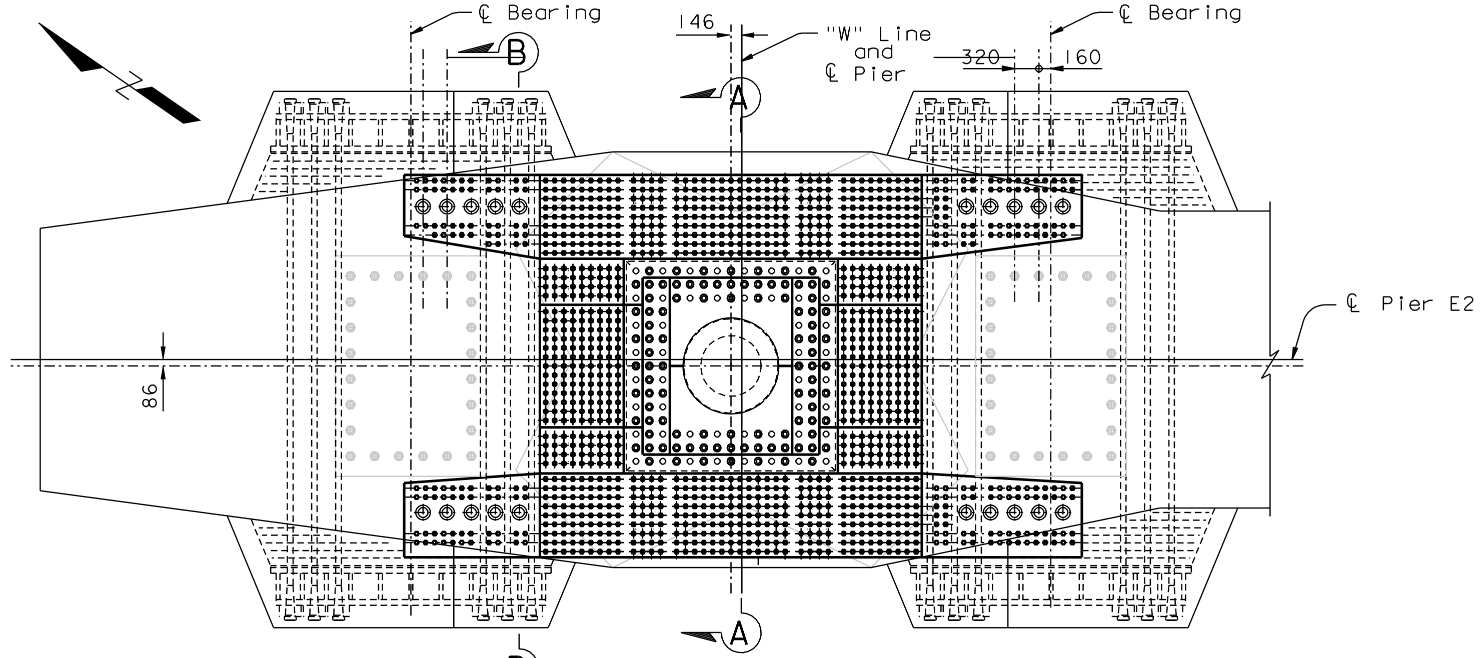
TOLL BRIDGE PROGRAM OVERSIGHT COMMITTEE

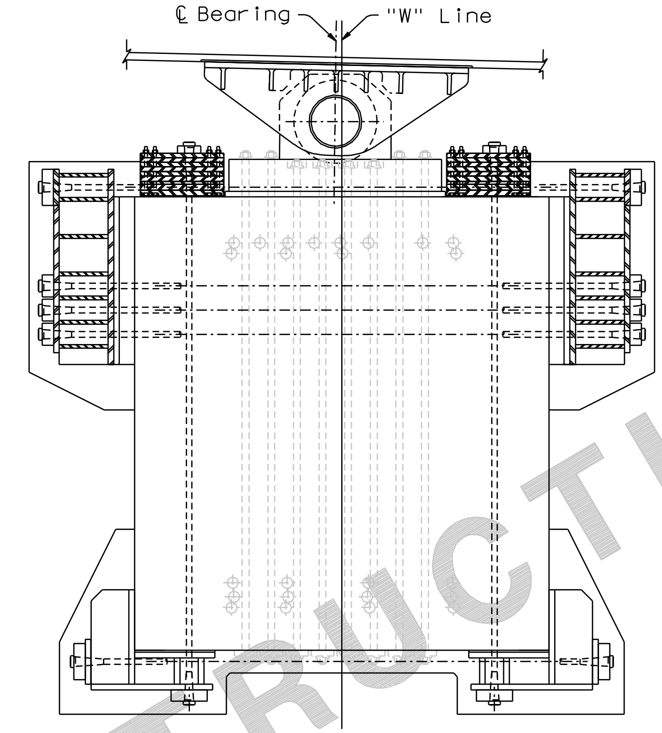
Final Agenda

TBPOC MEETING
May 1, 2013, 2:00pm – 5:00pm
Director's Conference Room, 1120 N Street
Sacramento, CA

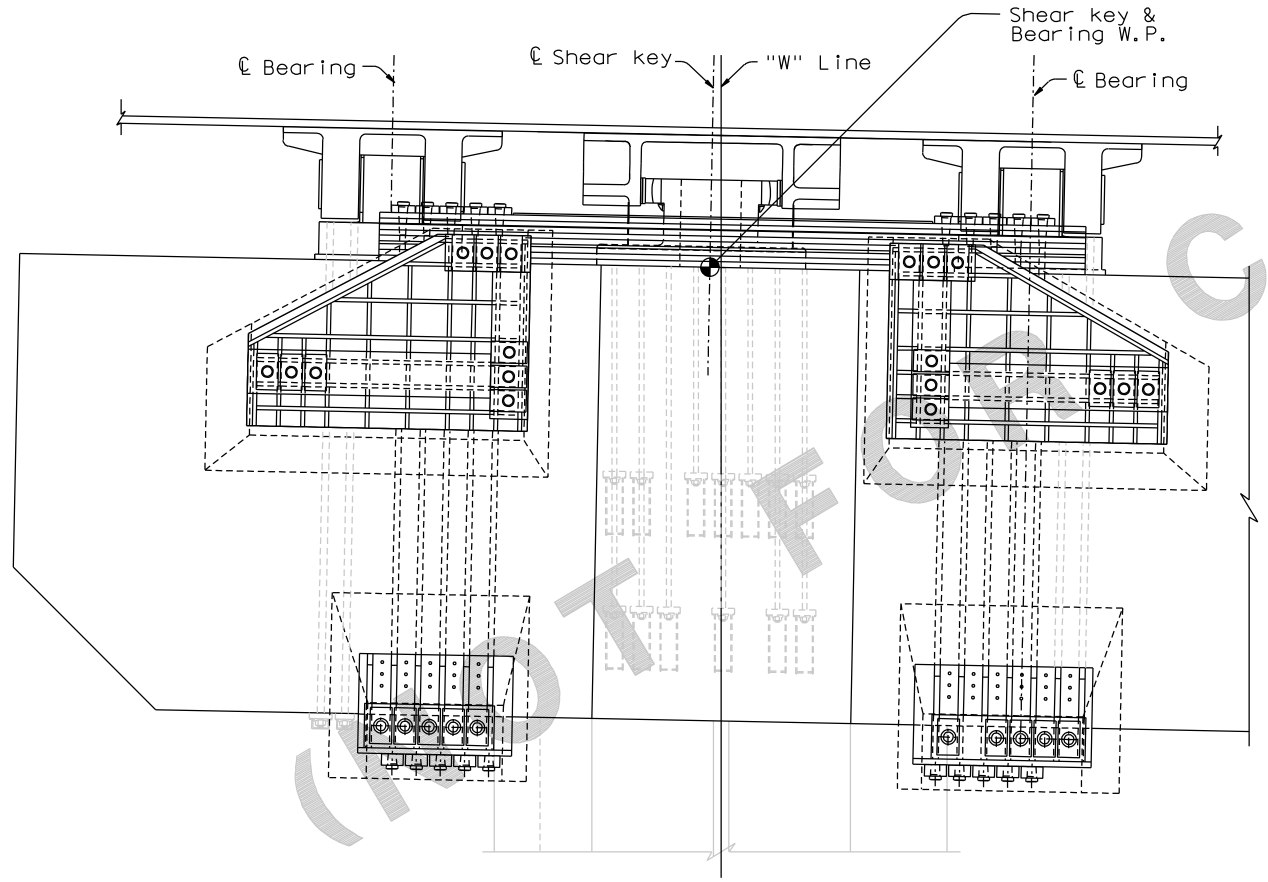
Topic	Presenter	Time	Desired Outcome
1. CHAIR'S REPORT	S. Heminger, BATA		Information
2. PROGRESS REPORTS a. 2013 First Quarter Project Progress and Financial Update *	A. Fremier, BATA	5 min	Approval
3. SAN FRANCISCO-OAKLAND BAY BRIDGE UPDATES a. Status Update on Anchor Rods 1) Retrofit strategy for 2008 rods – scope/ schedule/ budget, with PMT recommendation 2) Replacement strategy, if necessary, for 2010 rods 3) Additional inspection or testing of other SAS rods 4) History of the rods and design selection 5) Bidder inquires, per original and 2nd bids 6) Bridge opening LDW, per answers to Q1-Q5	PMT	3.0 hr	Information
4. OTHER BUSINESS			
Next TBPOC Meeting: May 9, 2013, 1:00pm – 4:00pm **1120 N Street, Sacramento, CA**			



PLAN VIEW
1:50



SECTION B-B
1:50



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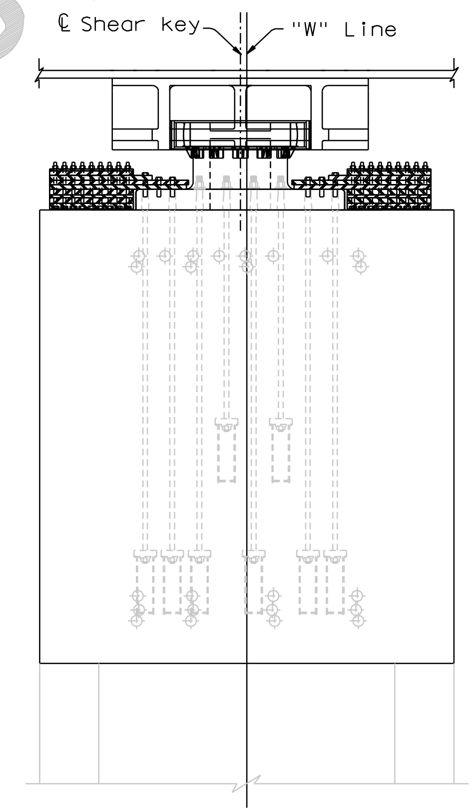

SECTION A-A
1:50

ALTERNATIVE BD(2)

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF	80	13.2/13.9	XXX	1204

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PROGRESS ISSUE: 30 APR 2013

GENERAL NOTES:

1. Design: CalTrans Bridge Design Specification and AASHTO Guide Specifications for LRFD Seismic Design, 2nd edition.
2. Scales: The scales shown on the plans are not applicable to reduced size prints. Divide the scales by 2 for half-sized prints.
3. Existing Conditions: Dimensions shown are taken from original design drawings and are not guaranteed. The Contractor shall determine and establish all dimensions and details necessary for the completion of all work by field measurement and survey.
4. The locations of the vertical PT ducts shall surveyed after coring and the detailing of the plate and the location of the horizontal PT ducts at the top and bottom of the cap beam shall be modified accordingly.
5. Structural Steel: All structural plate shall conform to the requirements of ASTM A 709M Grade 345 unless noted otherwise.
6. Welding: All welding shall comply with the provisions of the AASHTO / AWS Bridge Welding Code (ANSI / AASHTO / AWS D 1.5).
7. All structural steel plates interfaces shall be connected with continuous double-sided partial joint penetration (PJP) welds with an effective size of 15 mm each side, unless noted otherwise.
8. Steel plate interfaces designated as mill-to-bear do not require welding, unless noted otherwise.
9. Bolts: All bolts shall be shall be ASTM A 325M unless noted otherwise. All bolts shall be tensioned using a calibrated turn-of-the-nut metjod. All faying surfaces shall be Class B.
11. All bolts and related hardware shall be Type I galvanized and shall conform to the requirements of AASHTO M 164 unless noted otherwise.
12. Coating: All structural steel and components shall be coated with the project specified epoxy coating system.
13. Post Tensioning: ASTM A416 - Fu = 1860 MPa. All post tensioning shall be jacked to 70% of Fu.
14. Reinforced Concrete: f'c = 55 MPa (Self-consolidating)
15. Mild steel reinforcement shall comply with ASTM A706 - fy = 415 MPa, fu = 738 MPa
16. High Strength Non-Shrink Grout: f'c = 55 MPa

CONTRACT CHANGE ORDER NO. ____
SHEET ____ OF ____

REQUESTS FOR INFORMATION NOT ADDRESSED IN THIS CCO REMAIN IN FORCE

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)
E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-1)

R. Valizadeh/V. Toan/Y.L./W.L./F.C.
DESIGN OVERSIGHT
SIGN OFF DATE XX/XX/13

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REVISIONS

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DESIGN	X. XXXXX	X. XXXXX
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M. Nader
PROJECT ENGINEER

BRIDGE NO.
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13.2/13.9

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 04
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REVISION DATES (PRELIMINARY STAGE ONLY)

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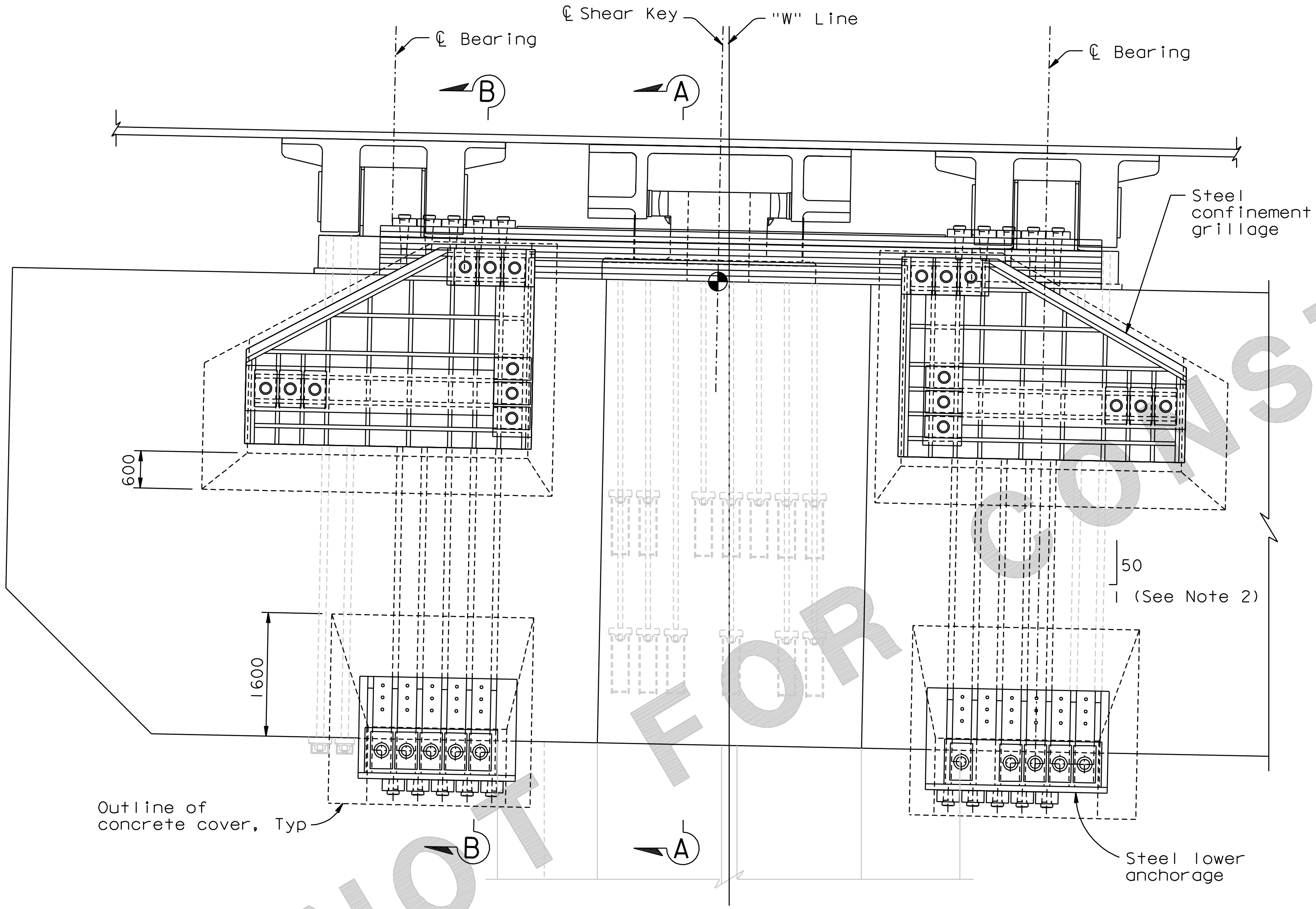
SCOPE OF WORK:

1. Core for PT tendons through Pier E2.
2. Install holding frames.
3. Place bearing concrete for confinement and lower anchorages.
4. Install steel confinement grillages and lower anchorage.
5. Install post tensioning (PT).
6. Tension PT in the following sequence:
   a. Tension PT to 25% Fu starting with all horizontal PT.
   b. Tension PT to 50% Fu starting with all horizontal PT.
   c. Tension PT to final installation tension starting, with all horizontal PT.
7. Install concrete cover.



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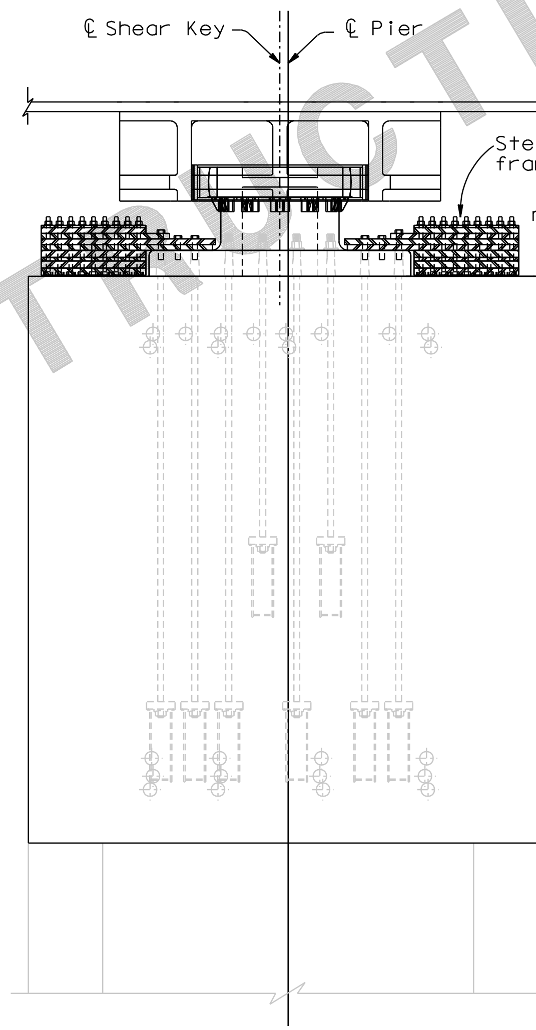
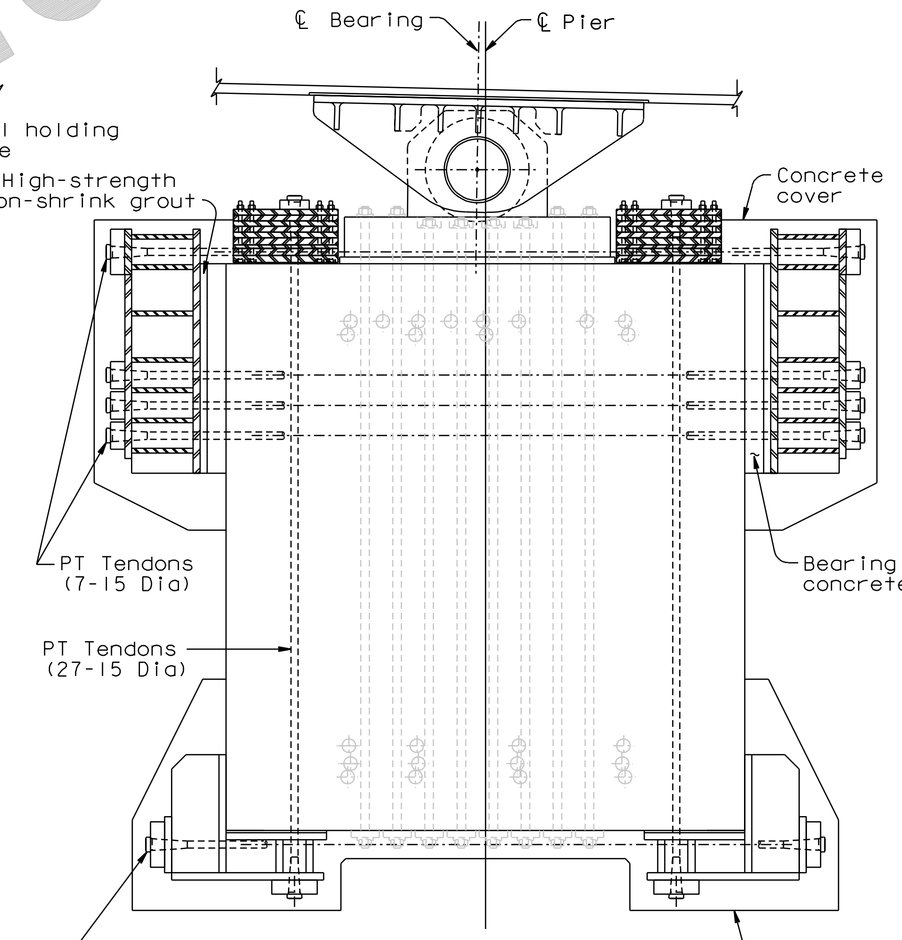


SECTION A-A
1:40



SECTION B-B
1:40

NOTES:

1. For Details 1 & 2, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-3)" sheet.
2. All upright tendons shall be placed parallel to the existing bearing anchor rods.

ALTERNATIVE BD(2)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-2)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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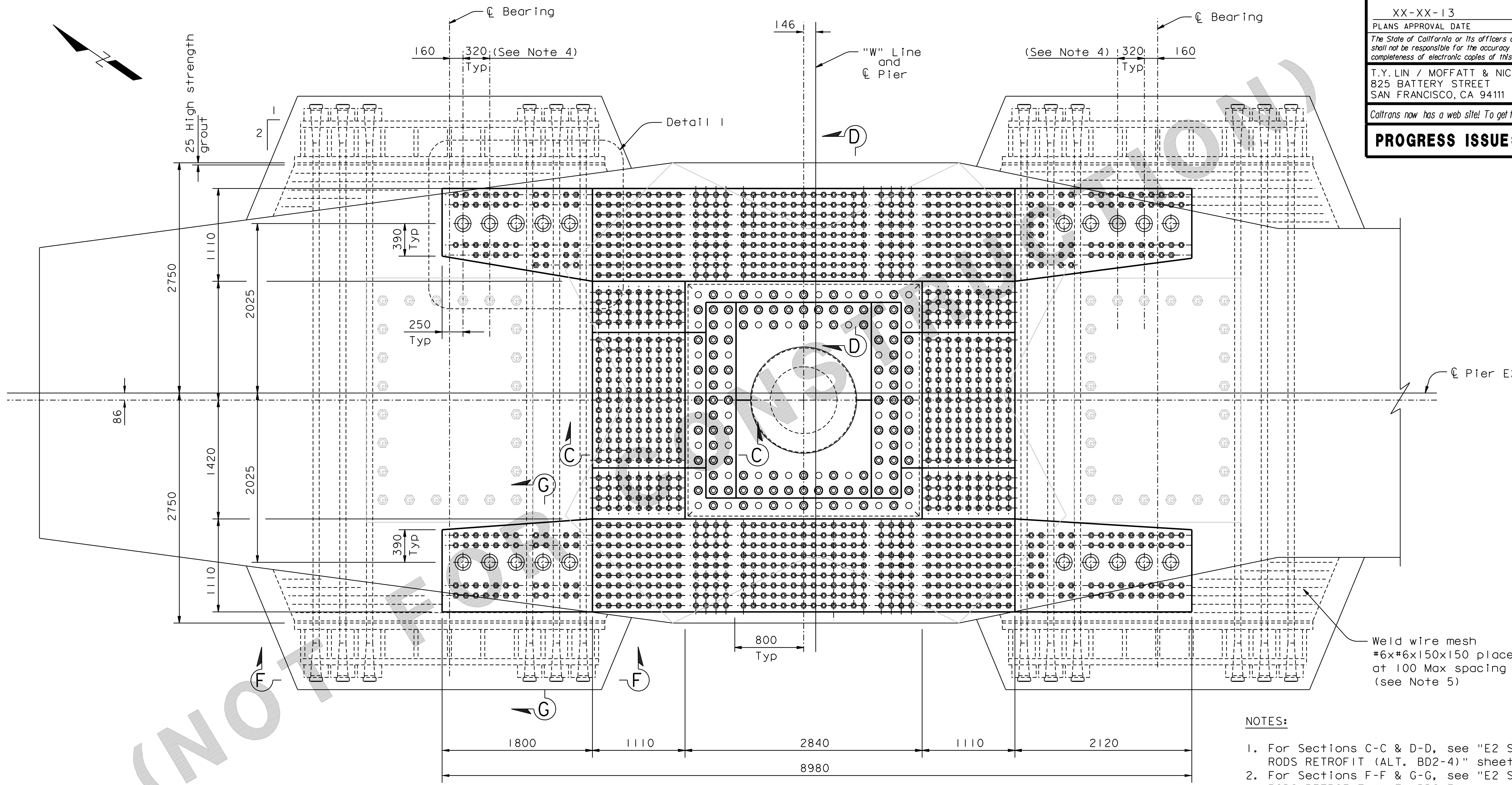

PLAN VIEW

1:25

ALTERNATIVE BD(2)

NOTES:

1. For Sections C-C & D-D, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-4)" sheet.
2. For Sections F-F & G-G, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-7)" sheet.
3. For Detail I, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-5)" sheet.
4. PT tendons shall be placed to align with the as-built locations of the Bearing Anchor rods at the soffit.
5. For other reinformcement details, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-7)" sheet.

