panel review that. And that has been our customary practice here, and I think that is appropriate here and sufficient, frankly. And I don't think the Federal Highway Administration had an interest in sort of revisiting or reviewing our construction decision. What we've really asked them to do is review our decision-making on the remaining bolts, so that we have a level of independence about what are we doing with Bolt A versus Bolt C versus Bolt X.

COMMISSIONER CAMPOS: And I appreciate that. I personally don't see that you lose anything necessarily by having... I think Mr. Maroney talked about having, you know, engineers welcome another set of eyes, having another set of eyes, a fourth agency looking at that. I don't know if that creates an issue in terms of, you know, affecting the timing.

HEMINGER: Well, I think timing, at the very least. We're operating on a very accelerated schedule here. And, essentially, it's a design-build job, because the designer and the fabricator and the contractor are working very collaboratively. So it's not that I necessarily have an objection to it. I'm just not sure it's necessary and it would be very atypical for all of the construction decisions we've made. Typically, the FHWA is coming in more in a forensic way and saying, 'Well, did you do... did you do this right?' not 'We're going to help you design the bridge.'

DOUGHERTY [?]: If I could just add, Commissioner, FHWA, we asked them to really, primarily look at the decision we made on the different sets of the bolts. One thing I do want to point out, they usually do not get involved in day-to-day design decisions. But FHWA is a member of the team, an active member of the team. They are participating in our team meetings on a daily basis and when we... not on a daily basis, but on a weekly basis. And this is an issue that has been discussed why they're a member of that team at the table. We did not formerly ask them to concur with the design. We formerly asked them to review all the data and the decisions that we come to on the disposition of all the remaining bolts. But FHWA is an active member of our team.

COMMISSIONER CAMPOS: Thank you. One of the things that I appreciate about the presentation is the fact that in a very proactive way you're identifying other possible issues, so that we do get out of the current situation where we actually learn more about what's happening by picking up the paper and we actually get information here. But one of the things that really troubled me about the *Sacramento Bee* report—and Mayor Quan asked you about it, but I'd like to follow up on that—is that, fundamentally, one of the things that they question with respect to the corroded tendons is the testing that Caltrans did with respect to that problem. And as Mayor Quan said, Professor Devine referred to it as useless findings, questioning

not only the method and how the testing was being done, but sort of your interpretation of data. The issue... the reason why that's so significant is because at the core of everything that's happening in this investigation, is testing that Caltrans is doing. For all of these solutions to work and this approach to make sense, we have to trust the testing that Caltrans is being... is doing. And so when you have a newspaper that cites experts questioning the way in which you conducted that testing, that raises a very important issue for me. And so I'd like to know if you can address that directly, because I think that really is very relevant to what we're talking about today.

DOUGHERTY [?]: Thank you, Commissioner. A couple of comments I would like to offer. Almost all of our testing, a majority of our testing is being done by external labs, and then there's also a portion of the testing that is being done by our own materials laboratory, but there's a significant portion of the testing that is being done by external parties. We also have consultants as members of our team that are identifying the testing that we should conduct as well as reviewing the day-to-day that comes out of that, both our testing as well as external labs doing testing.

Regarding the corroded tendons, and the logic that was used to reach the conclusions that were reached in the reports that were written, I think what we tried to articulate to you earlier, and I will try to make it clear as possible, we're going to take that information provide it to our experts that wrote that report, ask them for their feedback on that and then likely invite those experts to the table and discuss any of their differences of opinions and the conclusions that we bore out in that report. So as Dr. Maroney pointed out, we have no problem in bringing other engineering opinions to the table and debating those, and we're also going to take that engineering opinion and share it with the folks that wrote our report and find... see what their response to that vantage point is.

COMMISSIONER CAMPOS: I have a final question and I know that there are other commissioners who may want to weigh in on this. But something that stood out in the latest article that was in the paper today about the bike path bolts was sort of a statement that someone made in that article, and I think it was Professor Bea at UC Berkeley, and sort of referencing some of

the basic mistakes that were made and sort of decisions around those bolts. And this is what he said, and so I think in many respects for a lot of people, this goes to the core of sort of what's happening here. And I think it goes to the issue of public trust. And he said, 'If we are being challenged by straightforward, simple things, it raises serious questions about what we've done on complex situations.' In other words, if something as basic as some of these things that were done could not be done right, how do we know that on more complicated tasks relating to the construction of this bridge that we can have the confidence in the Agency?

DOUGHERTY [?]: Well, as simple as this design looks on the railings, it was a very detailed, engineering way to deal with a railing at an expansion joint, and it really comes down to a welding error that caused a problem that we had to go back and fix, and it is an issue that... that's exactly what we did was go back and fix it. It is a well-designed feature, but it was not implemented in the field and we're having to go back and correct that.

COMMISSIONER CAMPOS: I think his question was if you can't implement something as basic as this well, how do you know that you can do something more complicated well?

HEMINGER: You know, if... I could venture to an analogy and I know that's dangerous sometimes, but let me give you our experience in China. You know, when we went over there, we thought the tower was going to be the killer. You know, I mean, the thing is very unusual. It's very large. They had to invent this thing they call the rotisserie to actually rotate the thing on its side, so they could be welding standing up. I mean, and we thought that was just going to be murder. And that thing scooted right through there and they got it beautifully done. And if you go out and look at that tower from the base, it's just a straight line up in the air, and this steel is inches thick. They had a lot of trouble with the orthotropic box girders, and those are a very common bridge element worldwide.

So I do take your point that when sometimes a simple error or a simple oversight trips you up it does cause you to wonder about the more complicated things here. But what I've seen this team do on this bridge with the very complicated stuff, like picking the load up the first time and

getting it right, I have a lot of confidence. Now, that does not mean though that everything was handled with the same standard of care. And so I think it could work the other way too that you could focus a lot of time and attention on the really complicated, difficult stuff and maybe not put enough attention on something that's more ordinary or simple. And that may be what occurred on the bike railing, maybe not. As Brian Maroney indicated, it almost sounds like it might have been overzealousness. You know the guy was just going to weld the bejesus out of those places and he ended up doing too good a job. But we have a quality control process and it's supposed to catch that stuff, and it caught it, but late.

So I do think there perhaps is a way to separate the two, but that doesn't make the simple mistake go away. It still means it's a concern that you've got to deal with and we're going to address that whole range of issues when we look at the bolts. The bolts as Andy I think said in one of these presentations is sort of the dumb end of the mechanism. They're a very ordinary detail on a very extraordinary bridge.

COMMISSIONER CAMPOS: Thank you.

CHAIR REIN WORTH: Thank you. Commissioner Spering and then Commissioner Mackenzie.

COMMISSIONER JAMES SPERING: I'm not an engineer, I just play one as an elected official. I'm just... Steve, I agree with some of the comments on what's been in the paper, and we have to respond. I know you've said like the concrete resolved a year ago, the public is still reading about it today. And so I think that our next meeting is we have to have an inventory of all these claims that are being made and have a response even if it's in writing. And I think it's very important, because that's what the public is reading today, and that's what they're hearing. And, you know, they're not attending these meetings, so I think that's important.

The other issue, is there any part to this...and I'm just asking this question; I think I know the answer...is there any part of this bridge of concern that we don't have access to that, you know, bolts that we can't see, can't get to?

HEMINGER: There are... you know, if I don't know if we can go back to the slides, but I think there is... it's probably Malcolm's test plan might be the best slide, which is Slide 21. You'll see in a couple of cases, for example, Items 5 and 6, the bearing assembly bolts, that's a case where the bolts are internal to the bearing, so we can't get at them right now. It is true. Now, they were observed before the bearing was assembled. And so to that extent, they had a look-see, but what we're going on there largely is the quality control data that we had when they were fabricated, because other than simply to destroy the bearing, you don't really have much choice. So there are a couple of instances where that is the case, but the vast majority of these bolts are accessible and are replaceable. As you know, the once exception to that general rule is the 2008 bolts, just because they're stuck on top of the pier, and that's why the retrofit was necessary.

COMMISSIONER SPERING: My question is are there areas that you don't have access to that you have concern about?

HEMINGER: Well, I think until we get the testing information completed... and the testing information will give us information about similar bolts and similar material, because part of that, again, if you go back to the graph that I used which was Slide 18, you'll see the average hardness in the tension levels there. We do know, on those bearing bolts, we know what tension they're under. They're under similar tension to the bolts that did fail, as well as the bolts that didn't fail, the 2010 bolts. And we know their average hardness. So when we see some similar bolts in the test that Brian, in particular, is developing, this long-term stress corrosion test that will give us some important information. It will be implied. It won't be explicit, because we can't go in there and take them out and put them in that salt bath, but I think that will be a good leading indicator about whether we've got a concern with the tension level they're under or not.