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

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E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-3)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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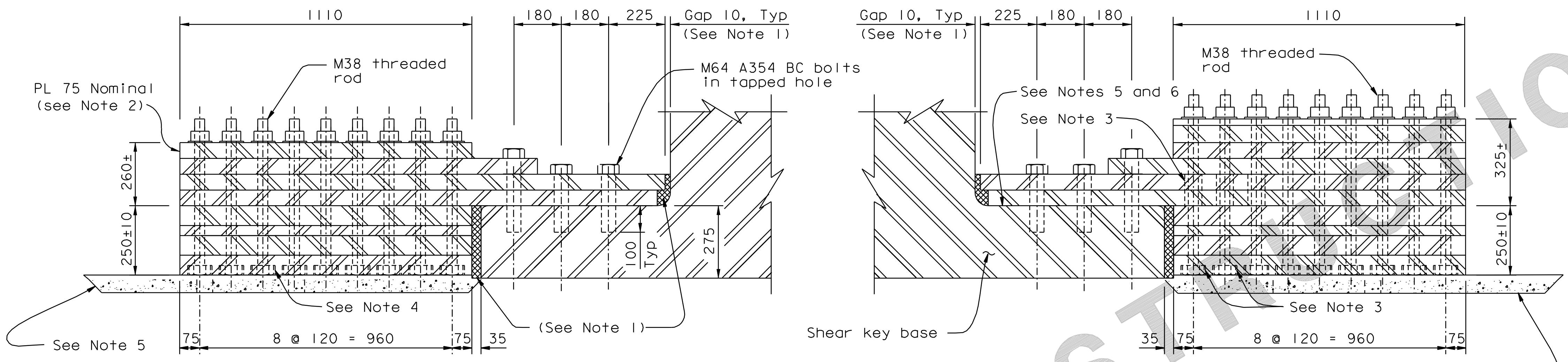

SECTION C-C
1:10

SECTION D-D
1:10

See Note 5

NOTES:

1. Fill gaps between Shear Key Base and Holding Frame with "Chockfast Orange".
2. Plate thickness may vary due to milling. Add additional plates to build up required thickness.
3. Rod couplers required in three rows closest to shear key as shown, East and West sides.
4. Place nuts in counterbore with nut retainer.
5. The Contractor shall remove existing concrete cover and place high-strength non-shrink grout as required to create a level surface at the specified elevation, with the steel plates in tight contact to the Shear key base.
6. Shear key top surface shall be flat within 2 mm and shall have a Class B coating.

ALTERNATIVE BD(2)

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-4)

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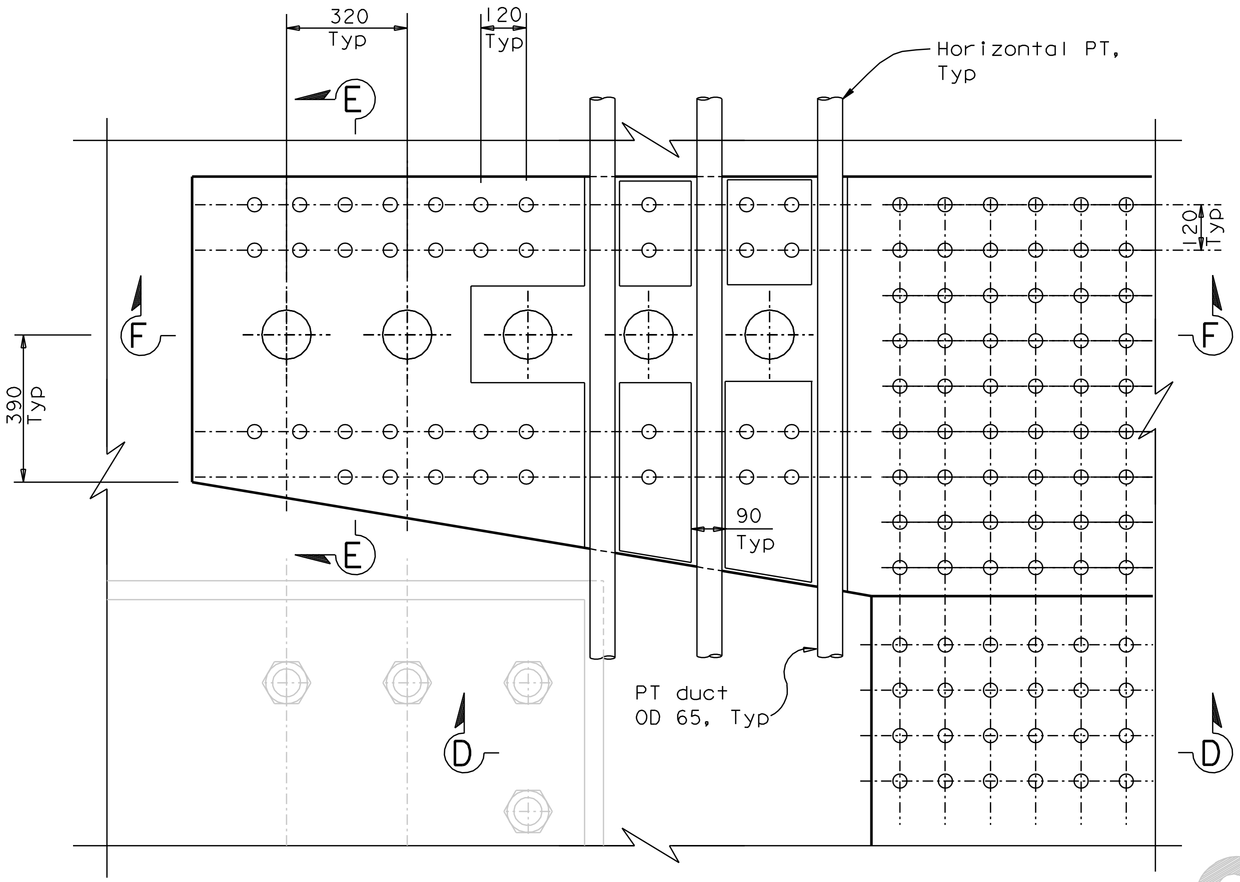
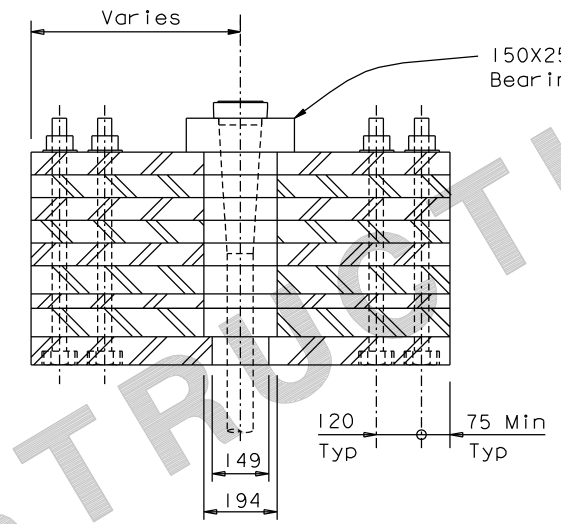
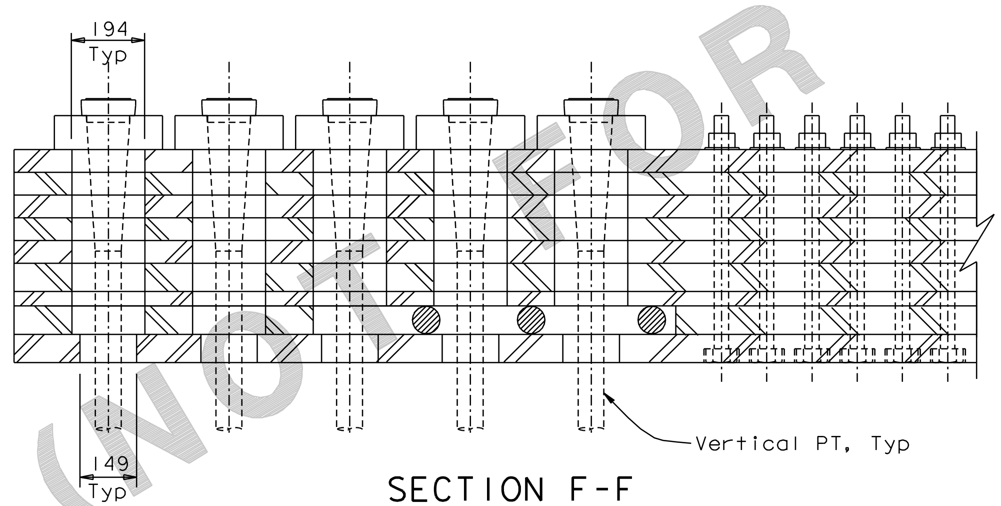


DETAIL I (Layer 2 Shown, See Note 2)
1:10



SECTION E-E
1:10



SECTION F-F
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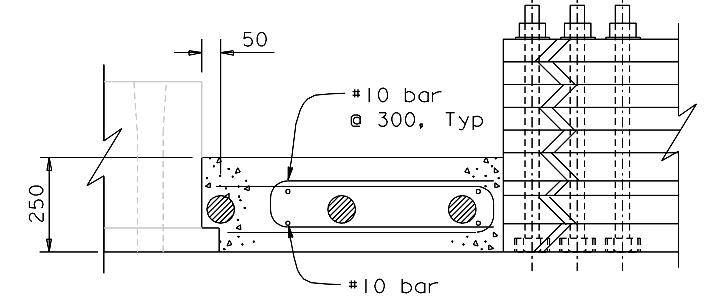

SECTION D-D
1:10

NOTES:

1. Plate thickness may vary due to milling. Add additional plates to build up required thickness.
2. For plate layers, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-6)" SHEET.

ALTERNATIVE BD(2)

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-5)

Rev. Date: 5-18-98

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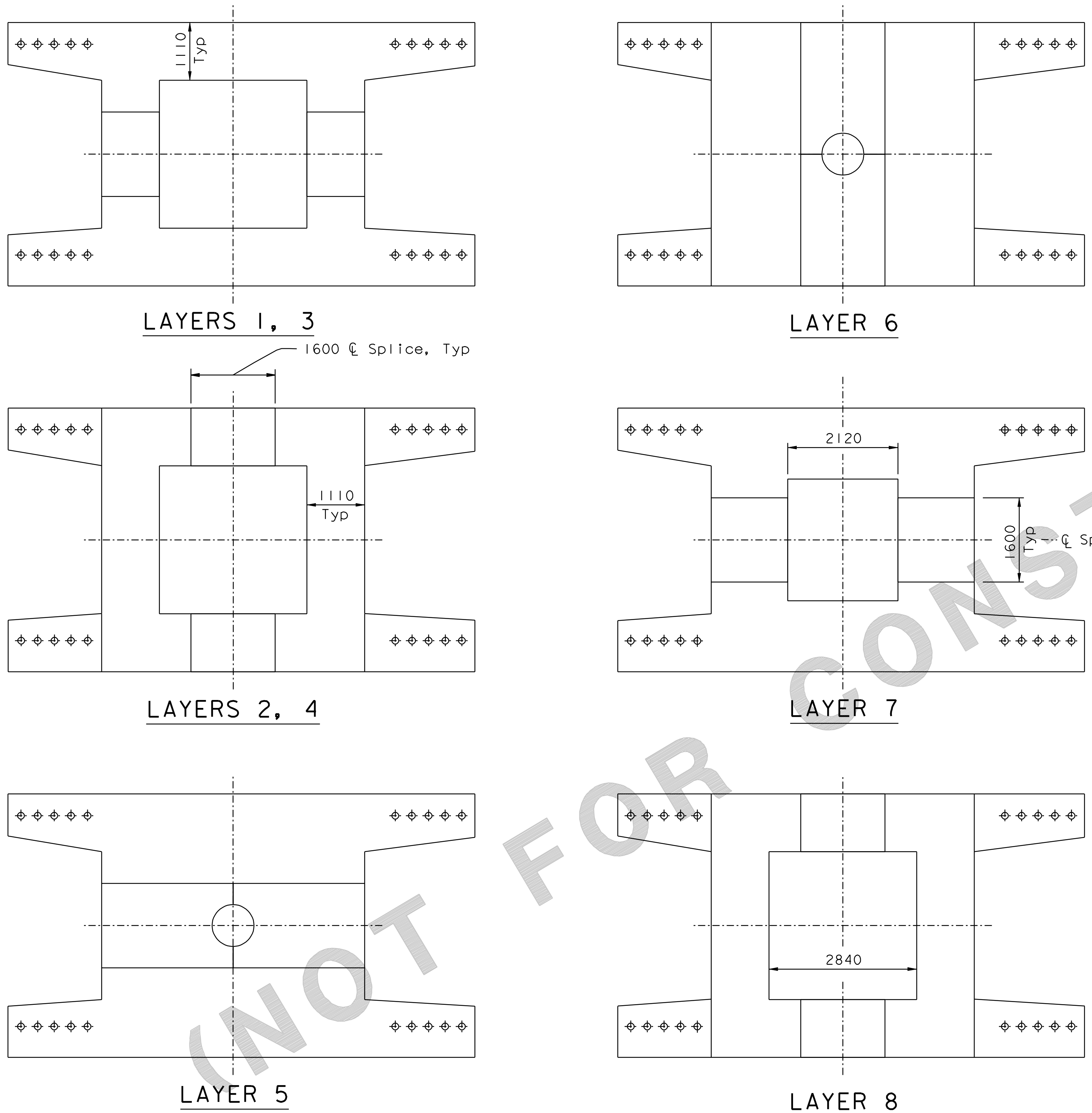


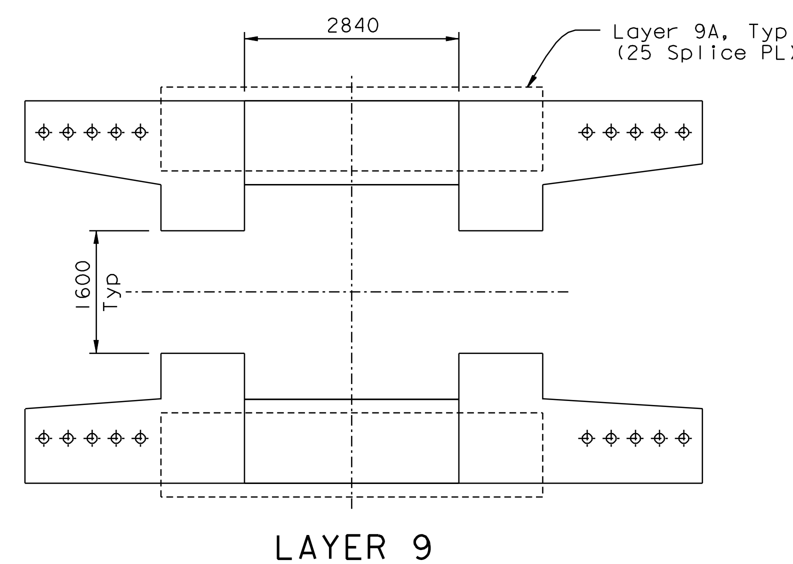
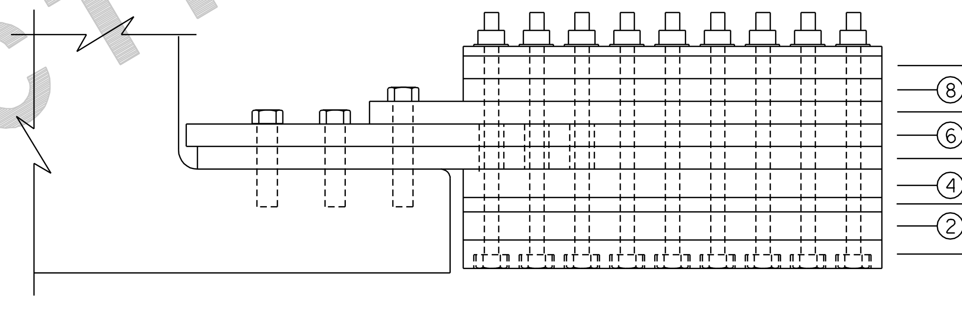


PLATE STACKING LAYERS

NTS



KEY TO LAYERING

NTS

NOTE:

1. Layering is based upon 64 milled plate thickness. The top of Layer 5 shall be placed in tight contact with the top of the Shear Key Base.

ALTERNATIVE BD(2)

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SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-6)

R. Valizadeh/V. Toan/Y.L./W.L./F.C.
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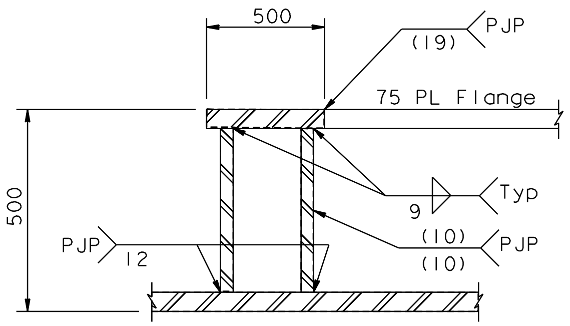
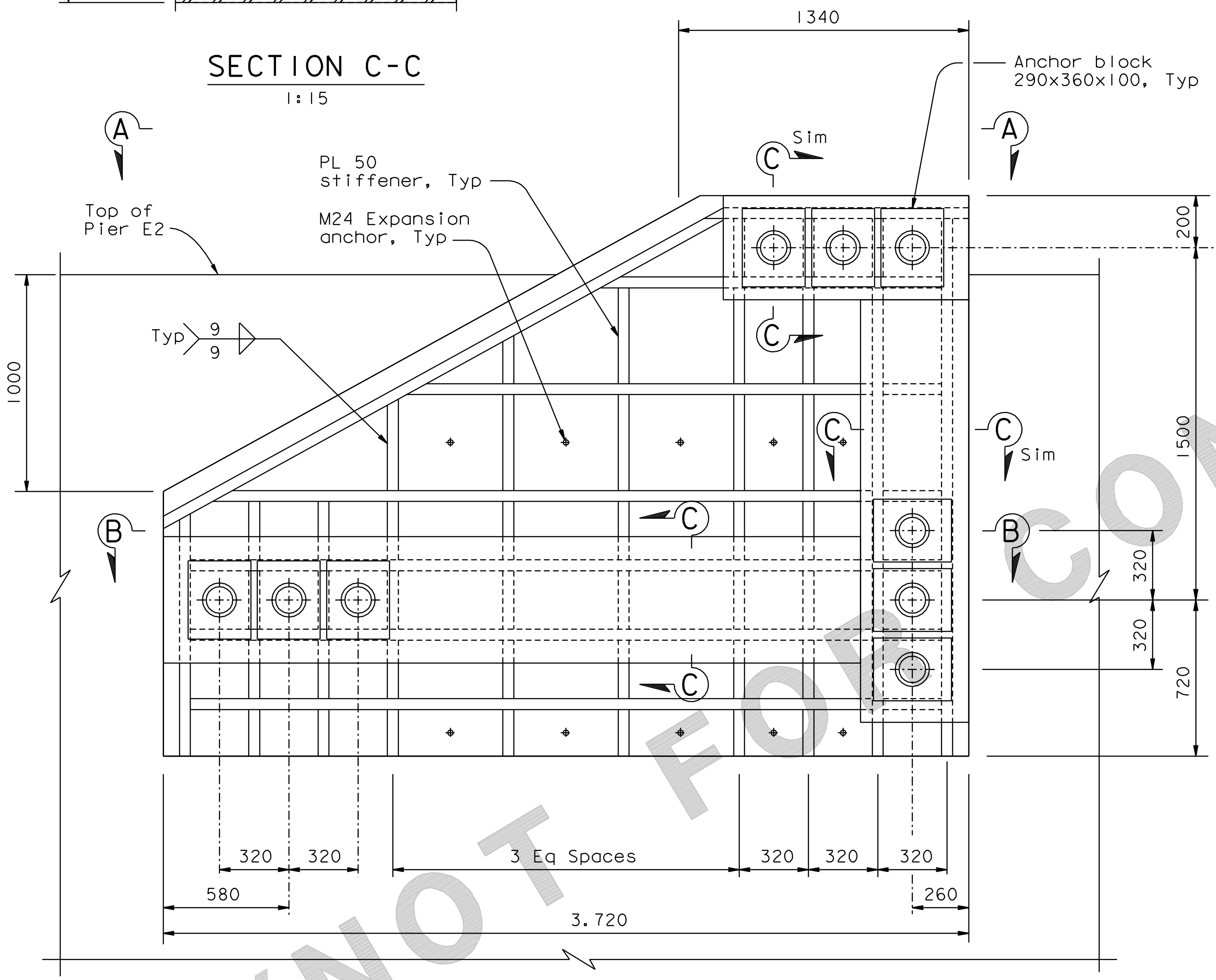


SECTION C-C

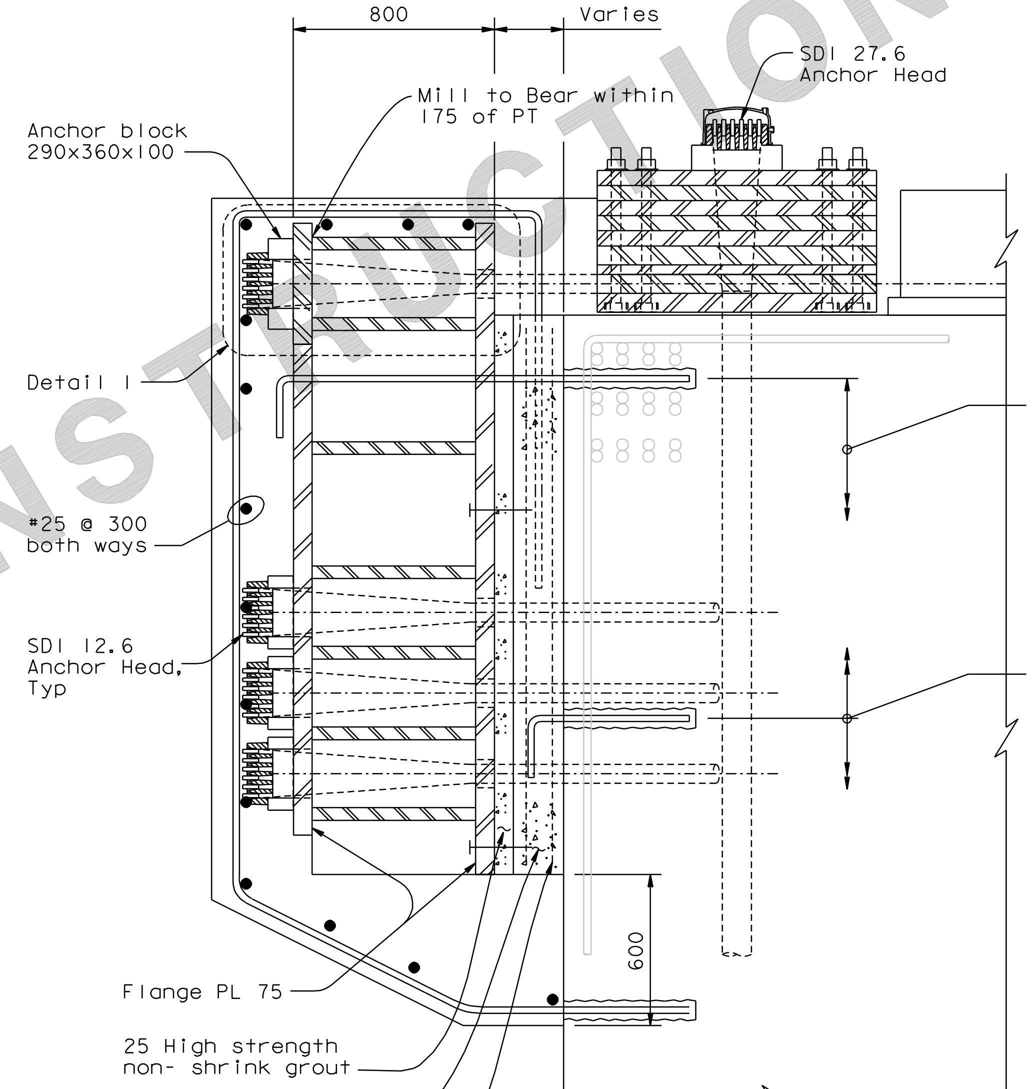
1:15



(TOP CONFINEMENT PLATE)

SECTION F-F

1:15



SECTION G-G

1:15

NOTES:

1. All webs and stiffeners shall be 50 PI, unless noted otherwise.
2. For Detail I, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-8)" sheet.