COMMISSIONER SPERING: Thank you.

CHAIR REIN WORTH: Okay, thank you. Thank you. Commissioner Mackenzie and then Commissioner Bates.



COMMISSIONER JAKE MACKENZIE: Thank you, Madam Chair. Jake Mackenzie representing Sonoma County and the nine cities of Sonoma County. Neither am I an engineer, but I did spend part of my professional life for the US Environmental Protection Agency dealing with questions of risk assessment, risk management, and risk communication with regards to pesticidal compounds, and, in fact, spent a considerable amount of time at the University of California, Davis teaching state regulators in this area. And I think, as we are looking at where we have arrived at this point in time, we're dealing with this question of the public perception of risk. And it's well established that there are principles involved here and we used to hire, at great expense, a risk communicator by the name of Cavalo [?]. And he taught a number of our classes, and one of the things that he taught us was involving the public as a partner, make sure that you appreciate the public's specific concerns, be honest and open, work with credible sources and meet the needs of the media. Well, half the media have disappeared, but that's all right. We still have 50% of you guys left.

And I was just... as this discussion was going on for now a number of times, but getting more and more detailed, more and more specific, more and more credible sources, it seems to me that we're, as Commissioner Sperring just noted, we're still not quite communicating with the public and trying to make sure that any sense of outrage that they might have is alleviated. And the best way to do that is just be honest and open, but get that information out there. And I think today's report for the first time, and particularly the work I'm talking about, the challenges faced, we'd heard about some of these challenges before at this committee. We heard about the parts that weren't being properly welded in Shanghai. We heard about the problems that the tower faced and how they were, you know, overcome and the tower was delivered. But what doesn't build public trust is all of a sudden another piece of information comes out. It's not that the bikeway problem wasn't identified and solved, as Director Dougherty just said. It was, but we didn't know about it. And I'm driving up to a 101 ribbon-cutting this morning and I'm hearing our chair talking about yet another problem and it involves the bike path, and it's a welding problem, and it's this.

So for July the 10<sup>th</sup>, information to all, every piece of information. The risk part of the communication is our executive director has told us, and I don't particularly want to be driving over the old east span anymore myself. I want to be driving on the new span, because I believe that the risks involved are much lesser, even although there are some quantifiable problems with rods and bolts... and I was looking it up this afternoon for my edification, the pH of the Bay Area, so water is around 8, so it's mildly alkaline, and it's a saline environment and so you have some of these factors that can lend to the... in the corrosion equation to hydrogen ions being formed. And so, yes, we need to make sure that this is laid out, that we are open, we are honest, and we are communicating.

And I think, myself, that we have come a long way this afternoon to laying out these problems, so I'd like to thank you, guys, because I think finally we've got to the point where here are problems. We have dealt with a number of these problems. We're dealing with some of these problems. We're using credible sources. We need to respond to inform members of the public who come in. And we're hearing these public comments are being heard, but I think we're on a much better track now. I know you're maybe not looking forward to the next period of time arriving at July 10<sup>th</sup>, but I think we'll be in a much better place, Oversight Board, and I thank you. And thanks, staff, Madam Chair. Thank you.

CHAIR REIN WORTH: Thank you very much. Commissioner Bates.

COMMISSIONER TOM BATES: Thank you very much. So, actually, Jake said a lot of the things I wanted to say. I think we've come a long ways. And I think it's really... thanks, Jake. But I think it's important that we did what we did today, which is lay out all the cards out. And, obviously, there's going to be other problems that we may uncover between now and the goal line. But the point is, for me, you know, and Jake also mentioned this and Commissioner Mackenzie, but I would think it would be helpful to help the public understand what we're comparing here, the old bridge versus the new bridge. And I think if you do a side-by-side analysis starting with how it's constructed, you know, how the anchoring, the bolts. I remember when I first came to UC Berkeley in the 50s and I went over the bridge, and I was scared when I went over the bridge. I mean, I don't know,

I'd never been over a bridge like that before or anything like that. And I kept thinking well what would happen if it, you know, fell down. Well, over time, I gained confidence that it was not going to be a problem. But if you look at that eastern section of what we have now, it is a disaster... it is... the way it's put together. I mean, if you had to choose which of these two bridges you want to go over, it's not even close.