ALTERNATIVE BD(2)

CONTRACT CHANGE ORDER NO. _____
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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-7)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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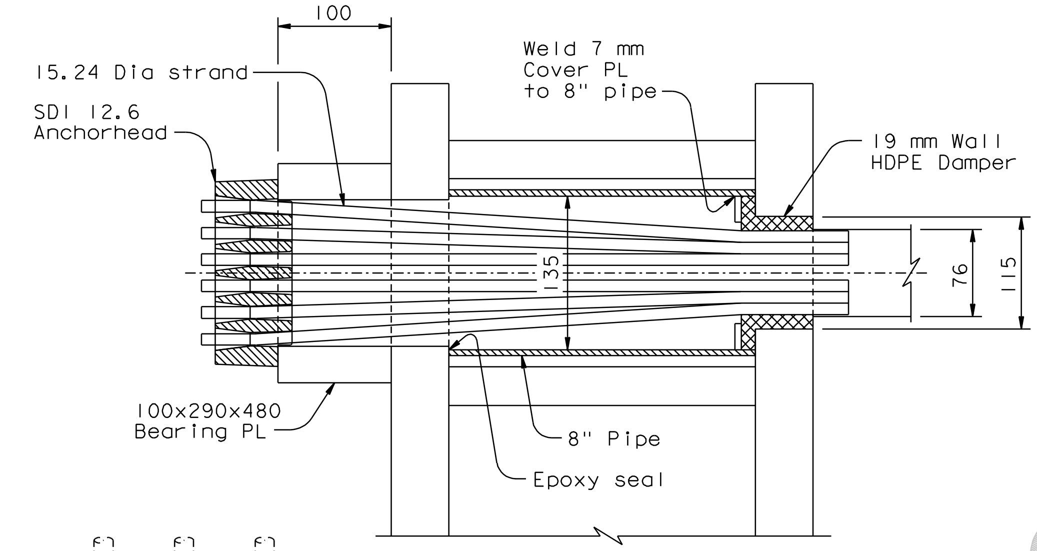

DETAIL 1
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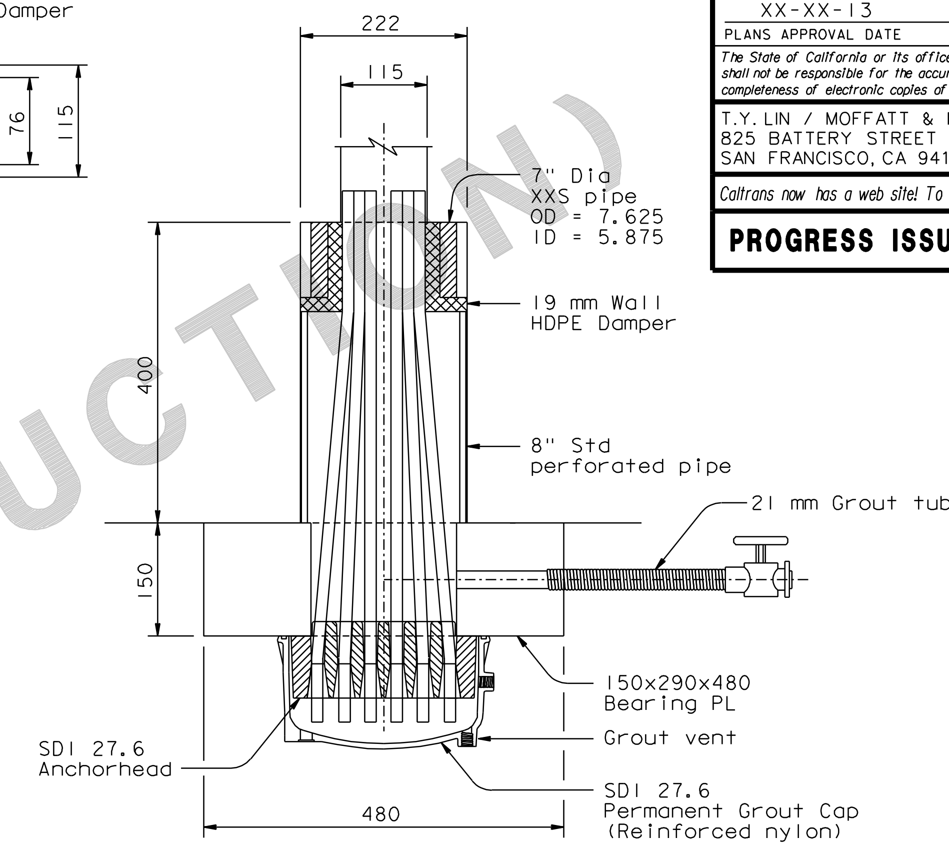

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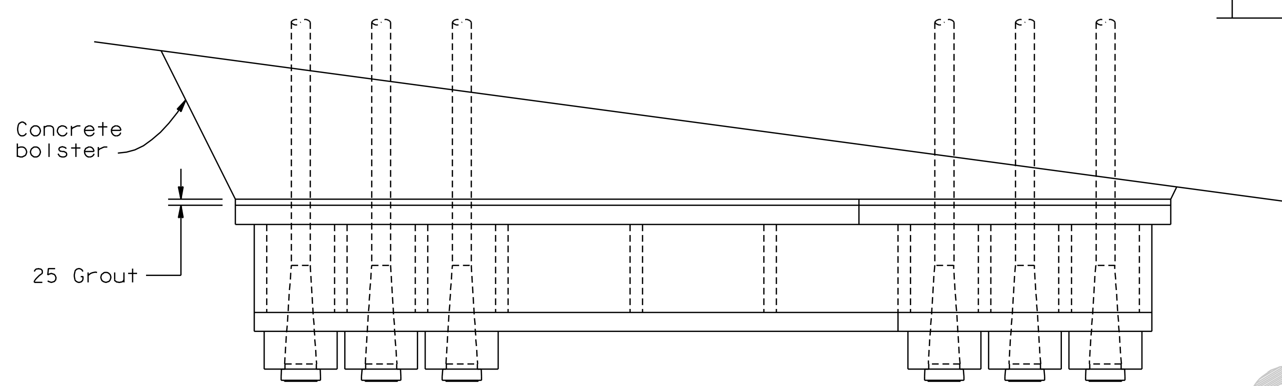
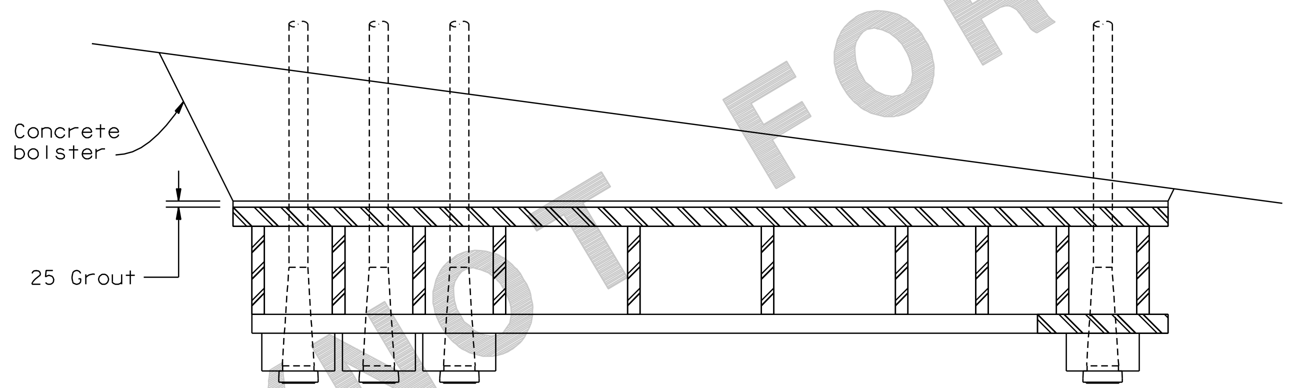


SECTION A-A
1:15



SECTION B-B
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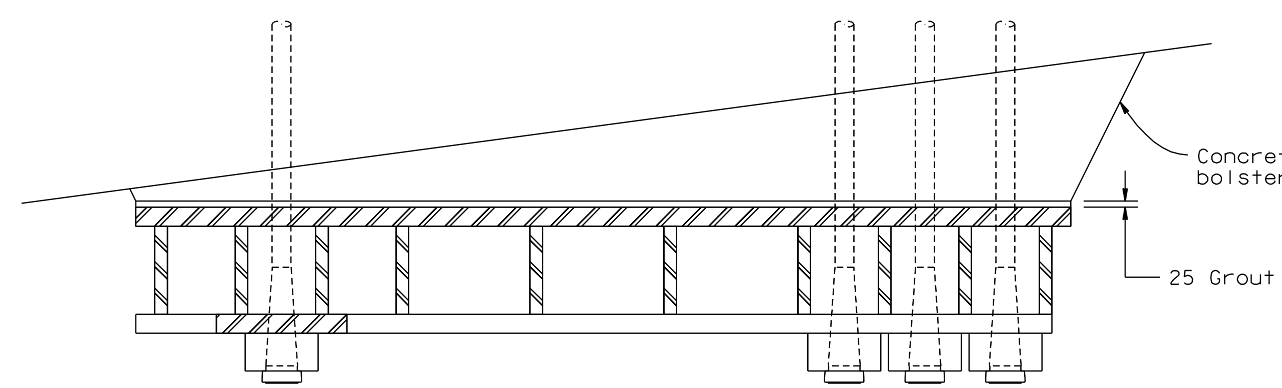

SECTION C-C
1:15

NOTE:

1. For dimensions and welds, see "E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-7)" sheet.

ALTERNATIVE BD(2)

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-8)

Rev. Date: 5-18-98

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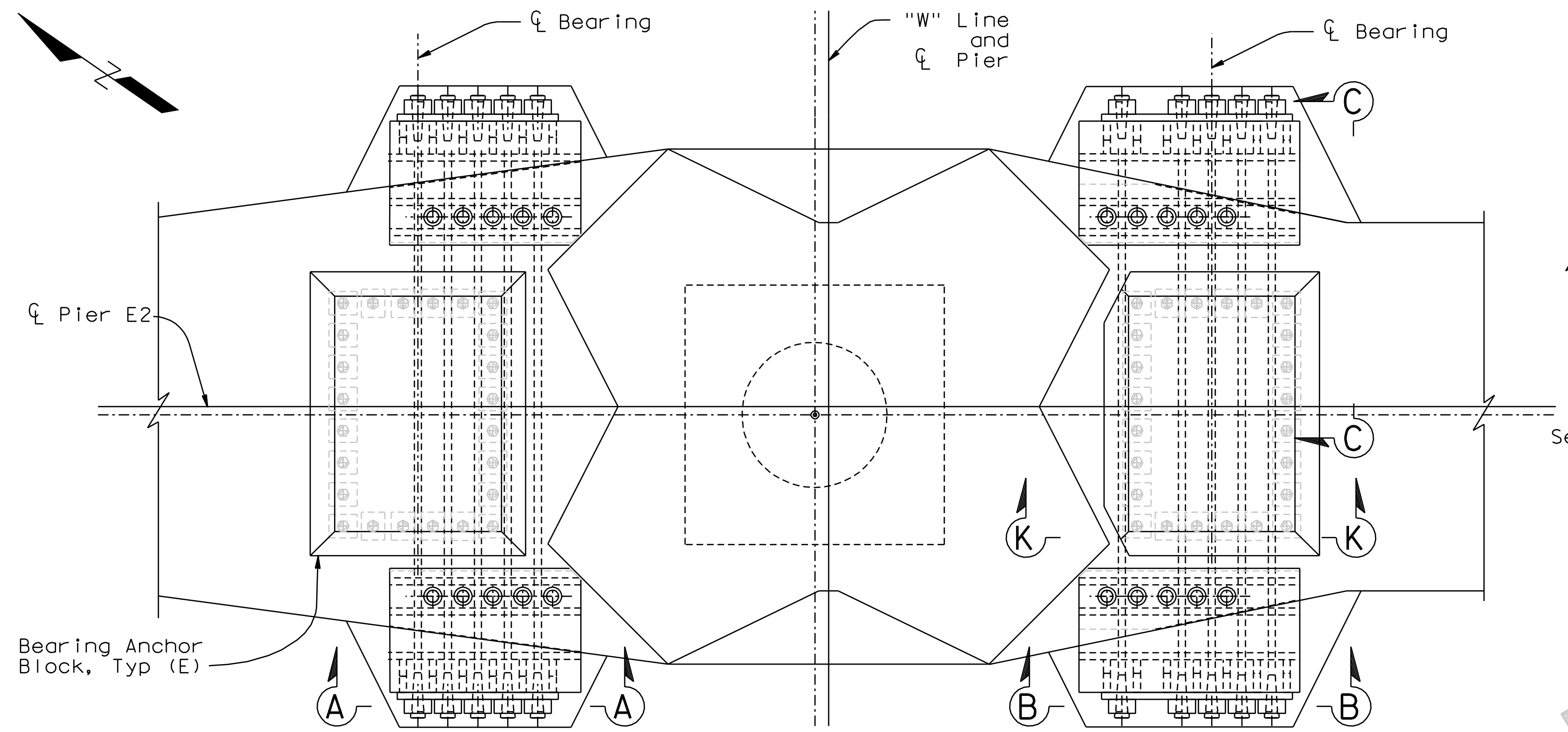

REFLECTED SOFFIT PLAN

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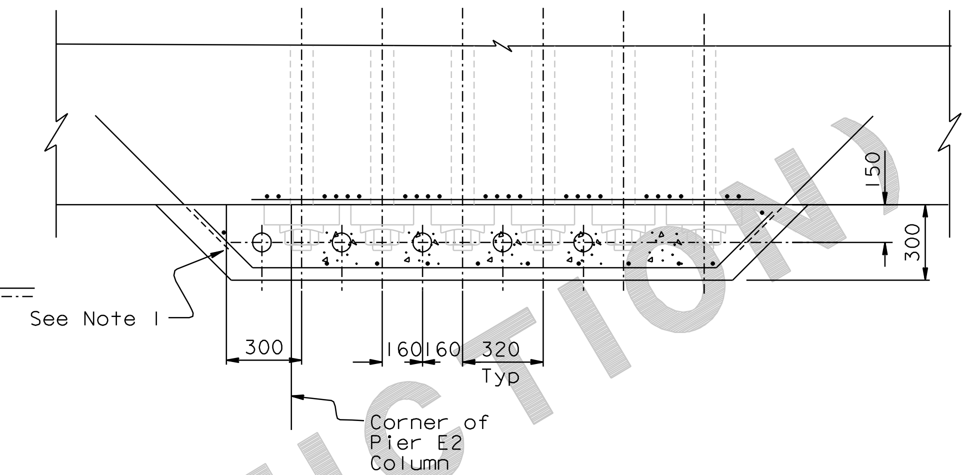
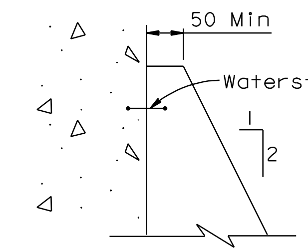


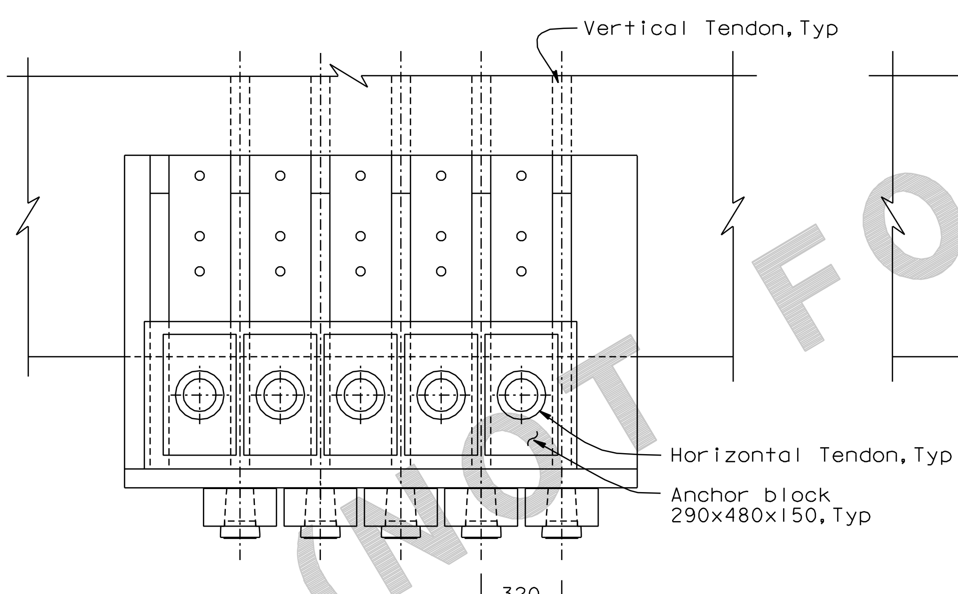
SECTION K-K

1:15



DETAIL 3

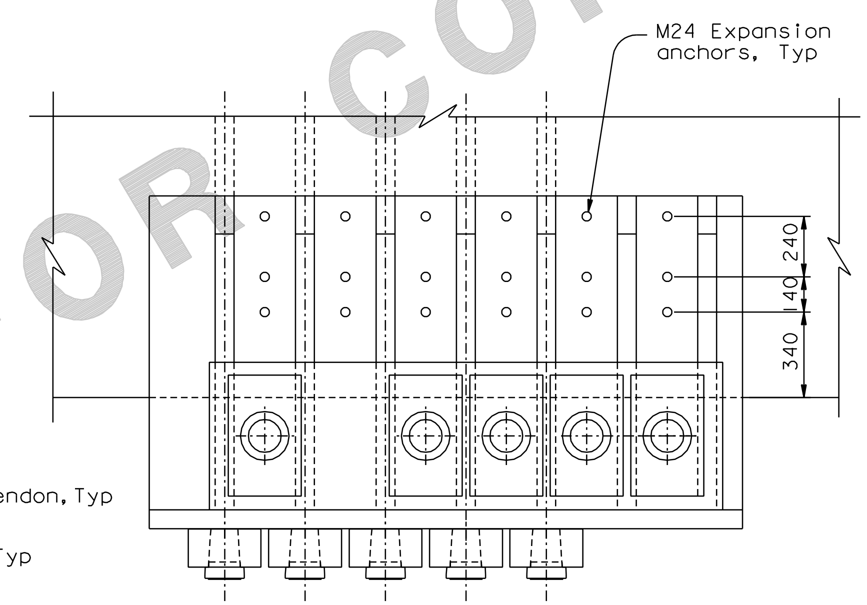
No Scale



VIEW A-A

1:15

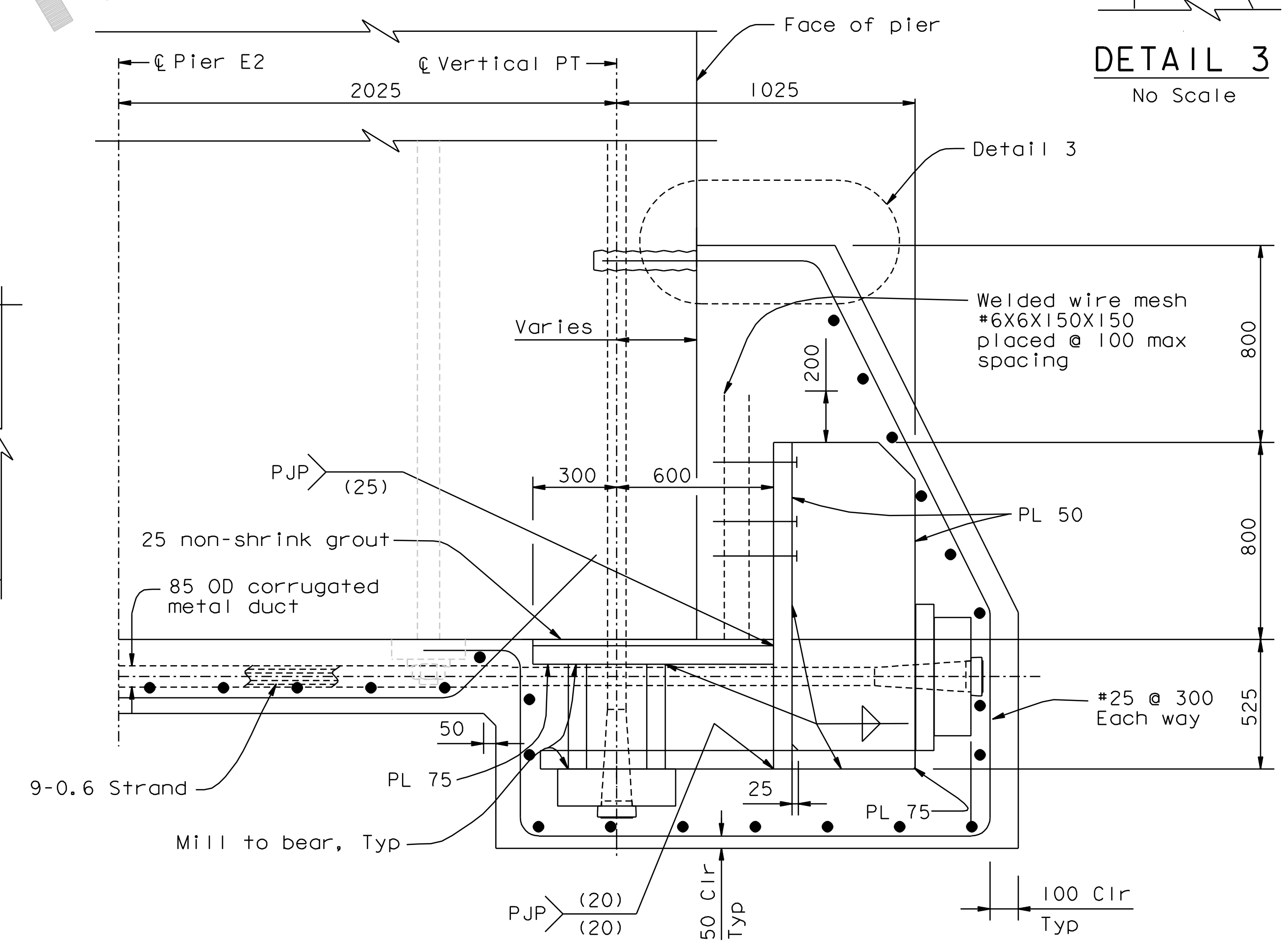
(LOWER ANCHORAGE)



VIEW B-B

1:15

(LOWER ANCHORAGE AT WB SOUTH BEARING)



SECTION C-C

1:15

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ALTERNATIVE BD(2)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. BD2-9)

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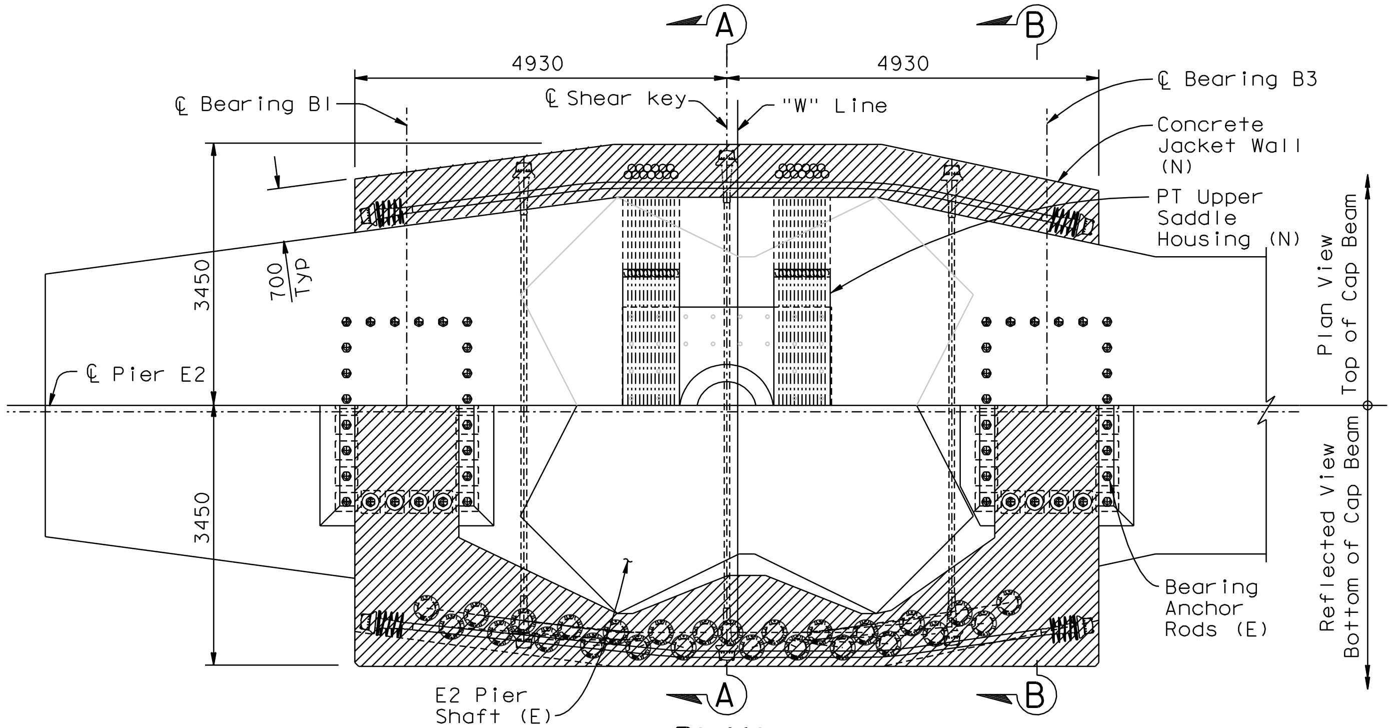
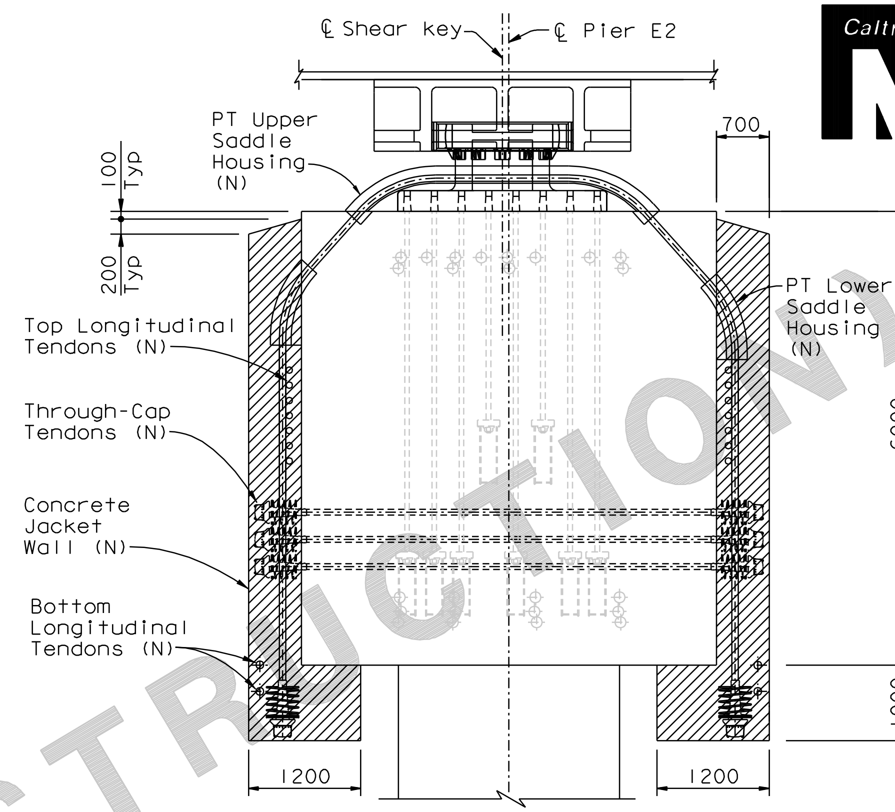


PLAN

1:50



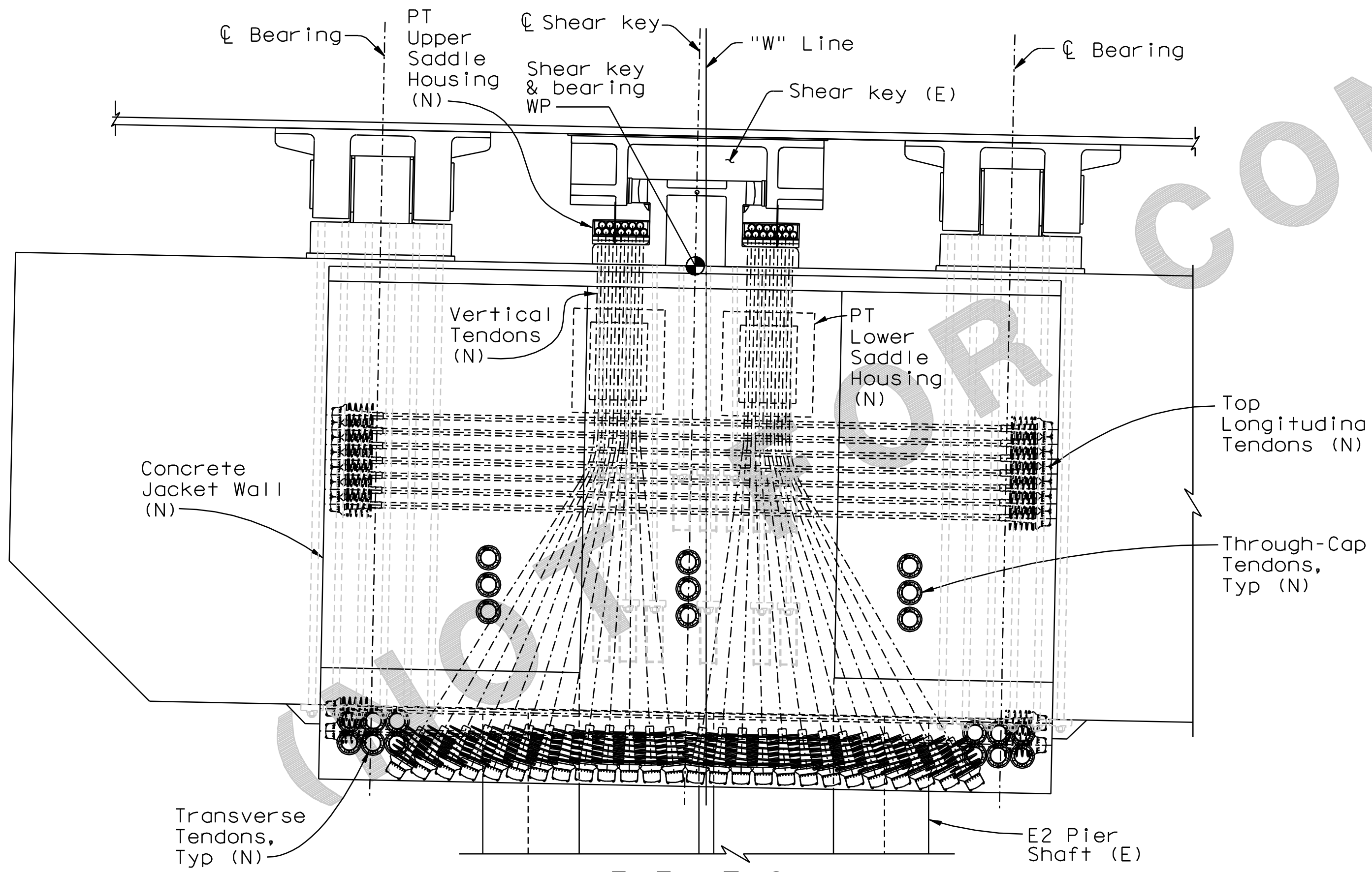
SECTION A-A

1:50

Post Tensioning Summary

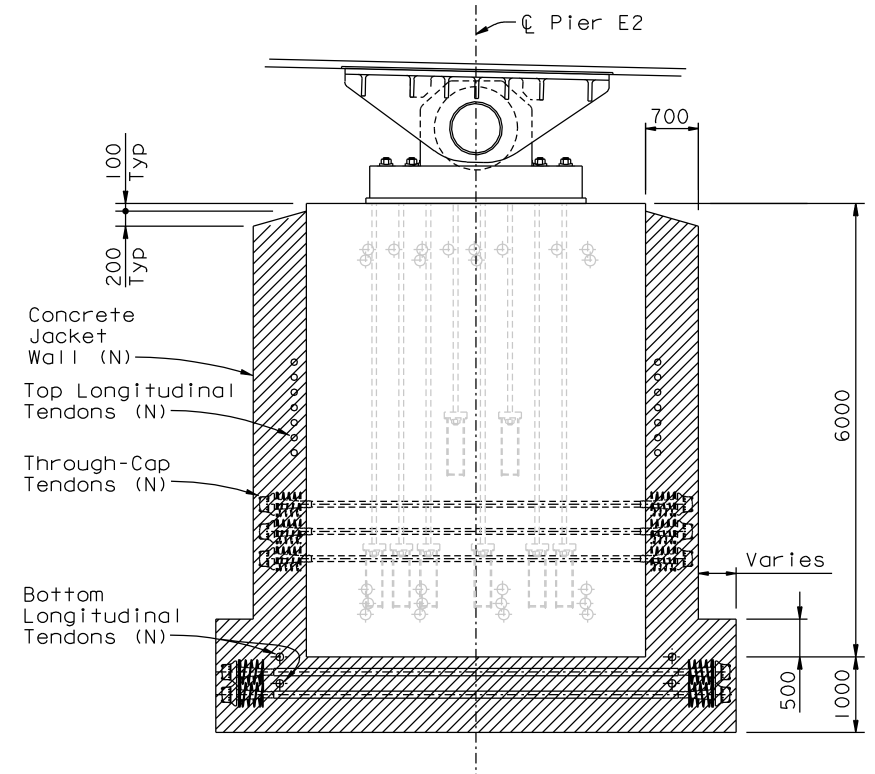
Global Stressing Order	Tendon Group	No. Strands per Tendon	Number of Tendons *
1	Bottom Longitudinal	9	4
2	Transverse	Varies See Sheet C2-6	
3	Top Longitudinal	9	14
4	Through-Cap	12	9
5	Vertical	19	26

* Tendon Count is per Shear Key



ELEVATION

1:50



SECTION B-B

1:50

Index to Plans

Legend:

55 MPa Concrete (N)

(N) New

(E) Existing

(NOT FOR CONSTRUCTION)

ALTERNATIVE C(2)

CONTRACT CHANGE ORDER NO. ____

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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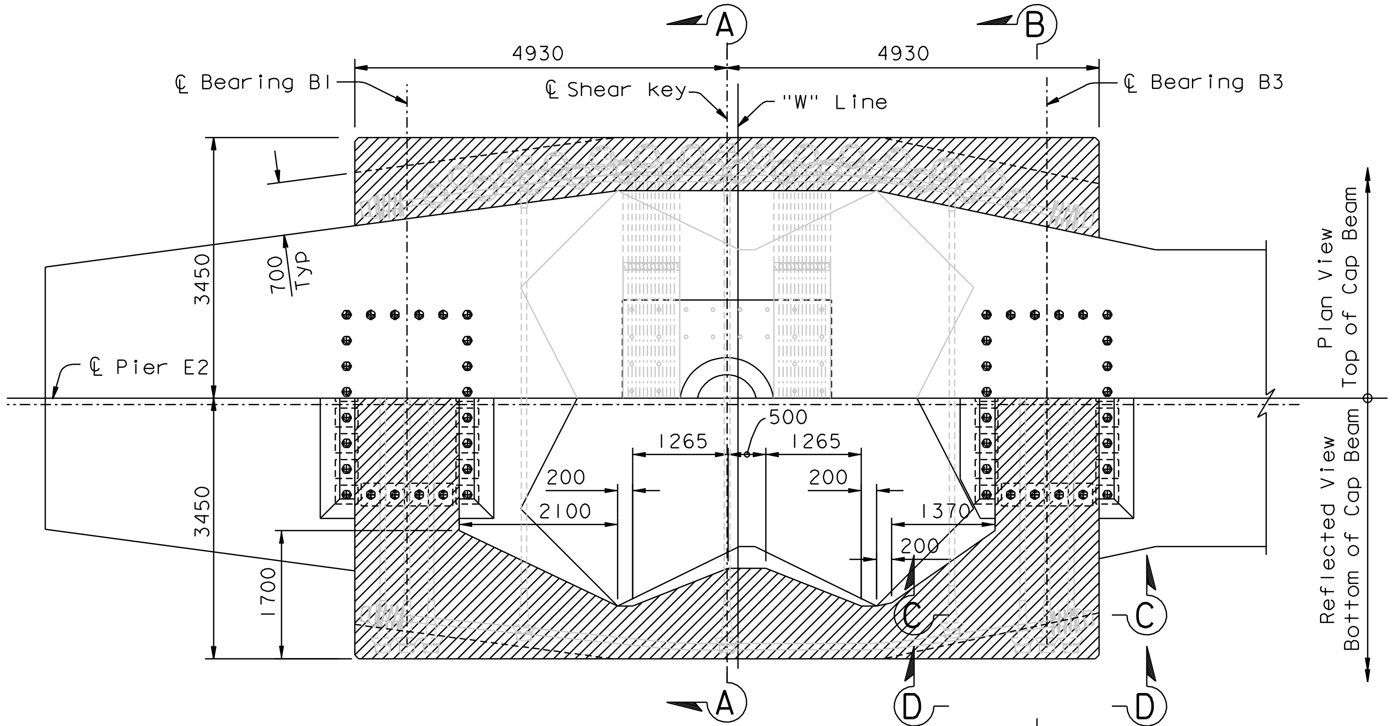
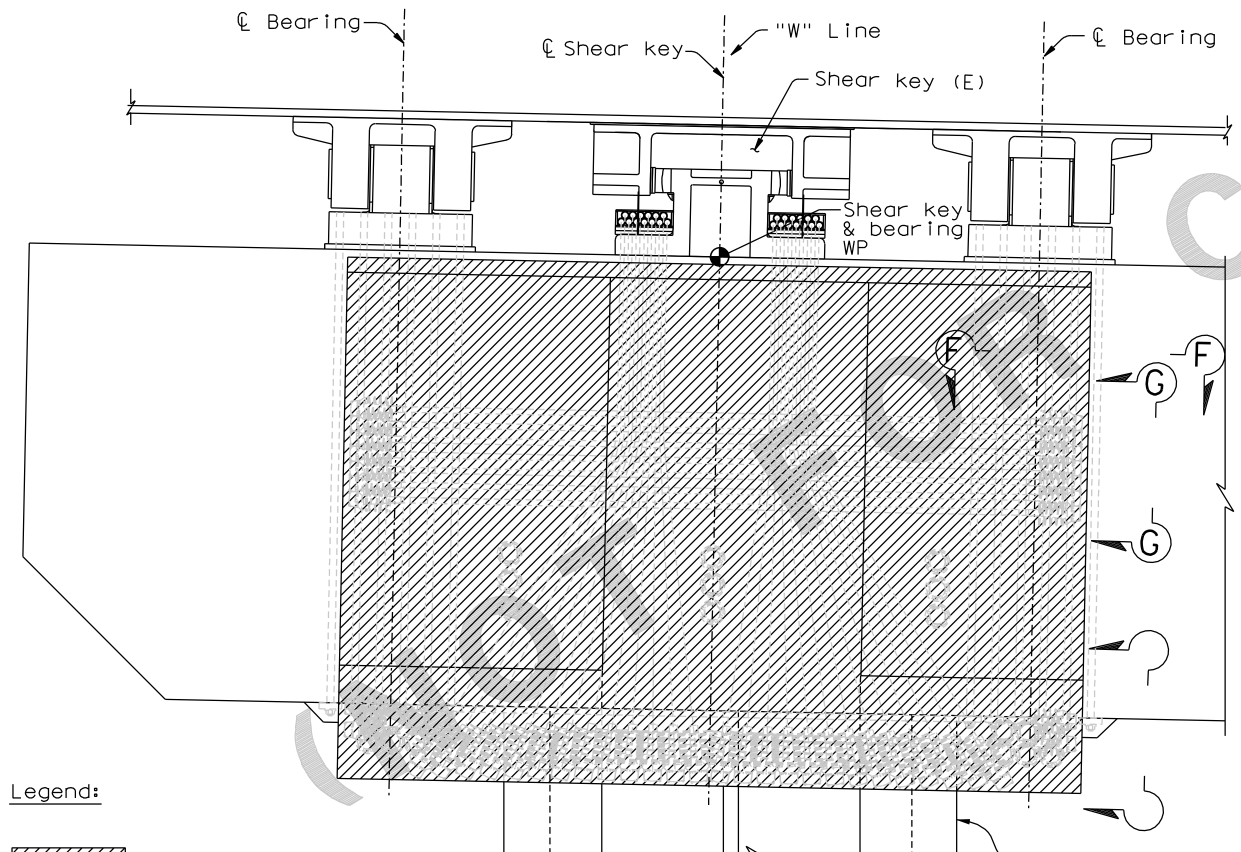


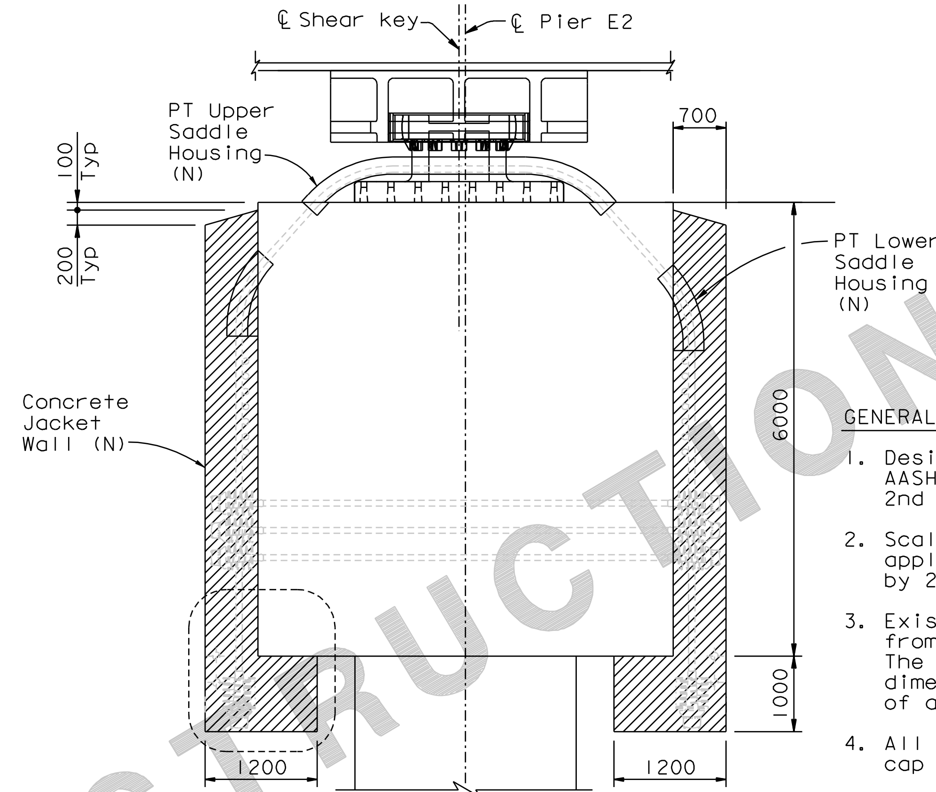
PLAN
1:50



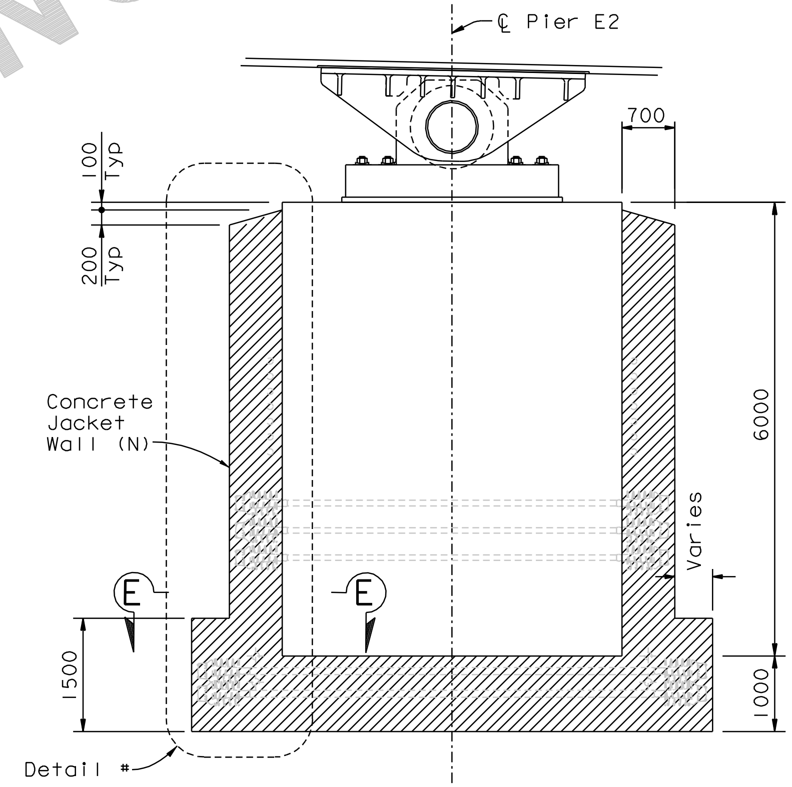
Legend:

55 MPa Concrete (N)

ELEVATION
1:50



SECTION A-A
1:50



SECTION B-B
1:50

ALTERNATIVE C(2)

(NOT FOR CONSTRUCTION)

GENERAL NOTES:

1. Design: CalTrans Bridge Design Specification and AASHTO Guide Specifications for LRFD Seismic Design, 2nd edition.
2. Scales: The scales shown on the plans are not applicable to reduced size prints. Divide the scales by 2 for half-sized prints.
3. Existing Conditions: Dimensions shown are taken from original design drawings and are not guaranteed. The Contractor shall determine and establish all dimensions and details necessary for the completion of all work by field measurement and survey.
4. All plan dimensions along longitudinal axis of cap beam are given at 2% slope to true horizontal.
5. Structural Steel: All structural plate shall conform to the requirements of ASTM A 709M Grade 345 unless noted otherwise.
6. Welding: All welding shall comply with the provisions of the AASHTO / AWS Bridge Welding Code (ANSI / AASHTO / AWS D 1.5).
7. Design clearances require that the Shear Key Bushing and Housing Assembly be fabricated in two horizontal pieces.
8. Bolts: All bolts shall be shall be ASTM A 325M unless noted otherwise. All bolts shall be tensioned using a calibrated turn-of-the-nut method. All faying surfaces shall be Class B.
9. All bolts and related hardware shall be Type I galvanized and shall conform to the requirements of AASHTO M 164 unless noted otherwise.
10. Coating: All structural steel and components shall be coated with the project specified epoxy coating system.
11. Prestressing strands shall conform to ASTM A416, 15mm low relaxation, 7-wire strands with ultimate strength Fu = 1860 MPa. All post tensioning shall be jacked to 82% of Fu.
12. A minimum compressive strength of 36 MPa (f'ci) shall be attained in the concrete prior to stressing.
13. Ducts shall be grouted with non-shrink grout (f'c = 60 MPa)
14. Reinforced Concrete: f'c = 55 MPa
15. Mild steel reinforcement shall conform with ASTM A706 - fy = 415 MPa, fu = 738 MPa
16. Pourable chocking compound (Chockfast Orange or similar) shall be applied between all new plates and existing steel or concrete surfaces to provide uniform bearing.
17. Drill & bond dowels with an approved epoxy adhesive anchor system.

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

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E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-1)

Rev. Date: 5-18-98

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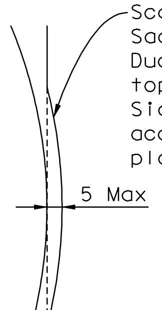
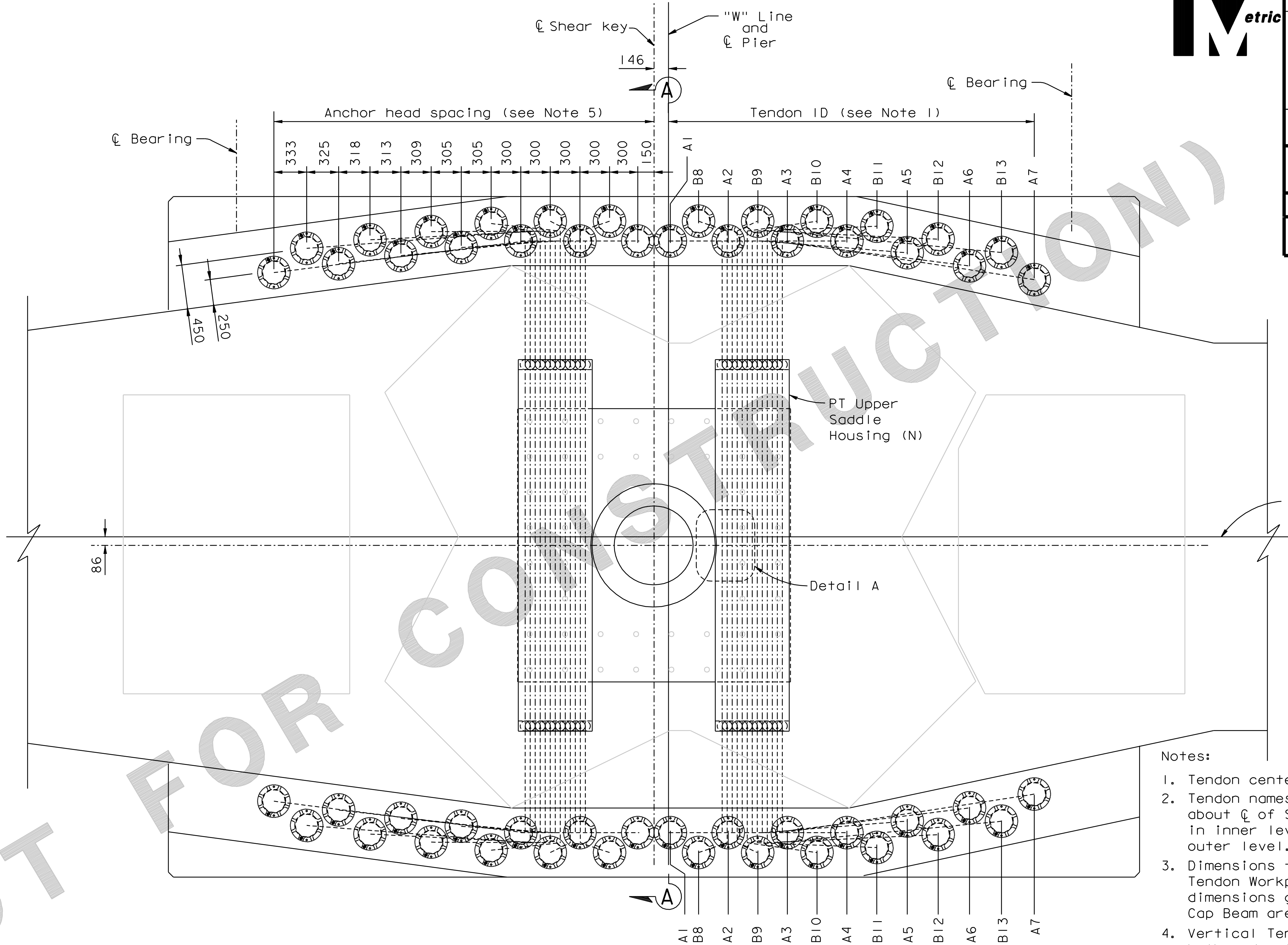
Vertical Post Tensioning Stressing Sequence

Tendon ID	Side of Shear Key	Order	Jacking Force (MN) (See Note 7)
A7	N	1	4.06
A7	S	2	4.06
A6	S	3	4.06
A6	N	4	4.06
A5	N	5	4.06
A5	S	6	4.06
A4	S	7	4.06
A4	N	8	4.06
A3	N	9	4.06
A3	S	10	4.06
A2	S	11	4.06
A2	N	12	4.06
A1	N	13	4.06
A1	S	14	4.06
B13	S	15	4.06
B13	N	16	4.06
B12	N	17	4.06
B12	S	18	4.06
B11	S	19	4.06
B11	N	20	4.06
B10	N	21	4.06
B10	S	22	4.06
B9	S	23	4.06
B9	N	24	4.06
B8	N	25	4.06
B8	S	26	4.06



DETAIL A
1:5



VERTICAL TENDON LAYOUT

PLAN VIEW

1:25

Notes:

1. Tendon centerlines are schematic only.
2. Tendon names and geometry are symmetrical about ℄ of Shear Key. "A" indicates Tendons in inner level, "B" indicates Tendons in outer level.
3. Dimensions to tendon anchors given at Tendon Workpoint (See sheet C2-5). All plan dimensions given along longitudinal axis of Cap Beam are sloped 2% from true horizontal.
4. Vertical Tendons shall be jacked from both ends simultaneously.
5. All Transverse, Top Longitudinal, and Bottom Longitudinal Tendons must be fully stressed prior to stressing Vertical Tendons. All Through-Cap Tendons must be fully stressed prior to stressing Vertical Tendons from 50% to 100% fjack.
6. Stage stress all Vertical Tendons to 50% fjack prior to stressing any Vertical Tendon to 100% fjack. Repeat stressing order for second half of stressing.