So I think it's important and maybe at our next meeting, Steve, to think about how we can just do a side-by-side. Start with the foundation and working all the way through, so people can see that this is so much better, we'll be so much better off, even though it cost a lot of money. And I do want to reiterate what you said, because I think it's right. We just need to guarantee the public when we... we're going to give them the best product we can possibly give them. When this bridge opens, it's going to be the best it can be and stop... and, you know, the more we say that and when we have more hearings like this with the public getting their answers to questions, their confidence will come. So thank you.

CHAIR REIN WORTH: Thank you. Commissioner Halsted and then Commissioner Tissier.

COMMISSIONER ANNE HALSTED: Quickly, I do think the specific and detailed responses to all the issues that have come up have been incredibly helpful and I wish I were quicker at understanding them. I think your presentation has been much understandable to me today and the diagrams clearer, etc., so I thank you very much for that. One question I have is on Slide 34 which compares the Bay Bridge seismic criteria with other standards. I wonder whether... I doubt that I could explain that slide to anyone, and I'm wondering whether the public can understand that, as well. What does that mean to our situation right now? Can you explain what those numbers mean and where we would stand on those seismic standards? I assume the standards apply to every process we go through, but is there an overall resulting standard that is... comes from that?

DOUGHERTY [?]: What these three curves do, they... Each curve characterizes the way the ground can move in a large event and how different... different structures would be designed to address those motions.

The bottom one, if you were building a building in San Francisco, that's what you design to, that's a 500-year return period motions, and the ground moves at a certain level. And the vertical axis—if you want to explain it to somebody else somewhat numerically—the vertical axis, that is ground acceleration, so it's how the ground moves and accelerates.

COMMISSIONER HALSTED: So would that relate to the scale of the earthquake?

DOUGHERTY [?]: You can tie it to that, indirectly. That's right, the larger... the higher you go up on that vertical axis, the more violent the ground-shaking is, and you have to design for that. So the picture here is the 1,500-year motions that we designed the Bay Bridge for—okay?— we designed this bridge for more violent shaking than you would a brand new building in the Bay Area and you would any other brand new bridge that you built here in California.

COMMISSIONER HALSTED: So does that mean with the current errors that have occurred, we'll be able to correct them sufficiently to return to that standard?

DOUGHERTY [?]: I'm sorry, could you repeat that?

COMMISSIONER HALSTED: With the failures that have occurred in the bolts, etc., will we correct them sufficiently to return to that standard?

DOUGHERTY [?]: That is an excellent question. I should have mentioned that earlier. The retrofit of the 2008 bolts, one of our fundamental design requirements of that retrofit—and we have a model in the other room that you could look at—it absolutely must meet the original criteria. There is no compromise between the solution where we had the original 2008 bolts—now those bolts are out; now we have the saddle system, the steel saddle system—it meets all of that same criteria. There was no compromise in the design.

COMMISSIONER HALSTED: With the same... obviously, the same should apply to other issues raised.

DOUGHERTY [?]: Absolutely, yes. That's a really good question, thanks.

COMMISSIONER HALSTED: Okay, thank you.

CHAIR REIN WORTH: Thank you. Commissioner Tissier.

COMMISSIONER ADRIENNE TISSIER: I'm going to keep this brief, but I do appreciate hearing what some of these challenges were. You know, the last thing you want to hear is having a phone call at 7 a.m. saying, 'Have you opened the *Chronicle* this morning?' and seeing yet another issue arise. And I do think that it's important that, as these challenges do hit, I sure would like to hear about them before I read about them. And I guess the concern I have as we move forward is as you respond to these challenges and you try to come up with a fix for the challenges that may create even more challenges, one because you may get differing opinions of how best to fix it. And so I do think that, you know, there may come times with other experts that, yes, we hear them, yes, we listen, but we agree to disagree on how we're going to address it, and I think we need to say that. You know, we may not agree with some of the things these individuals have said in the newspaper, or we may agree with them and want to sit down and talk it through. But I do think we need, as we said earlier, the responses to these allegations, because if not, it looks like, 'Well, they're right, we're wrong. Now, what do we do?' And yet that's another challenge.