ALTERNATIVE C(2)

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SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-2)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 04
EA 0120F1

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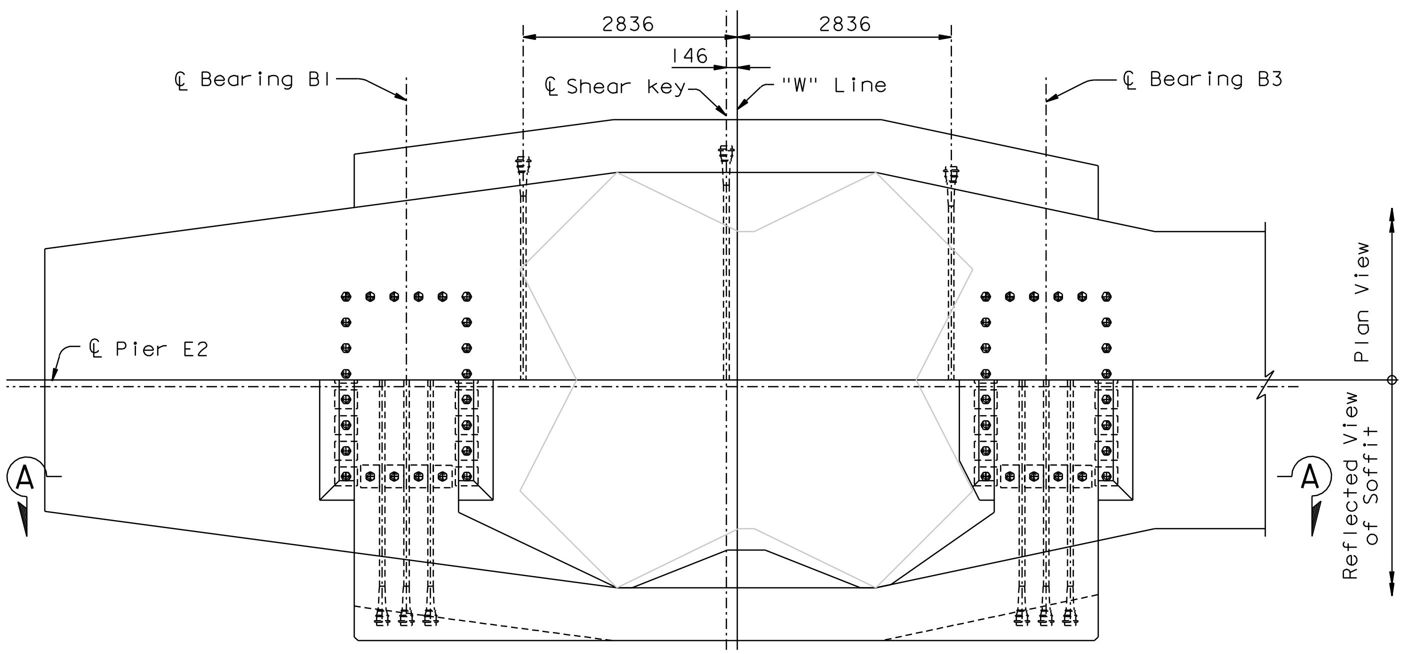
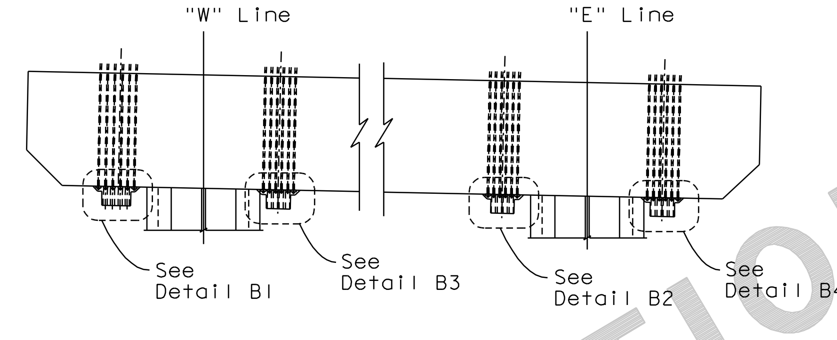
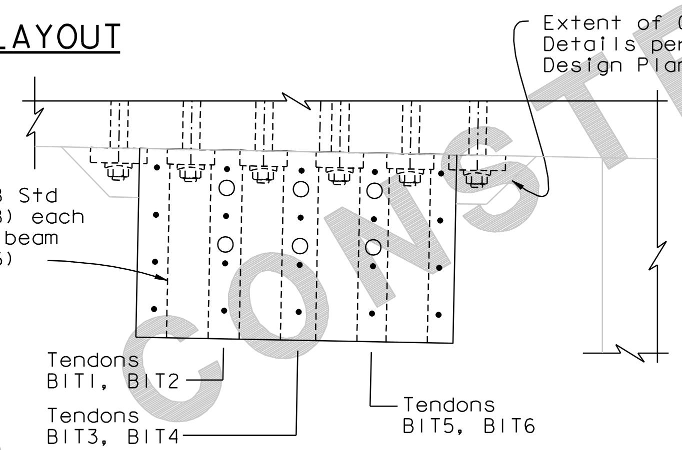


TRANSVERSE AND THROUGH-CAP TENDON LAYOUT

1:50

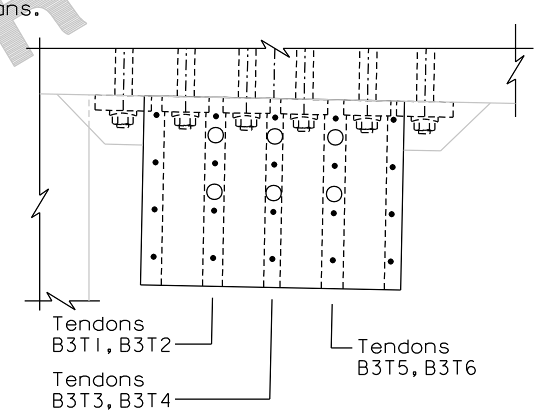


SECTION A-A



DETAIL B1

1:20



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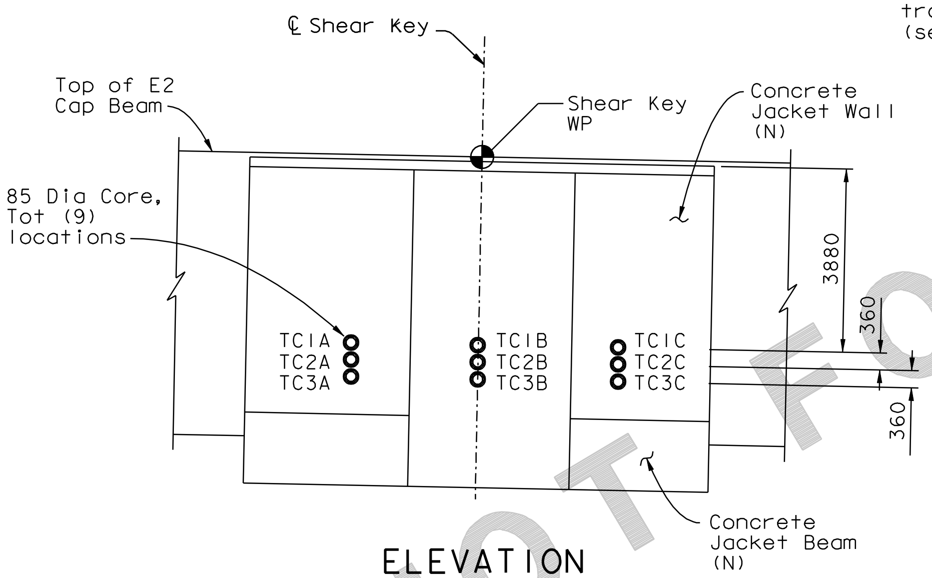

ELEVATION

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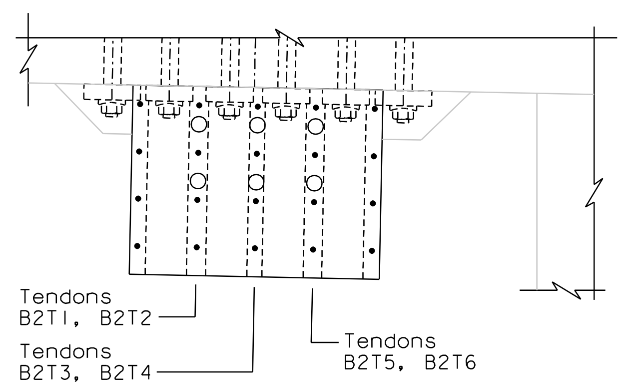

DETAIL B2

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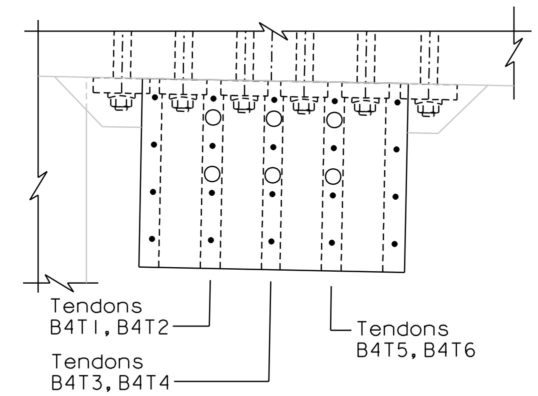

DETAIL B4

1:20

ALTERNATIVE C(2)

Shear Key S1 Transverse Tendon Stressing Sequence

Tendon	No. Strands	Jacking Order
B1T4	12	1
B3T4	12	2
B3T2	12	3
B1T6	12	4
B1T2	12	5
B3T6	12	6
B3T3	12	7
B1T3	12	8
B1T5	12	9
B3T1	12	10
B3T5	12	11
B1T1	12	12

Shear Key S2 Transverse Tendon Stressing Sequence

Tendon	No. Strands	Jacking Order
B2T4	12	1
B4T4	12	2
B4T2	12	3
B2T6	12	4
B2T2	12	5
B4T6	12	6
B4T3	12	7
B2T3	12	8
B2T5	12	9
B4T1	12	10
B4T5	12	11
B2T1	12	12

Tendon Jacking Forces by Strand Count

No. Strands	Jacking Force (MN)
6	1.28
9	1.92
12	2.56
15	3.20

Notes:

1. Provided dimensions are approximate and must be verified prior to coring.
2. See Detail B1 for notes common to all transverse beam details shown on this sheet.
3. Sufficient tails shall be left on all tendons to allow for jacking from either end.
4. Alternate stressing end on tendons in the same transverse beam.
5. Transverse tendon sizes set using field-measured clearances between bearing rod anchors. Site conditions may require corrugated duct to be deformed locally by ≤ 4mm each side of duct.
6. Eight sets of six 50mm 8 Dia Nelson studs shall be placed radially staggered along length of NPS pipes.

(NOT FOR CONSTRUCTION)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE (SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-3)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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Top Longitudinal Post-Tensioning Stressing Sequence

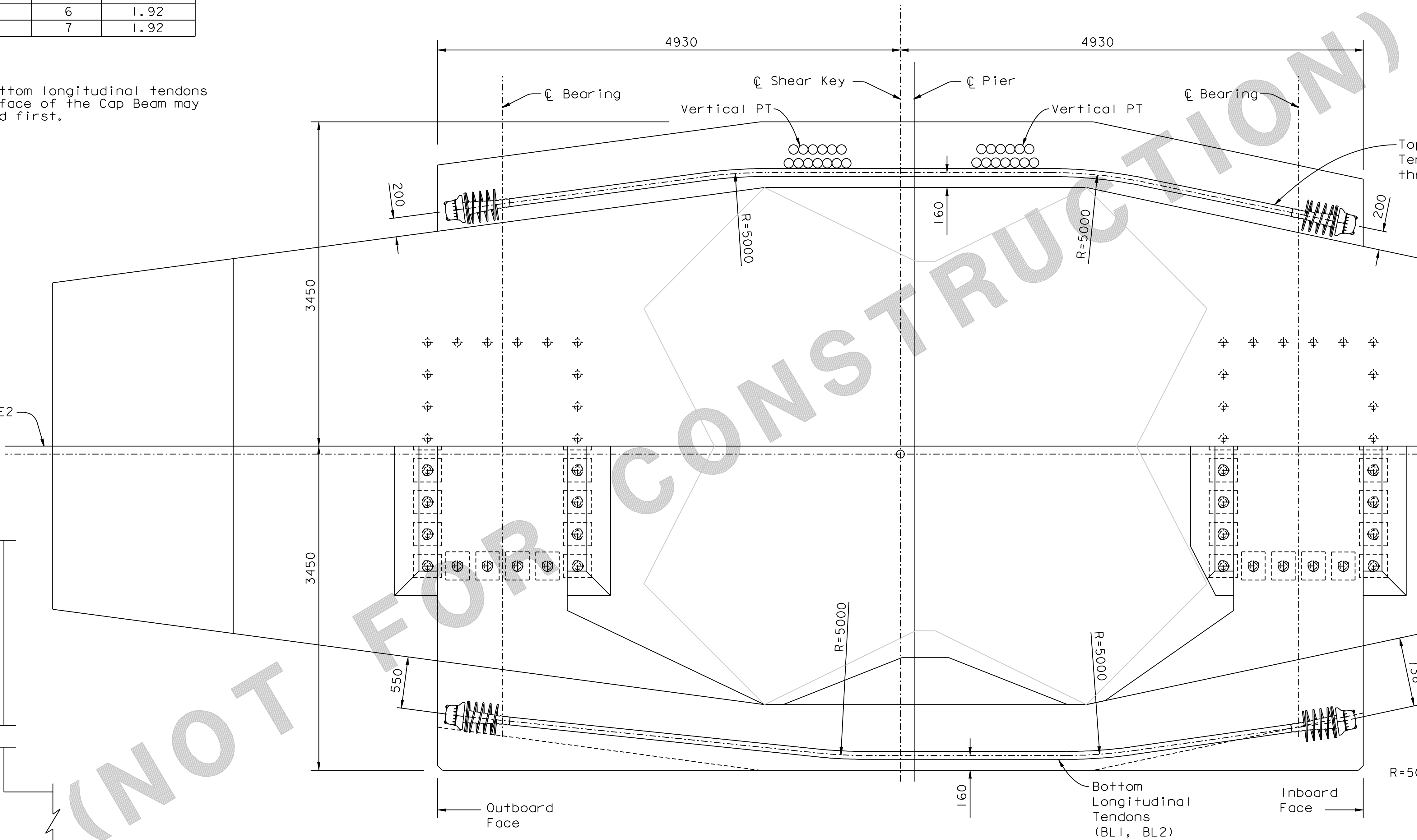
Tendon	Stressing End	Jacking Order	Jacking Force (MN)
TL7	N	1	1.92
TL1	S	2	1.92
TL4	S	3	1.92
TL6	N	4	1.92
TL2	N	5	1.92
TL5	S	6	1.92
TL3	S	7	1.92

Bottom Longitudinal Post-Tensioning Stressing Sequence

Tendon	Stressing End	Jacking Order	Jacking Force (MN)
BL2	N	1	1.92
BL1	S	2	1.92

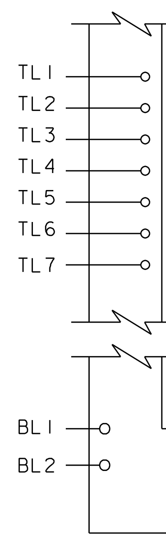
Notes:

1. Top and bottom longitudinal tendons on either face of the Cap Beam may be stressed first.



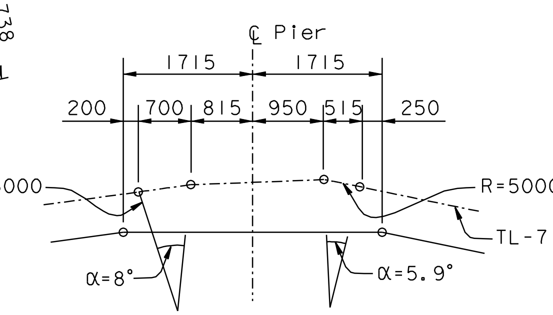
LONGITUDINAL TENDON LAYOUT

1:25



TENDON ID's

NO SCALE
View similar to Section A-A



TL-7 Profile adjustment to clear vertical ducts A7 and A6.

DETAIL FOR TENDON TL-7

1:50

(NOT FOR CONSTRUCTION)

CONTRACT CHANGE ORDER NO. ____
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ALTERNATIVE C(2)

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-4)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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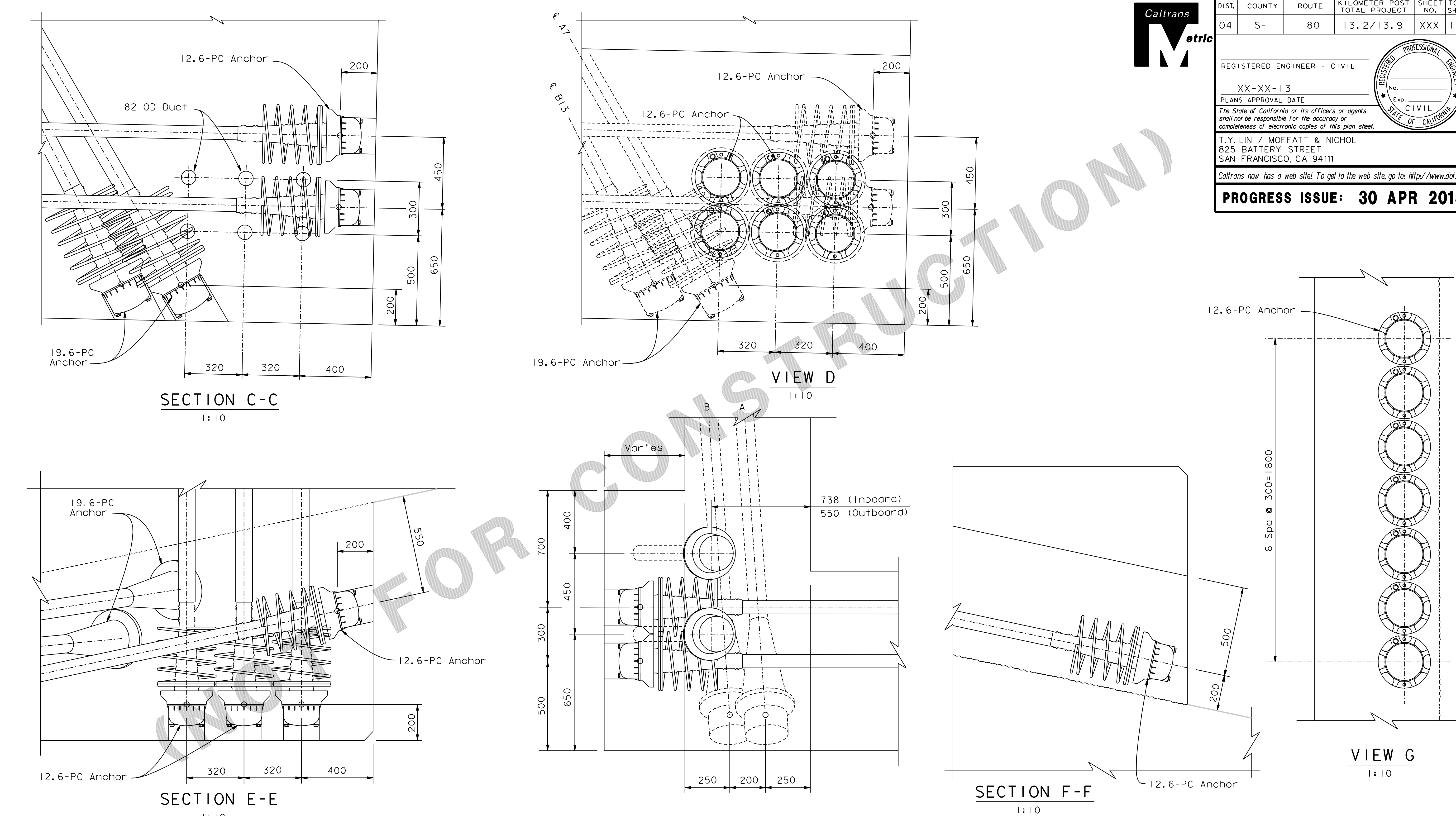

ALTERNATIVE C(2)

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NOTES:

1. Adjust spirals to clear tendons.

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-5)

Rev. Date: 5-18-98

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SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

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E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-6)

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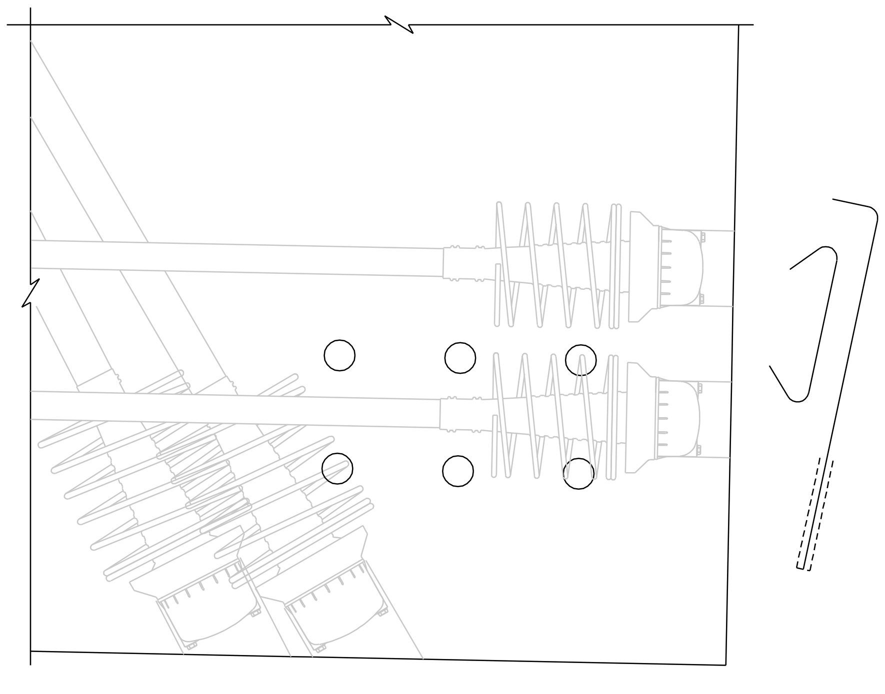

SECTION C-C
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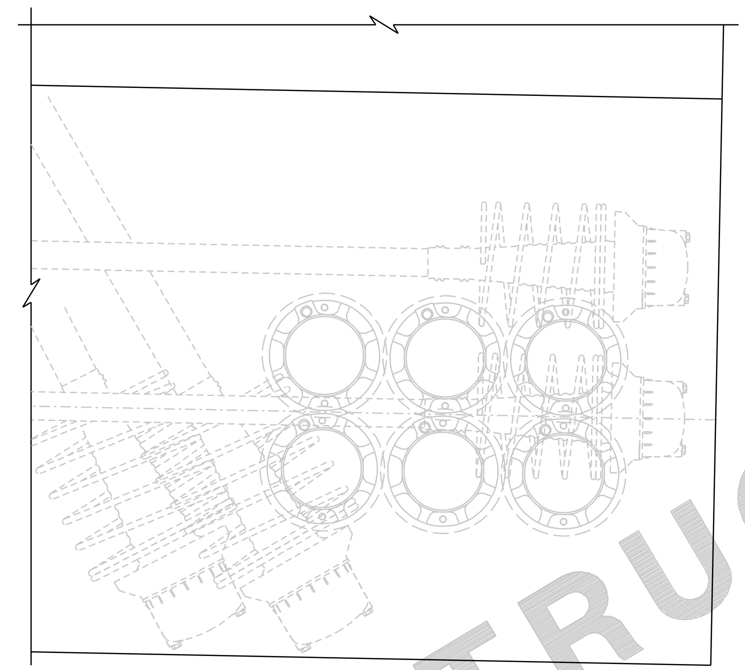

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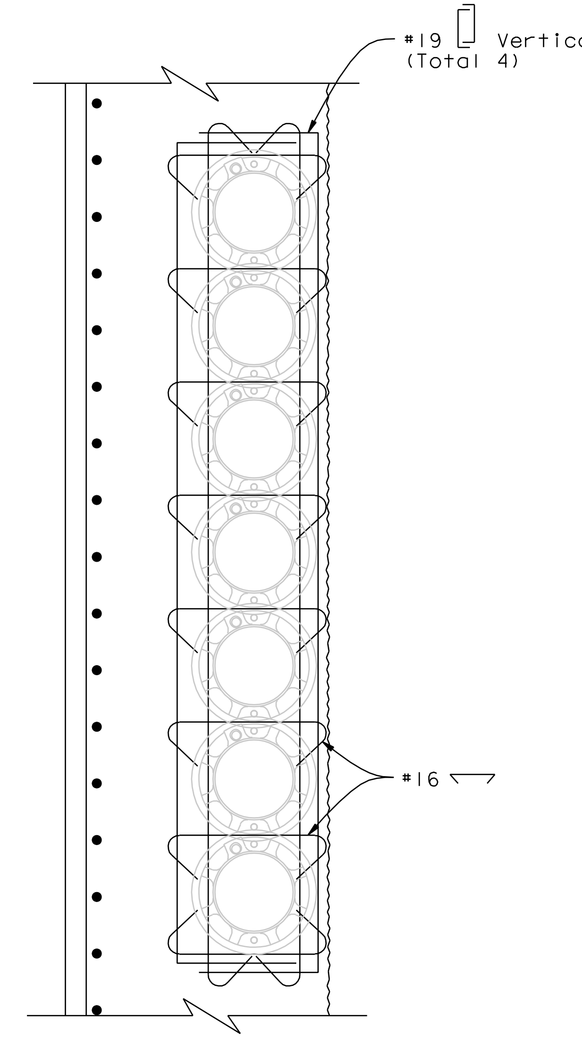

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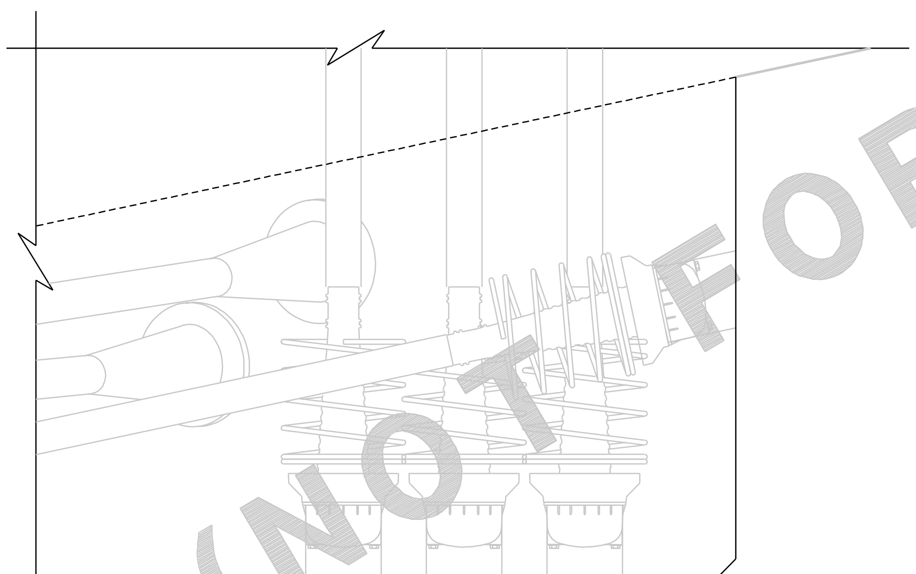

SECTION E-E
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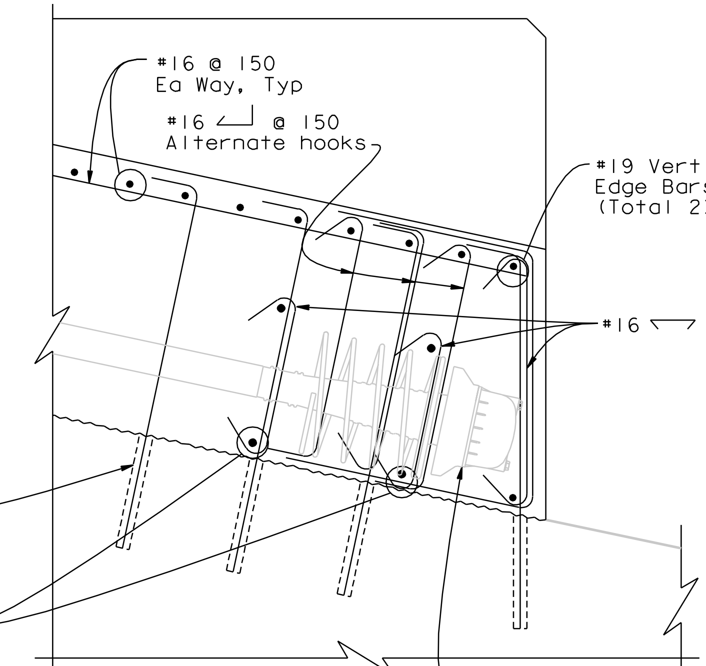

SECTION F-F
1:10

NOTES:

1. Adjust spirals to clear tendons.
2. Typical reinforcement not shown.

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-7)

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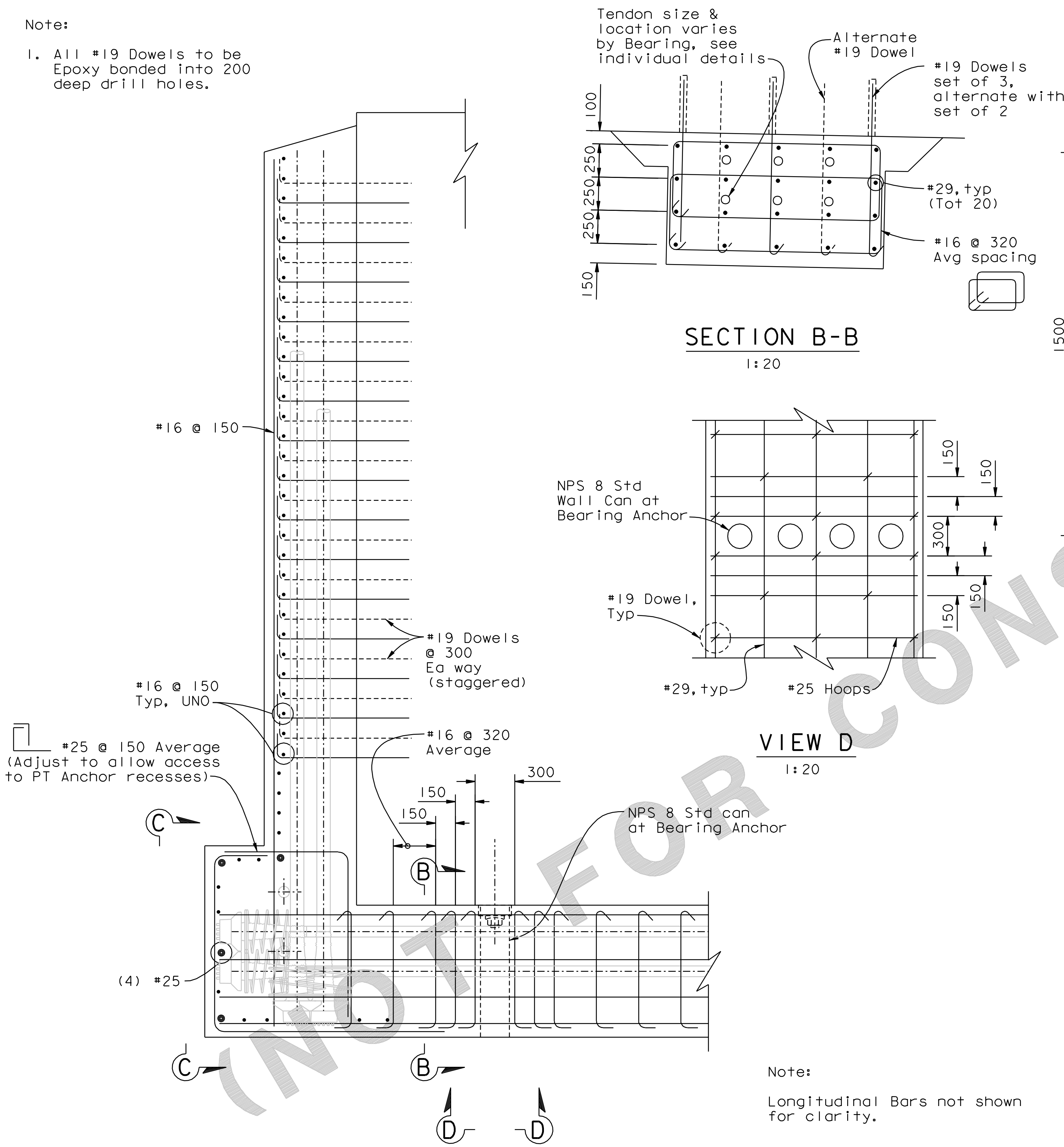
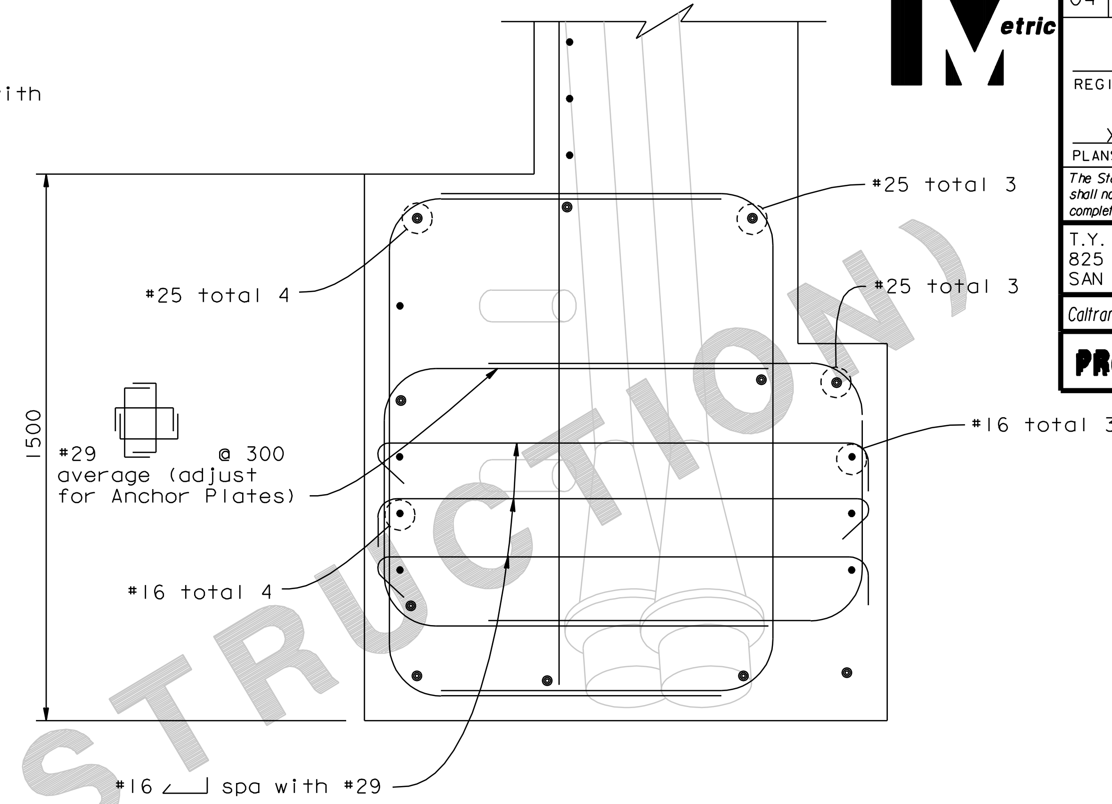
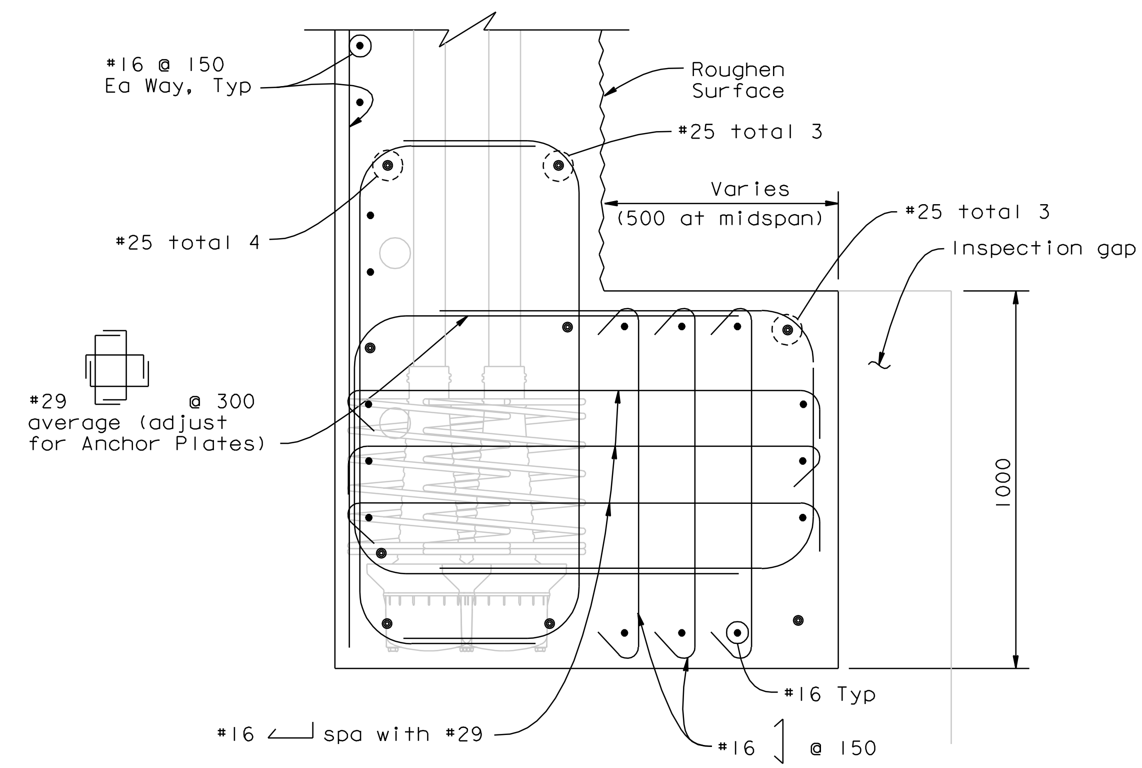
Note:

1. All #19 Dowels to be Epoxy bonded into 200 deep drill holes.







Note:

Longitudinal Bars not shown for clarity.

ALTERNATIVE C(2)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-8)

Rev. Date: 5-18-98

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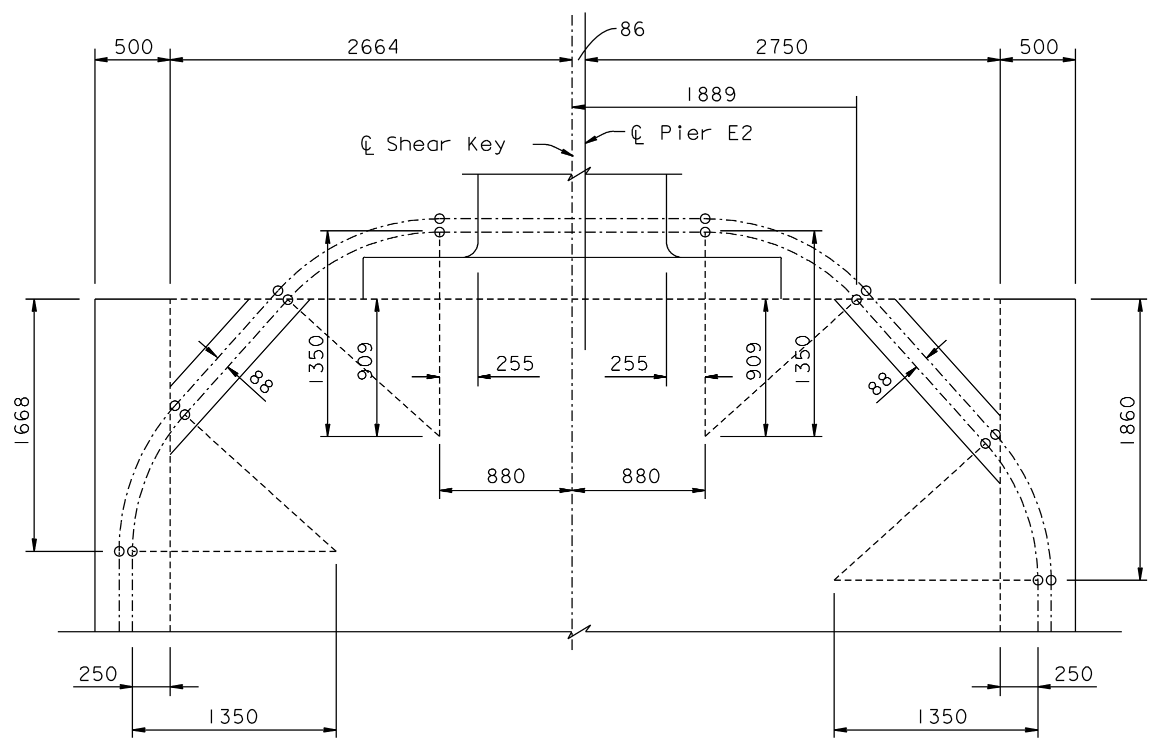

GEOMETRY KEY SECTION
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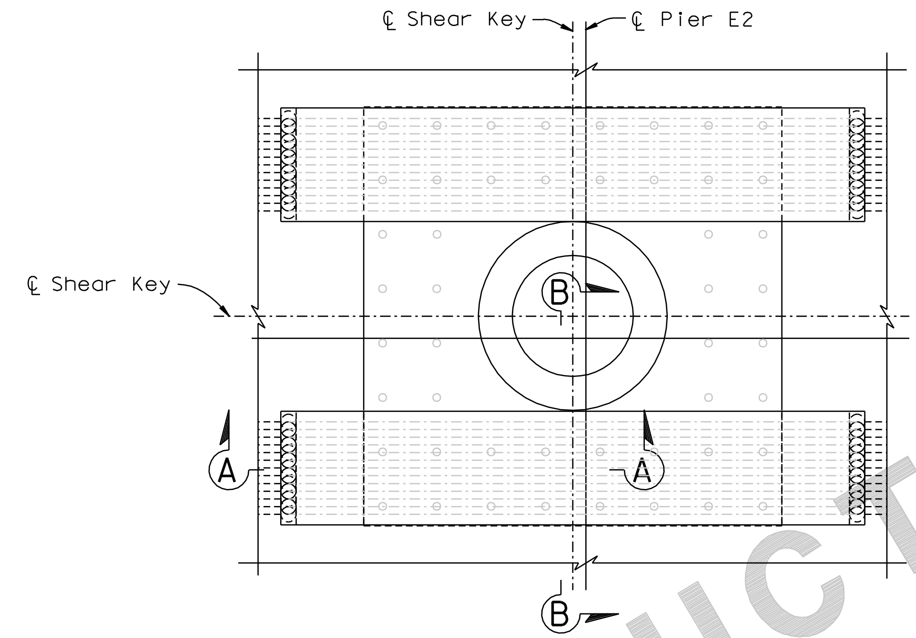
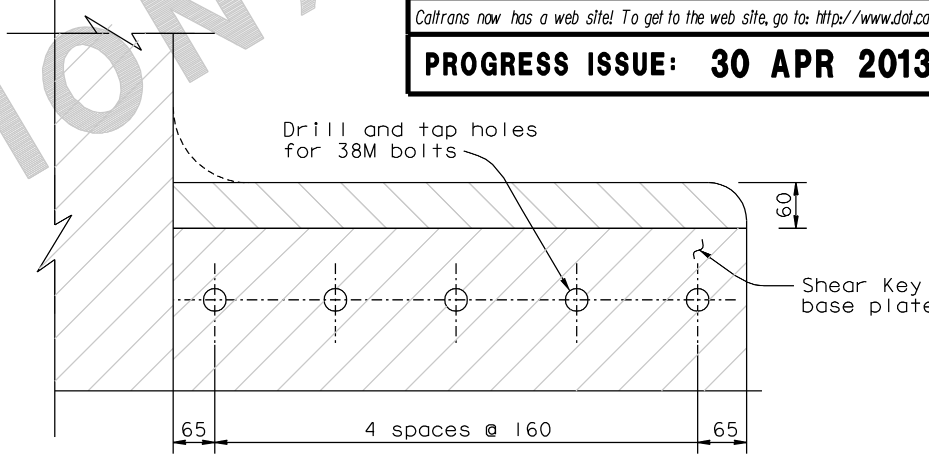


PLAN VIEW UPPER SADDLE
1:25



SECTION C-C
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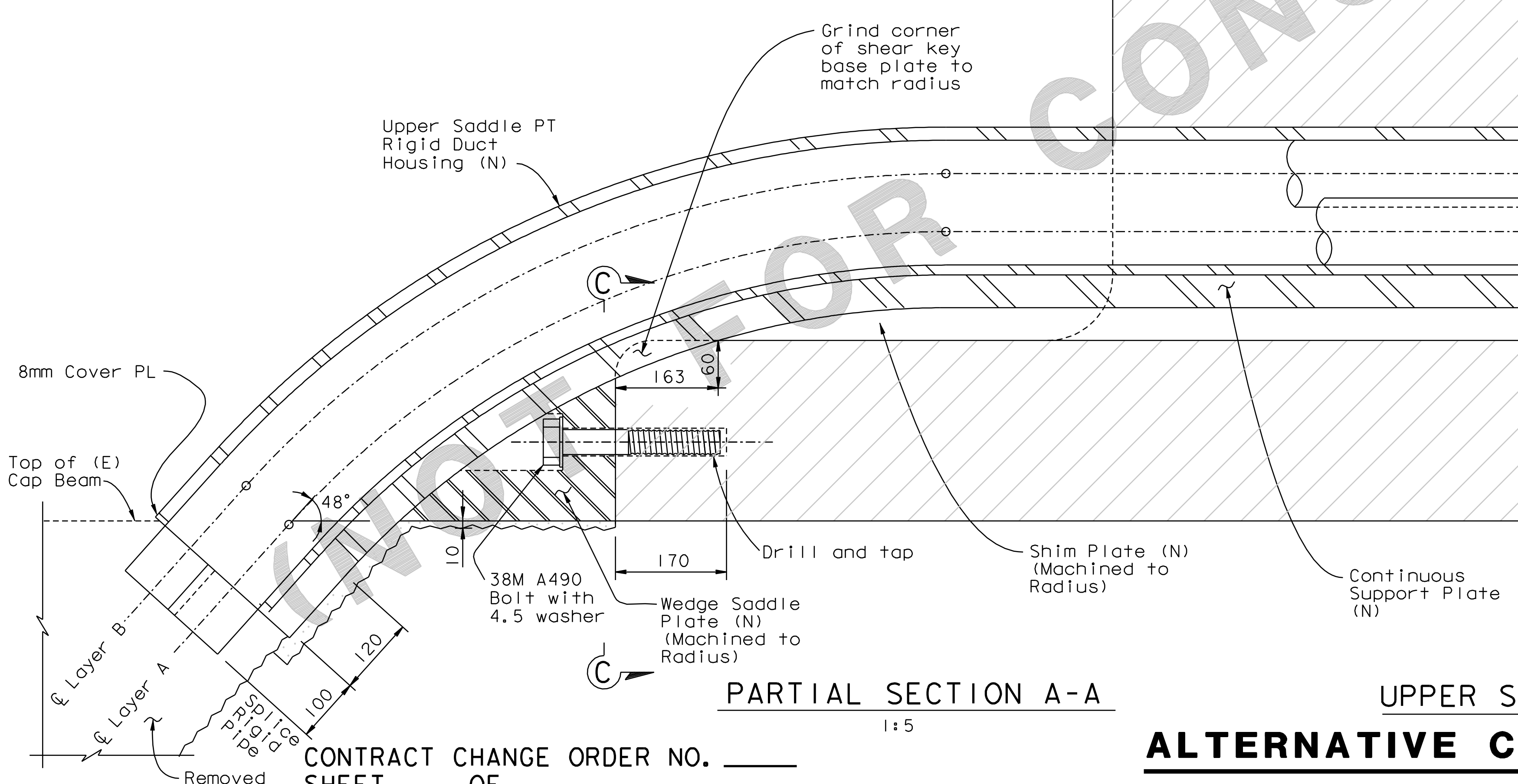

PARTIAL SECTION A-A
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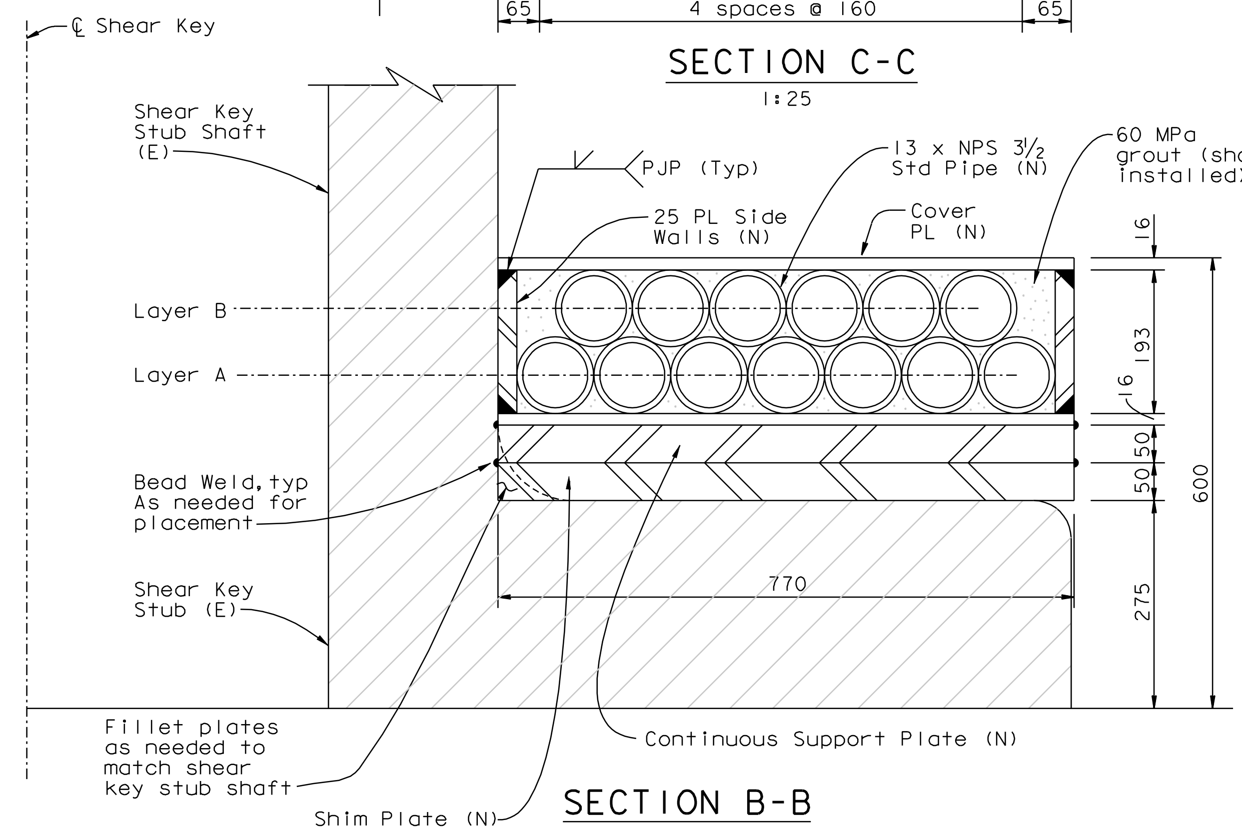

SECTION B-B
1:5

UPPER SADDLE DETAILS

ALTERNATIVE C(2)

Notes:

1. Survey of existing site conditions shall be used to set final dimensions.
2. Confirm geometry with full shop assembly prior to delivery to site.

CONTRACT CHANGE ORDER NO. ____
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M. Nader
PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.2/13.9

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-9)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 04
EA 0120F1

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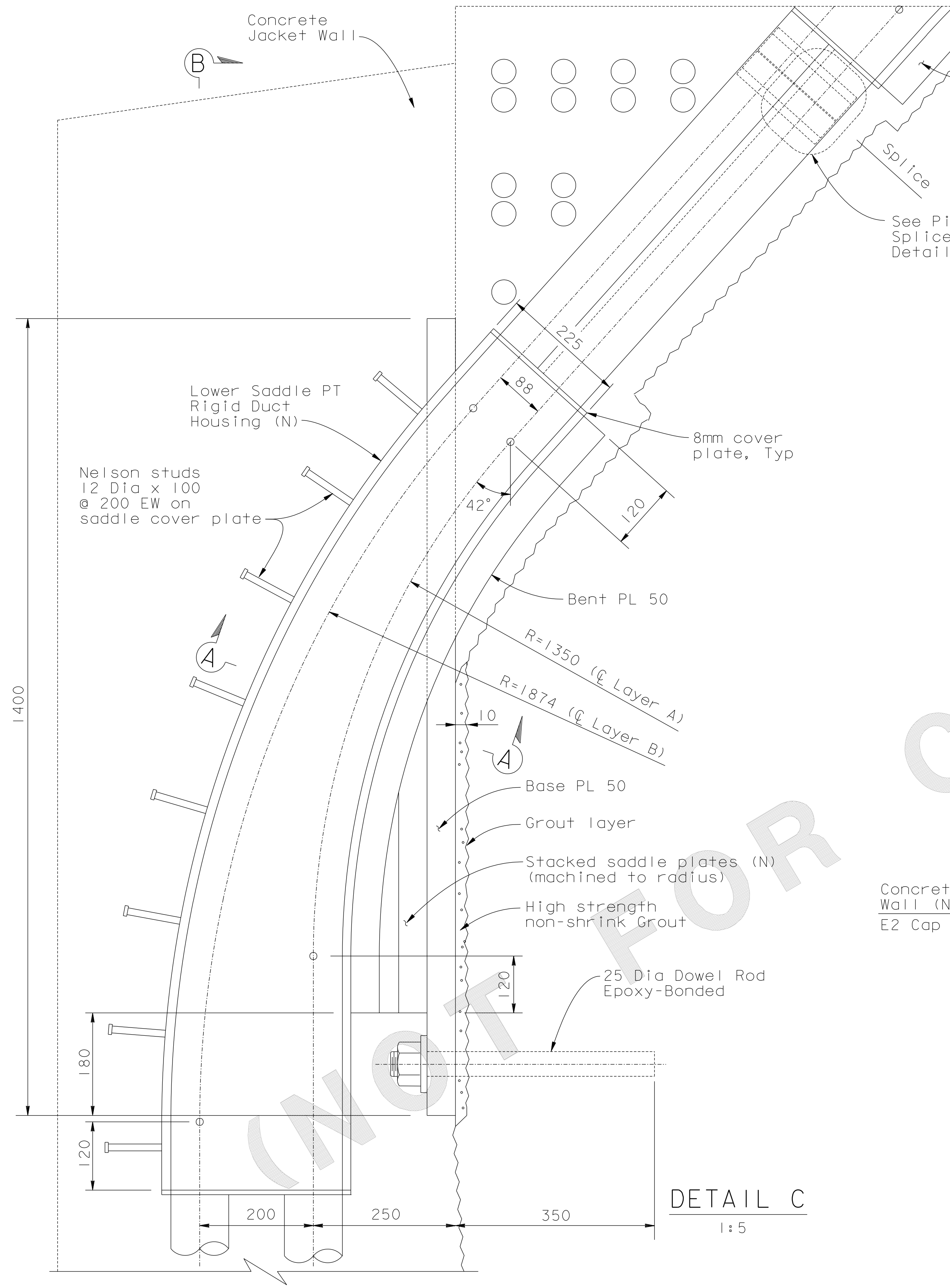