So like I said, I do know it's a complex project and challenges happen. I guess what I'm sort of curious about is this project more unique to challenges than other bridges that have been built in the recent past, like the Carquinez and others, or is it just that at those times when we hit a challenge, we fixed it, and, you know, we didn't read it in the newspaper every other day?

HEMINGER: You know, my sense of it, Commissioner, and Brian Maroney is the guy who has run it through all these projects, but we have lots of challenges on Carquinez, on the foundations, on Benicia. Benicia was, Andy can tell you, the real problem child. But the Bay Bridge is the Bay Bridge. I mean, that location and this design... which is just asking for

it—right?—because it's a glamour puss. It's an iconic bridge. I think it's just going to attract the level of attention, and it's attracted controversy from the day we selected it.

And, look, I do apologize to you for the fact that you are reading things in the newspapers. In many cases, you're reading about issues that were settled years ago, in our opinion. You'll recall that we give you these monthly reports. Not every one of these issues has been in these reports, but as Commissioner Mackenzie recalled, I mean a few of them have and we've dealt with them. And I have to say, we actually debated among ourselves how many of these challenges we wanted to cover today, and I think you're sort of validating that we made the right decision and maybe we should... You've got an appetite for more, we'll show you some more of them.

COMMISSIONER TISSIER: And just one last comment. You know, obviously, we've talked about having to expedite certain things to repair things and with the bolts and all. You've got these things that we need to... A+B+C will get us where we need to be to be able to make a decision on July 10<sup>th</sup>. And I guess the one thing I would say is I hope we don't use the word 'expedite,' because I really think this completion of the investigative report needs to be done in, obviously, a very thoughtful way. So I don't want us to feel like we have to be rushed to have it done by July 10<sup>th</sup>. If it needs more time to be sure we're thorough, then we need to do that. And I know we keep throwing out Labor Day as the be-all/end-all, but you know I do think because we have challenges with the public's confidence, I don't want to give the impression that we're rushing to meet a date. You know, if it takes longer to do that... you know, human beings only have so many hours in a day and can only do so many things. And you're all doing so much work and so much heavy lifting, that at some point maybe this is an impossible date to try to be able to come back with this information. So I'm not trying to get you off the hook, so you get to go lay in the hammock tomorrow, but it begs the question of, you know, how fast, how furious, and should we be more realistic in the time we need to take to make sure it's safe that the public feels confident that we're not using that date as sort of that goal line that we have to get to. So I just... and I know you said it repeatedly, 'Safety is number one,' but I still feel we keep throwing that date out as if that's the field goal. And I think when I talk to people in the



public, it's like, 'Well, do we have to get to that date?' And I said, 'We're not going to get to that date.' But they think that's the date we're trying to get to, which we are because we say it all the time. So that doesn't give them a lot of confidence, from what I've heard.

HEMINGER: Commissioner, I do appreciate the comment. I don't think Brian has ever been in a hammock in his life probably, but I have. The date, as I mentioned earlier, we have been driving at since 2010. And as you well know, this bridge we are not rushing. We are like years late on delivering this bridge, because of lots of delays that happened for lots of other reasons. So we do feel a strong imperative to try to finish the project as quickly as we can, but you're also absolutely right. And, as I said earlier, the public confidence that we need to restore when we open this bridge is almost equally important to the engineering questions we've got or resolve, because, we're not building this bridge to make the engineers happy. We're building this bridge to get people safely across it. And people have to have confidence in that, and they've got to feel like they've got their value for money, as well. So, look, if we can't make it, we're not going to make it. And I didn't mean to undersell it. As you said, it's A+B+C. It's all three of them. Any one of them, if they're delayed, we don't make it and we come back to you.

Now, there is a consequence to that. Labor Day is a good day for a lot of reasons, as I mentioned. And you slip a lot past Labor Day, you get into bad weather, you get into the holidays, and you're maybe looking at a multi-month delay. And I've got to tell you, personally, the thing I fear the most is if we lose this date, are we going to get another one back? Because, look, this is the Bay Area, this project has a pedigree where it seems like every time there's a chance for it to go off the rails, it will. And so if we can meet that glide path, we're going to try like heck to meet it, but we're very close on time now. And we're mindful of that, and I appreciate your acknowledgement of that.

DOUGHERTY [?]: And if I could add, I also appreciate the comments. Thank you, Commissioner Tissier. The magical thing about Labor Day to me is that for the past couple of years has been the point in time that is the earliest opportunity to move the traveling public off the old bridge onto the

new bridge. And if we can still do that safely, that's what we want to do because that is the earliest point in time that we have identified that we can do that. And if we can't, we won't.