DETAIL C
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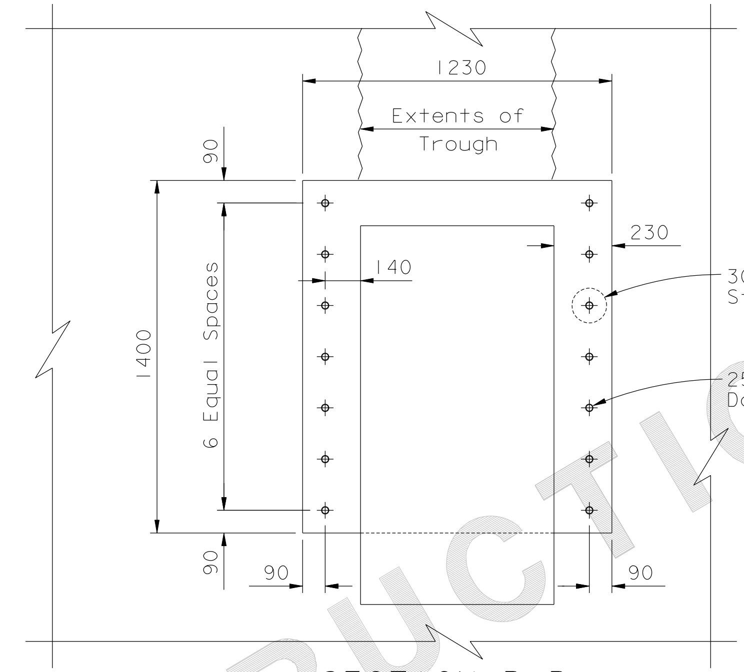
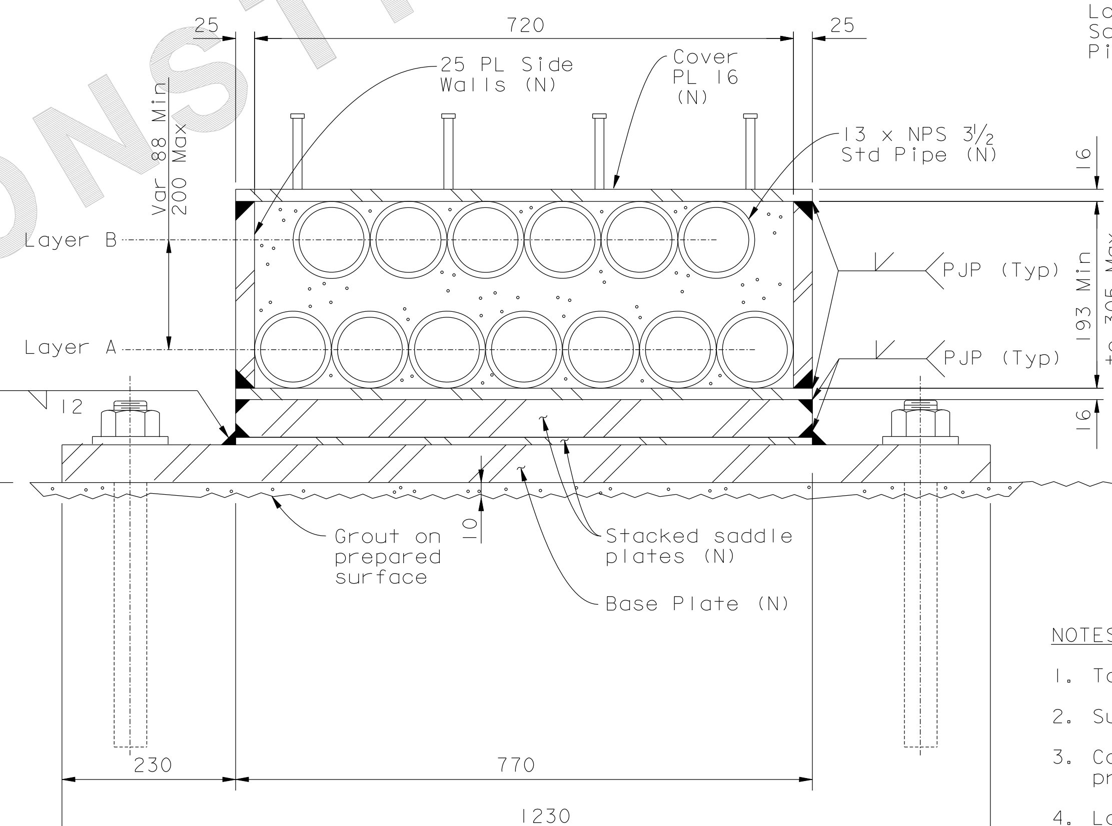


SECTION B-B
1:15



SECTION A-A
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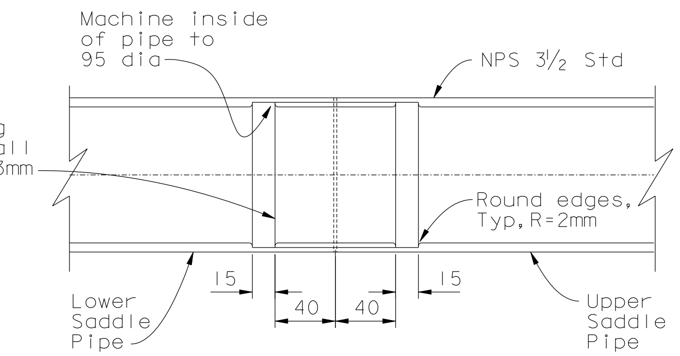

PIPE SPLICE DETAIL
1:2.5

NOTES:

1. Tack weld NPS duct pipes as needed.
2. Surveys shall be used to set final dimensions.
3. Confirm geometry with full shop assembly prior to delivery to site.
4. Lower Saddle must be supported until epoxy has set and dowel nuts have been tightened.
5. Contractor shall tie saddle rigid pipes into position to guarantee correct pipe geometry prior to grouting box housing.

(NOT FOR CONSTRUCTION)

LOWER SADDLE DETAILS

ALTERNATIVE C(2)

CONTRACT CHANGE ORDER NO. _____
SHEET ____ OF ____

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EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)
E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-10)

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PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
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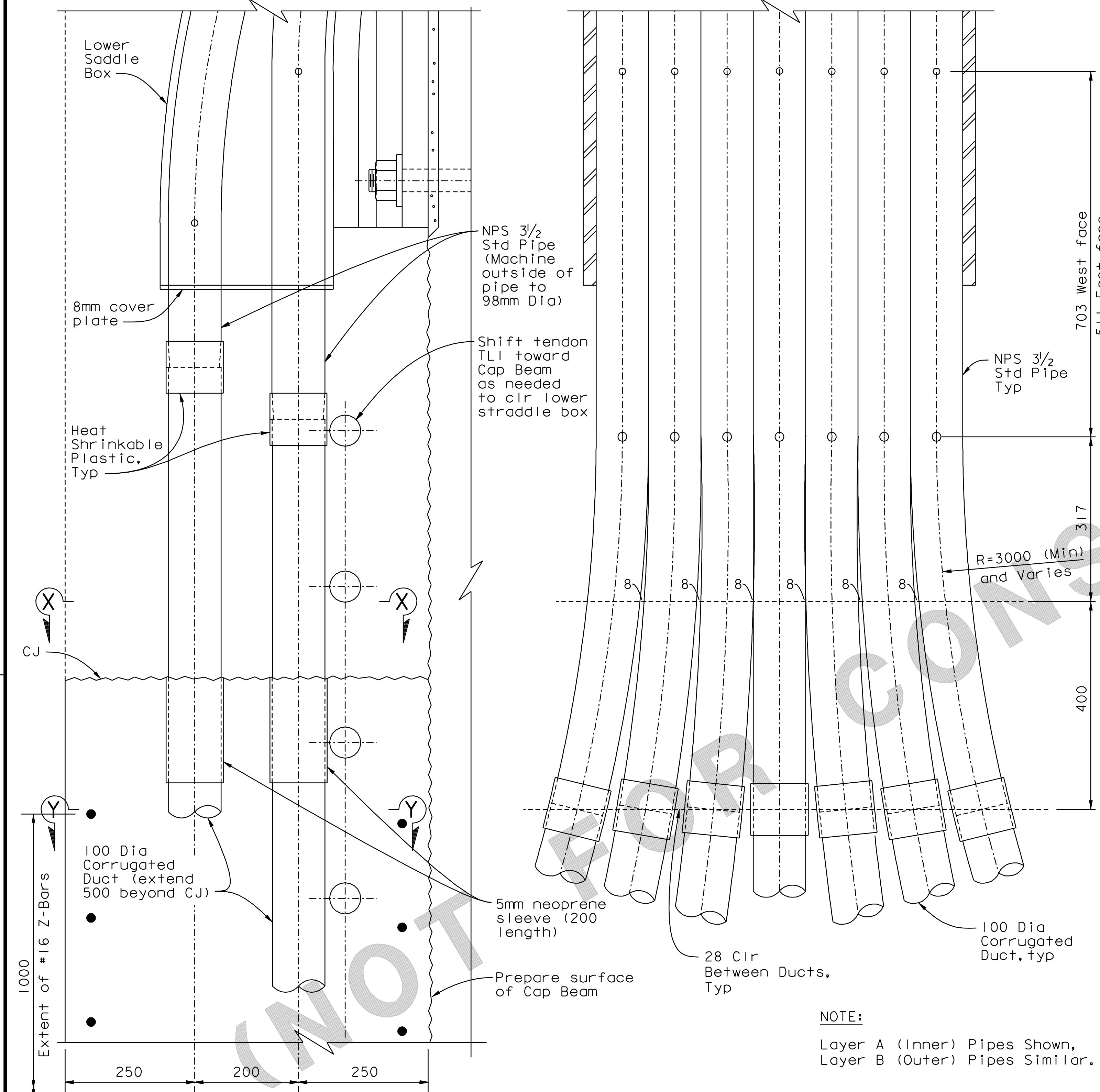
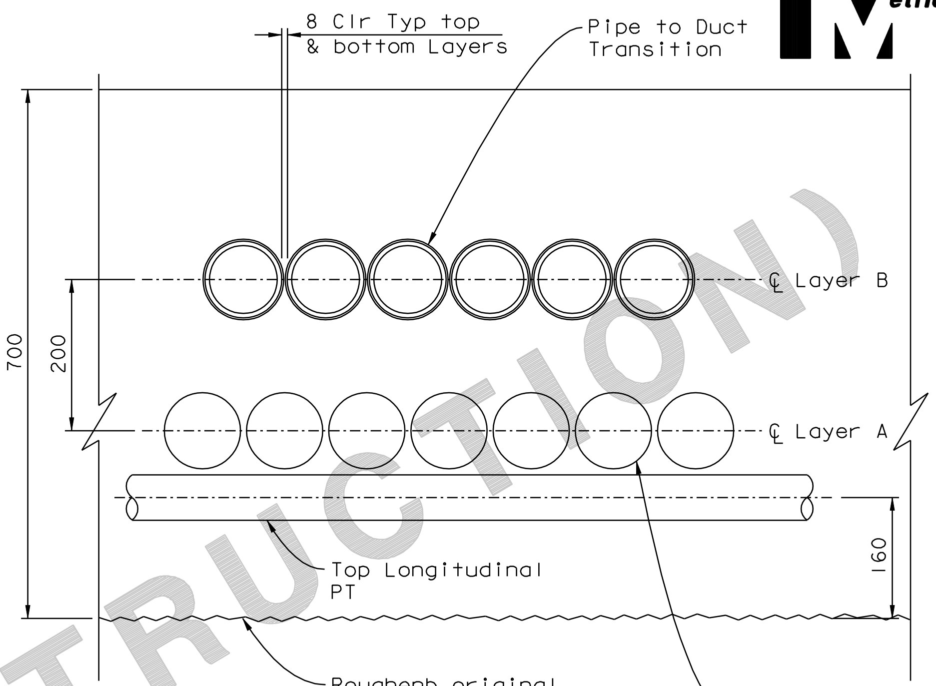


NOTE:

Layer A (Inner) Pipes Shown,
Layer B (Outer) Pipes Similar.

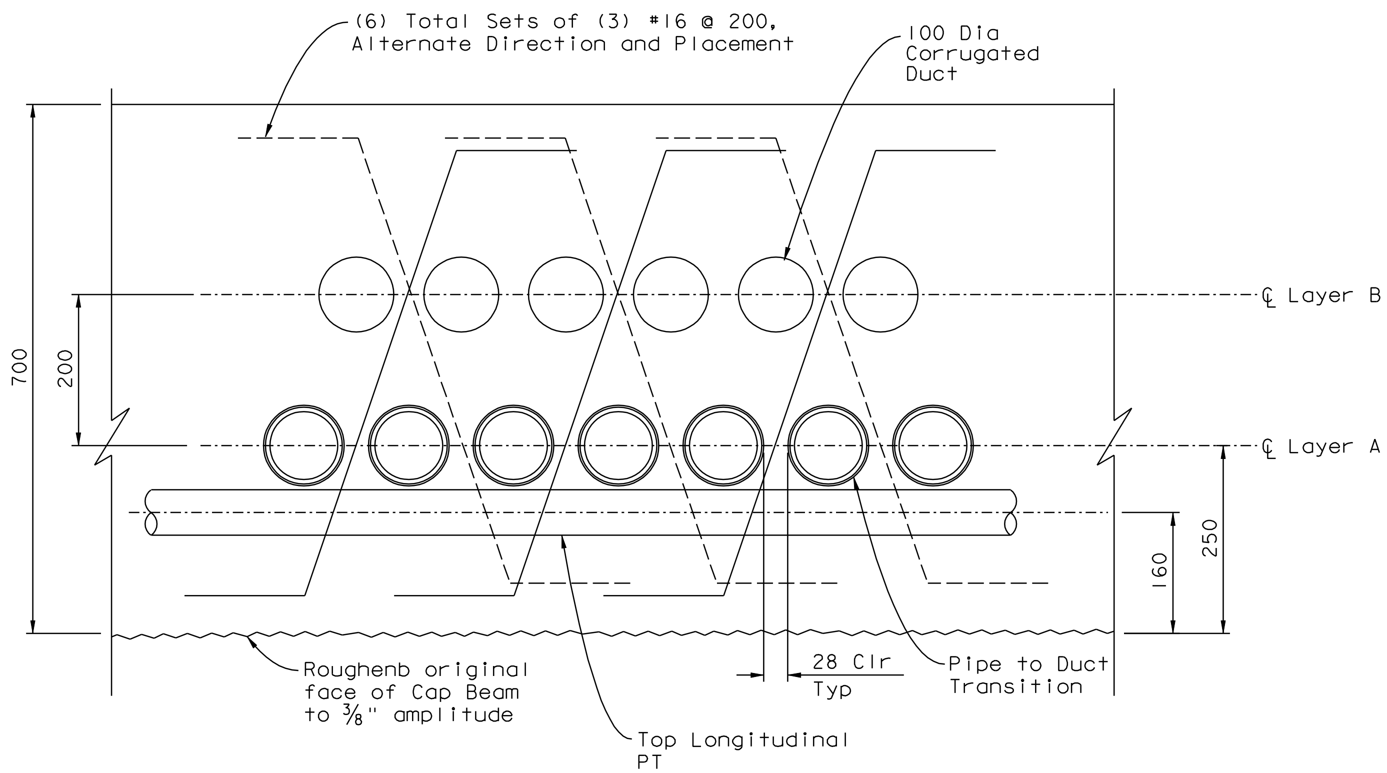
LOWER SADDLE PIPE SPLAY

1:5



SECTION X-X

1:5



SECTION Y-Y

1:5

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ALTERNATIVE C(2)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-11)

Rev. Date: 5-18-98

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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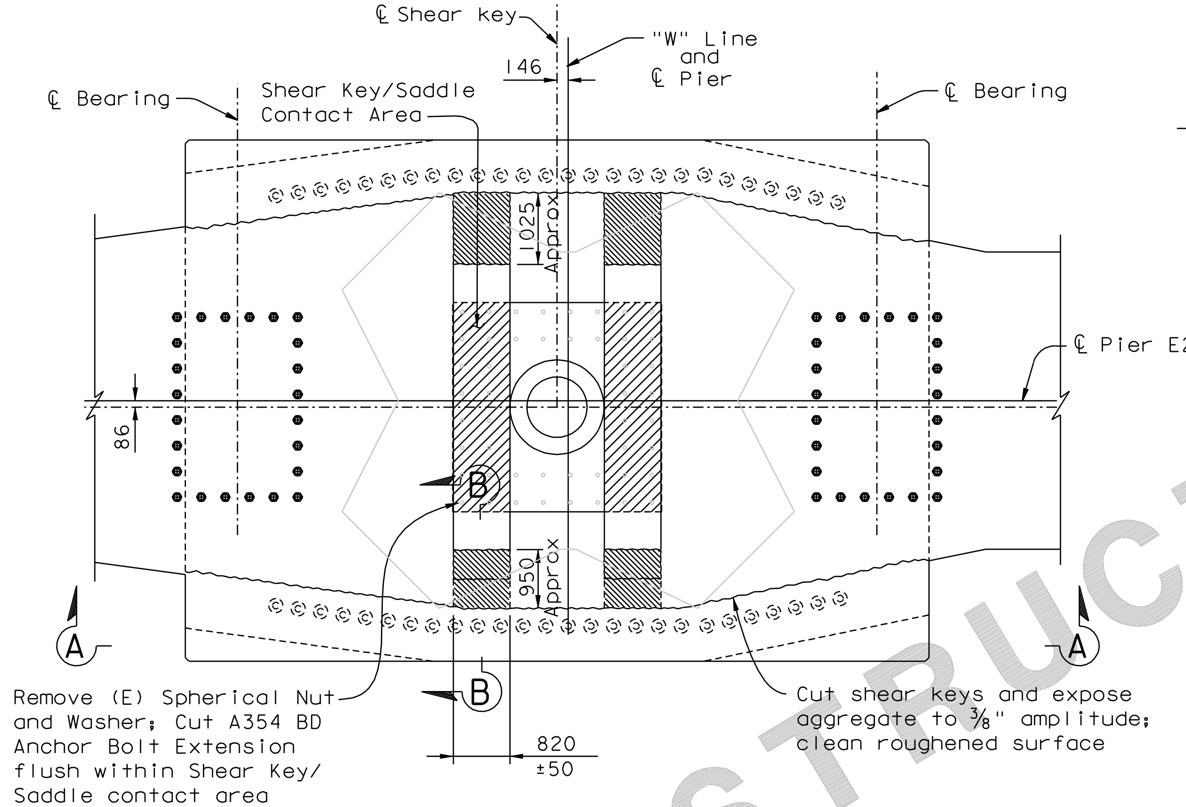
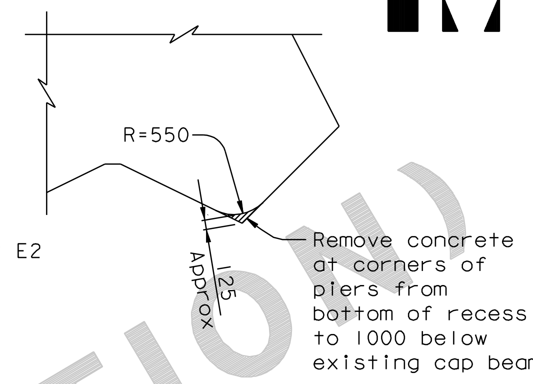
Option C: Construction Sequence

1. Survey existing conditions and locate control points.
2. Remove concrete trough at Cap Beam top corner for saddle boxes (existing corner rebar to remain).
3. Existing concrete contact surface preparation:
   a. Cut keys into the existing vertical concrete faces.
   b. Expose aggregate on the entire face by bush hammering (not required for soffit) to ⅜" amplitude.
4. Pressure wash all prepared concrete surfaces (side walls, excavated corner troughs and soffit).
5. Pre-locate tendon layouts.
6. Drill and place epoxy dowels (side walls and soffit).
7. Core Through-Cap tendon holes; surface hole may increase to accommodate trumpet.
8. Place rebar cages, post-tensioning ducts, and anchors. Place rigid (pipe) duct sections with extents below bottom saddle.
9. Cast Concrete:
   a. Pour soffit beams, with base of jacket walls.
   b. Complete jacket walls. Block out bottom saddle housing area.
10. Prepare surface of shear key base plate (removal of existing coatings on contact areas, grinding of corners).
11. Drill and tap Shear Key base vertical face for new saddle wedge plate installation.
12. Apply Chockfast adjacent shear key base and smooth immediately before placement of saddle wedge.
13. Place saddle wedge plates and bolt into place.
14. Remove existing A354 BD spherical nuts and washers; cut anchor bolt extension flush with shear key base plate top surface.
15. Install saddle shim plate and continuous support plate (grout with Chockfast for uniform bearing).
16. Install upper saddle PT rigid duct housing components and assemble. Seal component joints.
17. Install bottom saddles and splice to rigid pipes at either end. Adjust to final position, and drill attachment bolt holes. Place attachment bolts, and grout into place.
18. Thread PT strand through ducts, and stress per PT sequence plan.
19. Grout PT Tendons and PT anchorage block voids.
20. Pour back remaining corner trough concrete.



CAPBEAM PREPARATION
1:50



CONCRETE REMOVAL AT PIER
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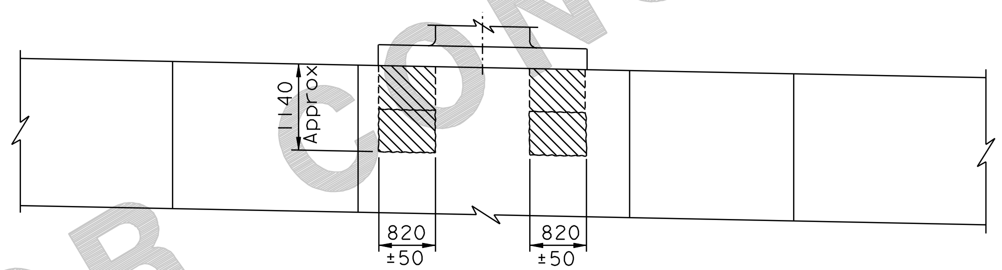
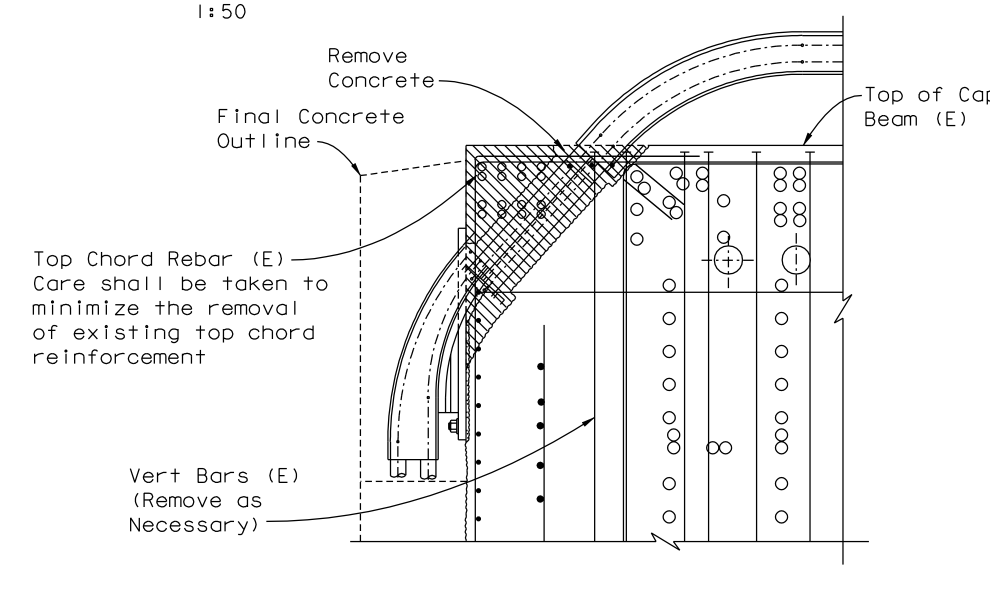


VIEW A-A
1:50



SECTION B-B
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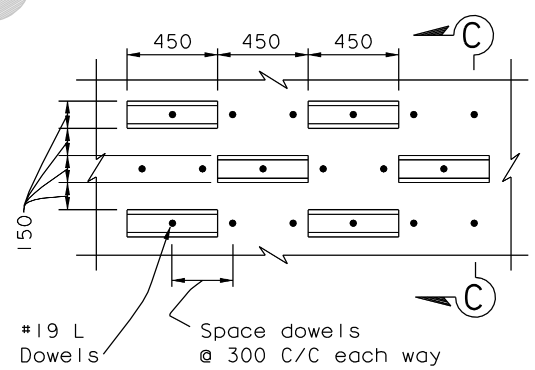
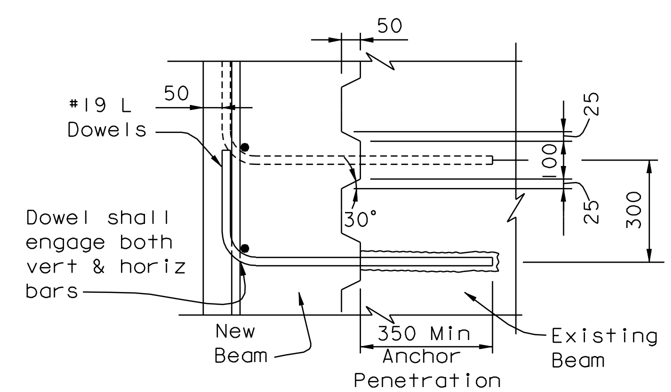


SHEAR KEY PATTERN
NO SCALE



SECTION C-C
1:10

Post Tensioning Sequence:

1. Bottom Longitudinal Tendons
2. Transverse Tendons
3. Top Longitudinal Tendons
4. Through-Cap Tendons*
5. Vertical Tendons

* Through-Cap Tendons may be stressed in parallel with the first 50% of the Vertical Tendons.