CHAIR REIN WORTH: Okay, thank you. Thank you very much for all the commissioners' questions and the staff report.

I'd like to now turn to public comment on this item. I have four speakers. The first one is Joyce Roy. There she is.

JOYCE ROY: My name is Joyce Roy. I hope you had a chance to read my opinion pieces that were in the *Tribune* and the *Contra Costa Times*. You know, one engages engineers not simply to design a safe structure, but to design an efficient, cost-effective structure. That should have been the program if one really believed that the present bridge would not survive another earthquake. But that was not the program. The program became a design a one-of-a-kind signature bridge, a very complicated, challenging bridge which would, oh, by the way, we would also make it seismically safe. That was the big mistake. And at that time, it seems like the engineers should have been able to do a better estimate of what the cost when they knew it was going to be a complicated, challenging bridge, what the cost and what the time was and give it... and that would have been a second chance to make a rational decision.

Now, this bridge is a Bay Area lifeline, but the public are opening their newspapers everyday and finding a new problem have little confidence in this bridge. And we keep hearing how the old bridge is so unsafe. But you have gotten this iconic bridge there that's taken mucho years. It can't be that unsafe. In fact, when it had a failure in the Loma Prima Earthquake, it took only one month to repair it. Now, there's probably going to be repair to any bridge that has a very big earthquake. Now, that took only one month. So this, instead of spending \$240 million to demolish this, leave it up not for use of cars—make it a barrier that they can't get onto cars—but for bicyclists, for pedestrians, particularly the top level would be attractive and so that if the next earthquake comes and the new Bay Bridge does fine or could be repaired quickly, then you can remove this safety net. But I really think you really need to keep that up, you know. Thank you.

CHAIR REIN WORTH: Thank you. Thank you for your comments. Our next speaker is Rick Hunter. And he will be followed by Leal Charnot.

RICK HUNTER: Thank you, ladies and gentlemen. Am I speaking? When called for an architect and a structural engineer usually work hand-in-glove as a team. The architect does designing and the structural engineer does the specs. At first, I have four questions and maybe address primarily to Dr. Brian Maroney. In this bridge, T.Y. Lin and Caltrans, who did the specs for the materials, for example, these failed bolts? Question number 2, what's the design spec of the load capacity per linear foot for the west suspension span, the SAS span and the skyway span? How do they compare? Are they the same? Some of them are higher than others, or some of them are lesser than others? Question number 3, similarly, what will be the factor of safety for these three different types of bridges in this Oakland... San Francisco-Oakland Bridge, the west span, the SAS span and the skyway span? Question number 4, worst-case scenario, with the space shuttle failure in mind that through maybe metal fatigue, seismic stress, sudden impulse impact, or shock that the SAS stack weld fails, would the main cable, in effect—and I underline 'in effect'—still be secured indirectly to Pier E2 through the bearing assembly and shear keys? That is, will they be able to take on this extra role or function successfully in such a potentially possible event? And years ago, I've been forming this bridge design diligently and I did ask Dr. Maroney about whether that's been... this very unique design, was there a study done as to the critical point, what part of the unique design has a critical point? All designs have critical points. And to follow up that would be, the critical point failure analysis, has that been done? And Dr. Maroney, you assured me that it has been done and I can go to the Caltrans office to get it. No one could find it for me. And you said when it's scattered throughout all the departments. When eventually you get it together, I'll get to see a copy. To today, I've not seen it yet. And in my limited knowledge, it would seem to me that the critical point in the SAS stack is that Panel Point number 95, maybe including Panel Point 109. When it fails, what happens? This has never been addressed, and you continue emphasizing of safety, safety, safety. I think you need to be responsible for this. Thank you very much.

CHAIR REIN WORTH: Thank you very much for your comments. And our next speaker is...

RICK HUNTER: I need some answers.

CHAIR REIN WORTH: Yeah. We're... we will take those questions, as soon as we finish all the public comment. The next speaker is Leal Charonot? I hope I got that...

LEAL CHARONOT: Close.

CHAIR REIN WORTH: Close.

LEAL CHARONOT: It's Leal Charonot. Yeah, I have to... full disclosure. Actually, Prez, my hairdresser, is the reason that I came up with the one-word answer solution to the Bay Bridge right now is 'Craig's List,' because I was trying to explain.... She asked me, 'What's the problem there?' And I was explaining it, and I said, 'You know, if there weren't earthquakes, because that's... it's all the earthquake forces, and there wasn't salt water, it would be a great place.' And I asked for the slide of the railing, if it could be shown up. And, yeah, I have also... I'm not a fan of this particular design. I think they've been doing a great job dealing with it, because this is mud flats. And the best example of a bridge here—and they did a great job—is that new Benicia-Martinez Bridge. If you drive over, it's a segmented bridge and you don't get to see it when you're on it. You have to be on the old one to see it, or even from a distance, but that is a bridge, all concrete, low maintenance, skips across the water.

Some serious advice for the Committee here, and that is you have \$240 million that somewhere is budgeted for the old bridge. You have to immediately spend that money on the old bridge and base-isolate it. Mayor Quan here has an office here and, also, the San Francisco City Hall. Both of those are steel structure buildings that were of the same era as the old Bay Bridge. They would not be able to survive an earthquake. But with base-isolation, they do. You need to take that money and base-isolate the bridge. This bridge, the myriad of problems it has is really amazing. If you could put up the slide on the screen of the railing, if you look at that slide of the

railing or look at the picture there, you'll notice that it was carefully explained to us that there was an expansion joint there. If you look at the railing, it then is spanning over that joint, but right next to it is a gap. What you would want to do is just put the gap there.

So somehow I think it's in the genetic make-up of this bridge that, you know, maybe things are that way. A weld four inches thick, that's 30-feet tall... I attended a lecture that was given at UC Berkeley a year after the Loma Prieta Earthquake. We had Loma Prieta, we had the Northridge, and we had Colby. During those three earthquakes, all about the same time, steel buildings that had been designed based on standard steel construction failed, cracked, shattered. It took the Getty Museum, they secretly hired A&M University to test, and what they discovered was that all the theories that steel buildings were under, designed under, based on 1950's studies, were incorrect, which is why now when you look at buildings under construction, you see those little angles, those little k's [?]. Thank you.

CHAIR REIN WORTH: Thank you very much for your comment. And we have one more speaker. I have Michael Sarabia, and that's the final speaker card that I have.

MICHAEL SARABIA: Thank you.

CHAIR REIN WORTH: Oh, would you please come and give it to our clerk and then she'll pass it forward to me? Thank you. No, please go ahead.

SARABIA: Maybe I should introduce myself. I have three...

CHAIR REIN WORTH: Okay, I think the last... excuse me. Okay. All right, looks like we have one more speaker card and then that will be it. Okay, please, continue, thank you.

SARABIA: Thank you for you allow me to address this most important meeting.

CHAIR REIN WORTH: Excuse me, do you mind speaking into the microphone, so we can hear you? Thank you.

SARABIA: A little bit louder.

CHAIR REIN WORTH: Yes, please.

SARABIA: All right, I can... I can, sure. This most important meeting, but I do not believe I will say anything new to you, so I thank you for your attention.

Question 1: We're the bolts tested in their... up to their destruction load? I never read that. Were the bolts tested for fatigue failure? That's when you put in and out of loads and they fail at the very low level of load? I work in the aircraft industry and I got my three degrees in engineering. I think I know... I'm convinced that I know what I'm talking about. Would you say that there was a communication problem? I'm sure the credentials of the principalities are all in order.

Do you think nobody suspected there could be a bolt problem? I went to the Google, did a search of bolt problems, and they tell me that yesterday one in Fremont failed by a different means of shear, not tension. I didn't get... when I see the geometry of the bolts shear, is a possibility, especially if you have an earthquake that moves one part and not another part.

And the last thing I want to mention before you shut me down, when the Golden Gate had an anniversary, a lot of people went onto the Golden Gate and it... instead of having that curve, that gracious curve, it got flattened, because the cable stretched with the heavy load of people, not trucks, people, not pounding trucks, but people. Now, this one is not going to stretch. If you know that we have earthquakes, I would suggest that you consider all the things that were not considered in the design. For example, what was the safety margin of the bolts? I've never seen it. And in school, freshman class, they taught me that you will... don't design for the full capacity of anything—aluminum or bolts or frames. You pick a safety, like 66%, or something like this. But the fact that the bolts failed means that

that number better be kept a secret because that indicates a degree of failure. Thank you.

CHAIR REIN WORTH: Thank you very much for your comments. And our next speaker is... I'm trying to read the handwriting here. D. Jones, Dalene?

DALENE JONES: That is correct.

CHAIR REIN WORTH: Thank you.

JONES: Madam Worth, thank you, Chairwoman and everyone else on the Transportation Committee. I am Dalene Jones, a former AC Transit bus driver. I retired in 2010. And I would like everyone to know that I was one of the bus drivers in the Loma Prieta Quake on the Bay Bridge with people on the C-route going toward Piedmont. From my perspective, since we're talking about the safety of this bridge, I would want the evacuation for an earthquake on the day of... on this new bridge when you do decide to open it to be part of the plan. Please write that down. Safety, evacuation for the earthquake on the day of, before you even open up the Bay Bridge. Include AC Transit, include Napa buses, Vallejo buses, all of the transit buses that go across the bridge. There should be an evacuation, in case of emergency of an earthquake. We need to come up with a serious plan. That's all I have to add. You have enough problems. Get to it. Nobody is in a hammock. Thank you very much.

CHAIR REIN WORTH: Thank you. Thank you very much, and thank you for your service and thank you for getting those people off the bridge safely. So, thank you. Our final speaker is Bruce Donohoe.

BRUCE DONOHOE: Thank you for the opportunity to come before you and thank you for listening. Today, as the experts described the tendon problem, I kept saying to myself, 'Well, that's the key component of the bridge, my God.' The *Chronicle* has said that the specifications called for the tendons to be grouted within 10 days, and then the *Chronicle* went on to say that if they were installed beyond that, special drying additives would be added to the grout and it should be done within 30 days. The *Chronicle*



concluded that it was 17 months before the grouting was accomplished. And so the engineer expertly has gone ahead and said that they have analyzed... I don't know how they got to the tendons, because I think they're grouted, but they've analyzed the tendons and they have come up with a factor of safety in terms of the calculations. Well, that all makes great sense, but I don't think anyone... or maybe I didn't hear it, said today that the corrosion is an ongoing issue. In other words, my car is corroded, bolts are corroded, things around my house corrode. They never addressed the long-term corrosion issue and I don't think they've come up with a test that would restore the public confidence in these tendons. When I first read the story, the *Chronicle* was rather expert at saying the bridge is going to fall down, that these are old issues according to the spokesman, these are within the stress design limits. But the hundred years that is going to... the bridge has to service, it would seem that the corrosion has not been dried out or isolated or even commented on. Is it the type of corrosion that will continue after years and years? It's the same issue with the bolts at the base of the tower. The *Chronicle* reported that they were... and one of your questions, I guess, to these people in writing, I learned today, was that... were they pickled or were they actually treated in a different way? The *Chronicle* said there was a problem in the specifications and then it said, 'Well, no, the fellow never really understood. You've asked a good question and it seems correct.'

The speaker before me obviously had some expertise in stress and he... what he tried to say and what I think he said adamantly was that there's combination stresses. There's shear stresses, principal stresses, tension stresses. The people here have suppressed any idea that fatigue or any other frequency idea, the live load idea or the vibration idea, as one of your commissioner said, has any impact on the failure of these bolts. But I think if you asked the aircraft engineer, he would say that, 'Yes, the vibrations, plus the pretension load are always considered.' There's not been any public disclosure of what's going to happen when the vibrations hit the bridge. Are we going to wake up and say, 'Oh, it failed because of vibrations. It's a new problem we have to handle.'

Thank you for your time and I appreciate it.

CHAIR REIN WORTH: Thank you very much for your comments. That completes the public comment. I just want to return it back to the Commission to, first of all, ask if staff would like to offer any responses to the questions now or take those questions under submission and then provide an answer to those, certainly, either in the course of the report or separately. And I'll turn to our executive director.

HEMINGER: In the interest of time, we would prefer the latter.

CHAIR REIN WORTH: Okay, that sounds fine. Then are there any other comments or questions from the Commission?

Well, then with that, again, I want to express on behalf of all the commissioners, our deep appreciation for all of you being here, to the commissioners who came, you know, who are here today with your questions and participating. And thank you, again, recognizing this was a special meeting that we called, and I, again, thank everyone for attendance. The meeting is adjourned. Thank you.