Legend:

Removed Concrete

ALTERNATIVE C(2)

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SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE & TOWER)

E2 SHEAR KEYS ANCHOR RODS RETROFIT (ALT. C2-12)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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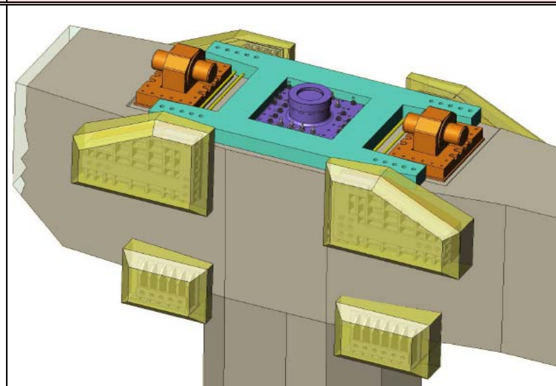
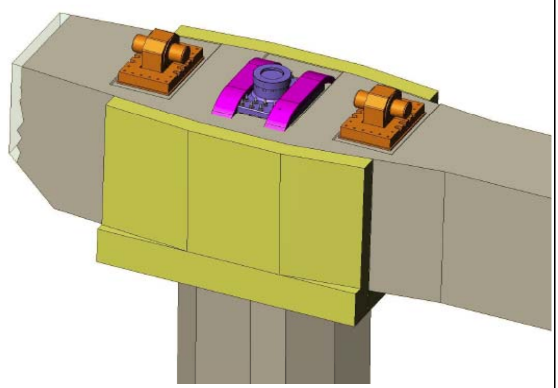
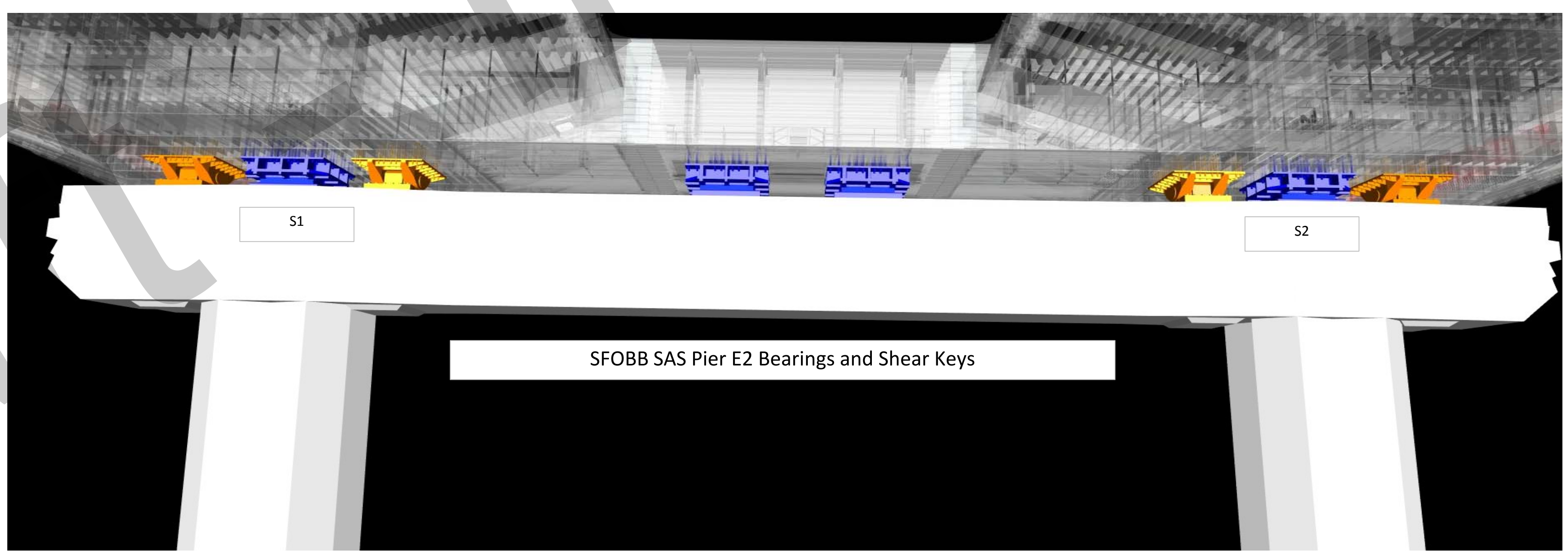
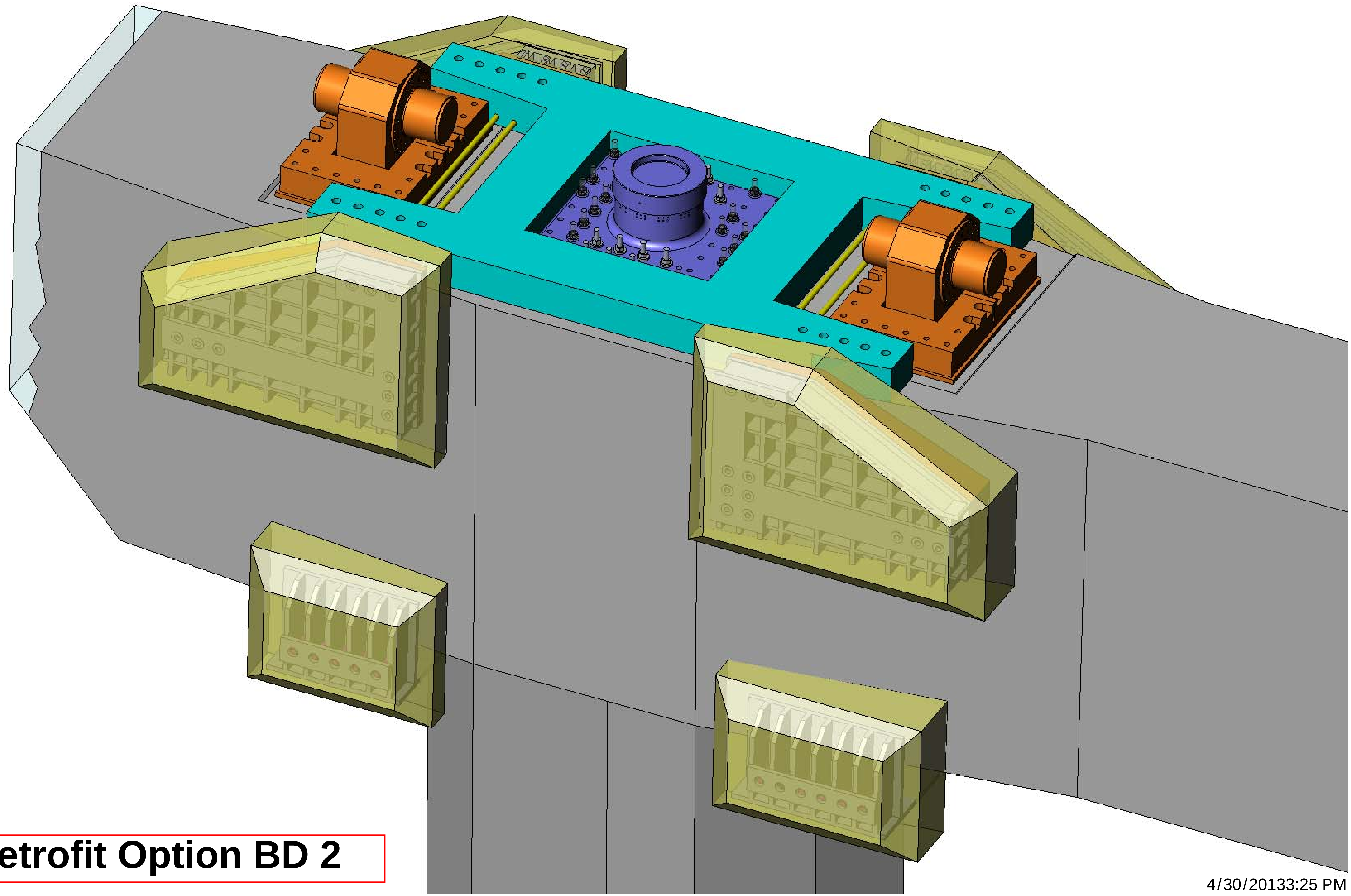
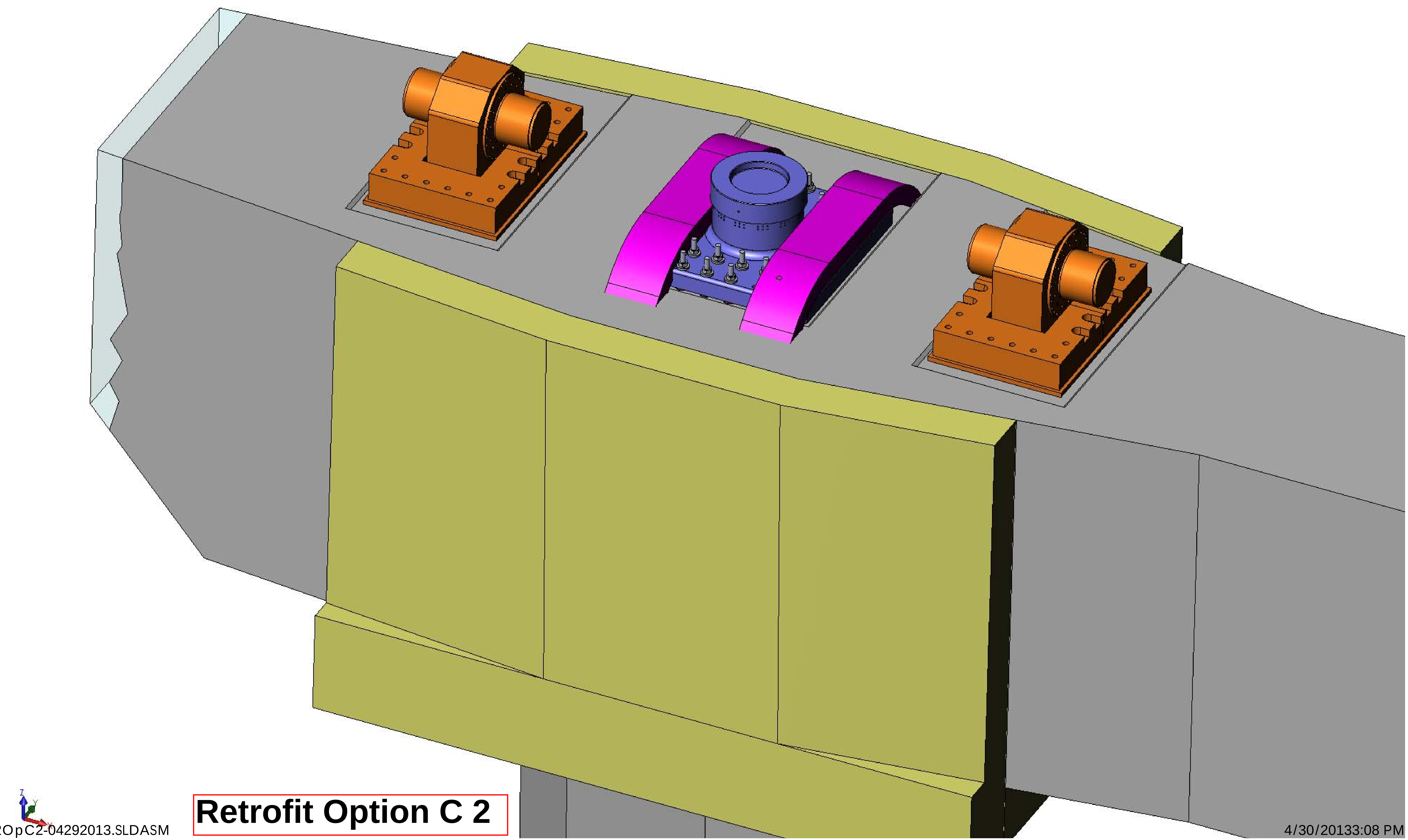
RETROFIT ALTERNATIVES FOR SHEAR KEYS S1 & S2

ID Tag	ID Text Label	Image	Major Steps	Major Pros	Major Cons
BD(2)	Steel Collars		1) Procure material (PT strands/ steel plate/ bolts) 2) Fabricate steel frame/ transverse steel grillage 3) Tap holes in existing lower housing and prepare surface 4) Core existing concrete and cast supplemental concrete 5) Install steel frame and grillages 6) Grout under steel frame and grillages 7) Tension PT and grout 8) Cast cover concrete	- Potentially faster - Shear keys do not need to be removed - Does not require splitting the bushing	- Requires more steel fabrication (milling/ welded steel grillages/ bolted steel frame) - Requires multiple vertical and horizontal cores - Requires an alternative procedure for future bearing replacement
C(2)	Prestressed Collars		1) Procure material (PT strands/ steel plate) 2) Fabricate steel frame/ saddle 3) Concrete surface preparation/ drill and bond 4) Core existing concrete 5) Cast concrete jacket 6) Install steel frame/ saddle 7) Grout under saddle 8) Tension PT and grout	- Potentially faster - Shear keys do not need to be removed - Requires fewer horizontal cores and no vertical cores	- Requires concrete jacket - Requires complex saddle fabrication - Requires splitting of the bushing





Retrofit Option BD 2



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Retrofit Option C 2

4/30/20133:08 PM

E2 SHEAR KEYS (S3 & S4) AND BEARINGS CONNECTION TO E2 CAPBEAM

EQUIVALENT SUBSTITUTION

192 ROD REPLACEMENT ALTERNATIVES (2010)

(To be considered in the event that test results indicate that change of existing rods is advisable)

ID Tag	ID Text Label	Nominal Diameter [inch]	Minimum Strength (Fu) [ksi]	Prestress [ratio of Fu]	Pre-Tension Load per Bolt [kips]	Major Pros	Major Cons	Lead Time
1	ASTM A354 BD Rods w/ Supplementary Requirements	3	140	0.7 Fu	585	- Does not require fit-for-purpose evaluation - Size of components (rods, spherical washer, spherical nut) works with existing condition	- Additional requirements above ASTM standards - May require removal of grout in pipe sleeve for rod replacement	- Estimated at 3-4 months
2	ASTM A354 BC Rods	3.5	115	0.61 Fu	585	- Avoids use of high strength material	- Requires machining of bearing bottom housing for larger spherical washer and nut assembly (32 locations) - Requires re-evaluation of the bearing bottom housing by FEM analysis to confirm if it is fit-for-purpose - Requires reaming of holes of the bearing bottom housing and the shear key bottom housing by 12mm for larger rod diameter (192 locations) - Larger diameter bolt removes 12mm of the available tolerance for fit-up - Requires removal of grout pipe sleeve for larger diameter rod. Requires modifications to jacking equipment	- Estimated at 3-4 months
3	DYWIDAG Bars	3" (3.15" max)	150	0.57 Fu	585	- Proprietary alloy and chemistry (strength meets ASTM A722; however, 3" rods are not covered under ASTM A722)	- Sole-source - No standard spherical nuts, washers, and dished plate; but can be designed and manufactured - Requires machining of bearing bottom housing for higher spherical washer and nut assembly (32 out of 96 locations) - Requires re-evaluation of the bearing bottom housing by FEM analysis to confirm if it is fit-for-purpose - Requires reaming of holes of the bearing bottom housing and the shear key bottom housing by 4mm to for larger rod diameter (192 locations) - Requires removal of grout in pipe sleeve for larger diameter rod. Require modifications to jacking equipment	- Estimated at 3 to 4 plus weeks
4	Williams Rod	3" (3-3/64 max)	150	0.60 Fu	581	- Proprietary alloy and chemistry (strength meets ASTM A722; however, 3" rods are not covered under ASTM A722)	- Sole-source - Requires machining of bearing bottom housing for higher spherical washer and nut assembly (32 out of 96 locations) - Requires re-evaluation of the bearing bottom housing by FEM analysis to confirm if it is fit-for-purpose - Requires reaming of holes of the bearing bottom housing and the shear key bottom housing by 4mm to for larger rod diameter (192 locations) - Requires removal of grout in pipe sleeve for larger diameter rod. Requires modifications to jacking equipment	- 3 to 4 weeks
5	Prestressing Strand	16 strands	270 before losses	0.44 Fu after losses	585	- ASTM A 416	- At bearings (48 out of 96 locations), anchor frame assemblies interfere with the upper housing - Requires fabrication of anchor frame assembly - Requires reaming of holes of the bearing bottom housing and the shear key bottom housing by 10mm to for strands - Requires re-evaluation of the bearing bottom housing by FEM analysis to confirm if it is fit-for-purpose - Does not allow for bushing replaceability for both bearings and shear keys - Requires removal of grout in pipe sleeve for strands. Requires modifications to jacking equipment	- strands and anchors readily available; anchor frame assembly time estimated at 6-8 weeks

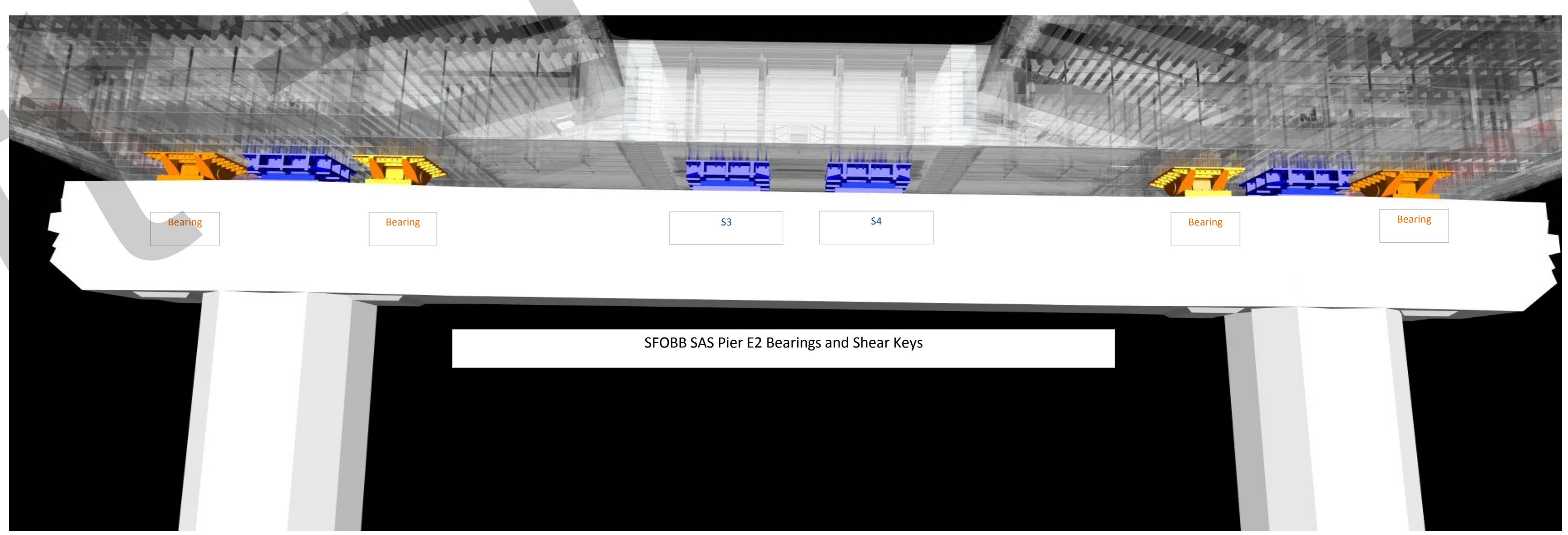
E2 SHEAR KEYS (S3 & S4) AND BEARINGS CONNECTION TO E2 CAPBEAM

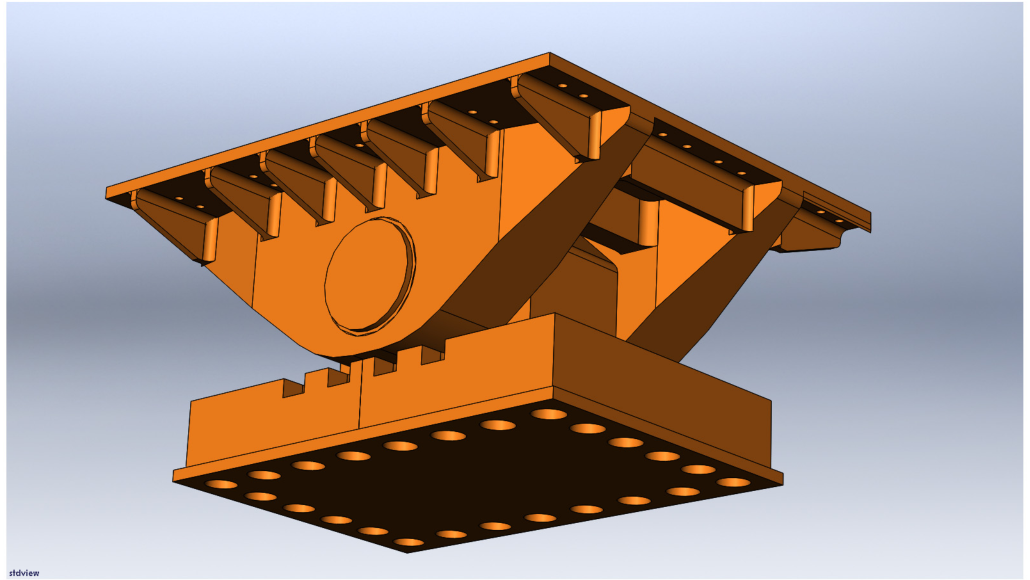
POTENTIAL FIT-FOR-PURPOSE SUBSTITUTION

192 ROD REPLACEMENT ALTERNATIVES (2010)

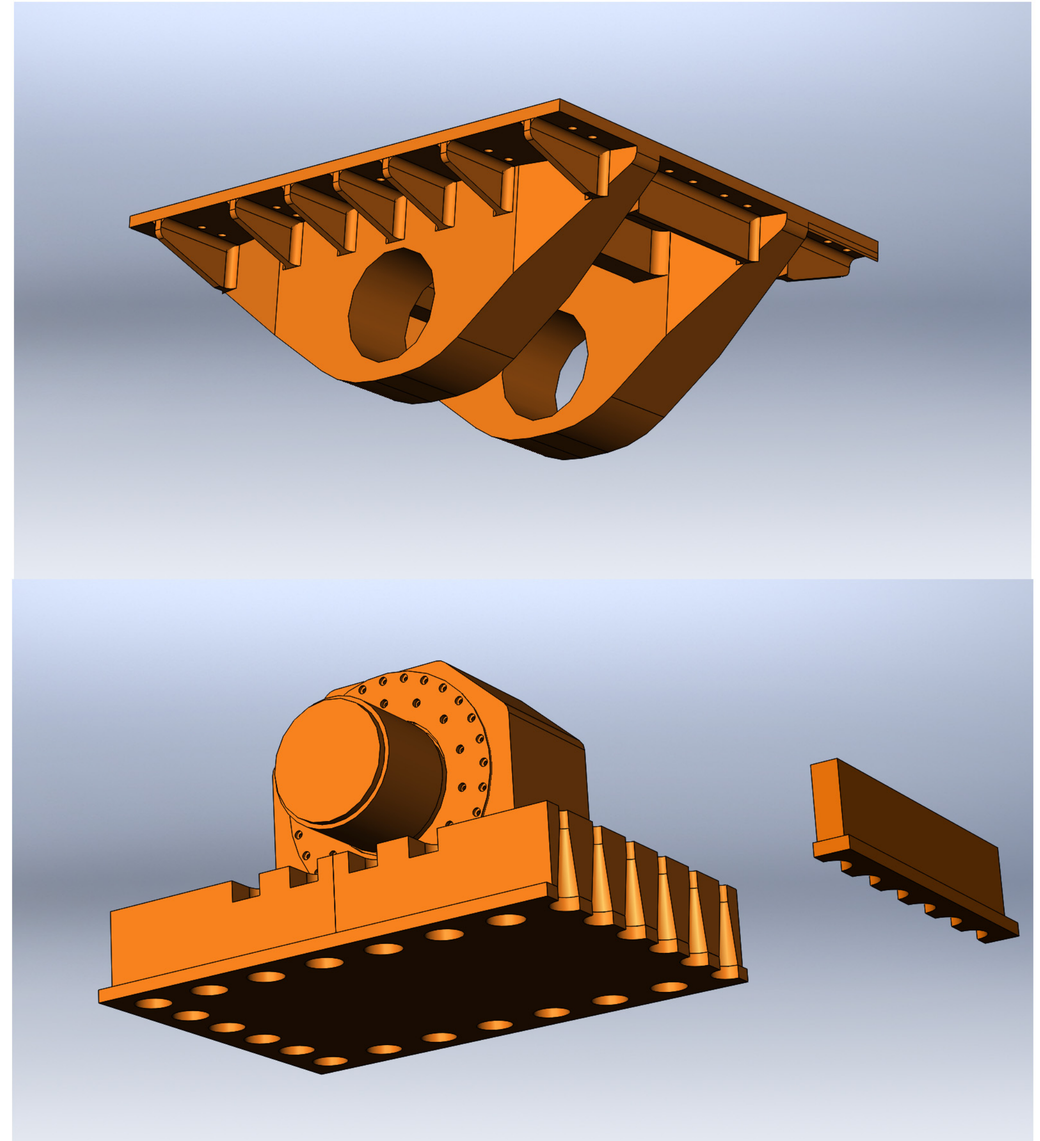
(To be considered in the event that test results indicate that change of existing rods is advisable)

ID Tag	ID Text Label	Nominal Diameter [inch]	Minimum Strength (Fu) [ksi]	Prestress [ratio of Fu]	Pre-Tension Load per Bolt [kips]	Major Pros	Major Cons	Lead Time
6	Existing ASTM A354 BD Rods w/ Reduced Pre-Tension	3	140	< 0.7 Fu	< 585	- Size of components (rods, spherical washer, spherical nut) works with existing condition	- Requires fit-for-purpose evaluation	No lead time
7	ASTM A354 BC Rods	3	115	0.7 Fu	481	- Avoids use of high strength material	- Requires fit-for-purpose evaluation - May require removal of grout in pipe sleeve for rod replacement	- Estimated at 3-4 months
8	ASTM F1554 Gr. 105	3	125	0.7 Fu	522	- Size of components (rods, spherical washer, spherical nut) works with existing condition	- Requires fit-for-purpose evaluation - May require removal of grout in pipe sleeve for rod replacement	- Unknown



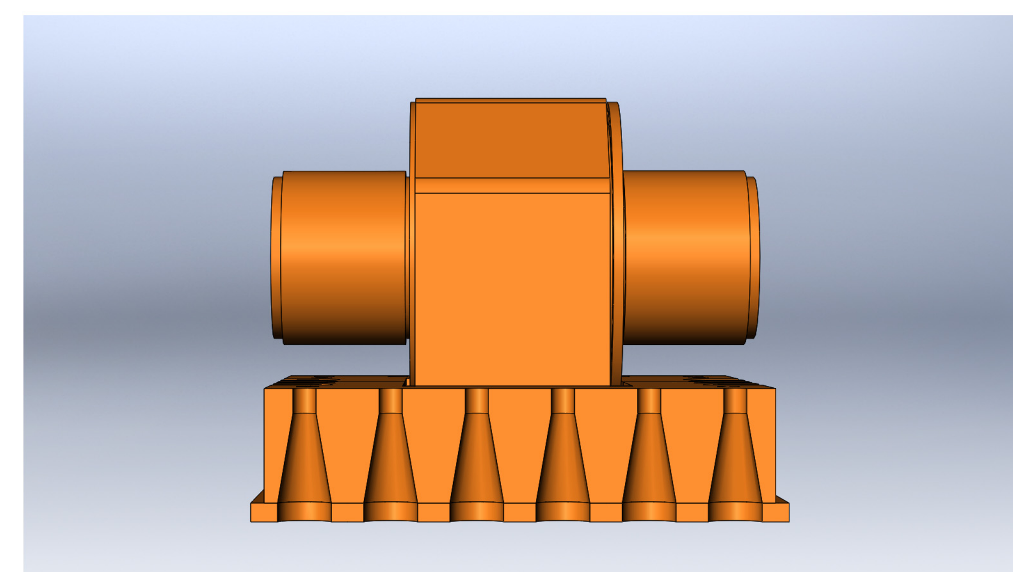


BEARING ASSEMBLY

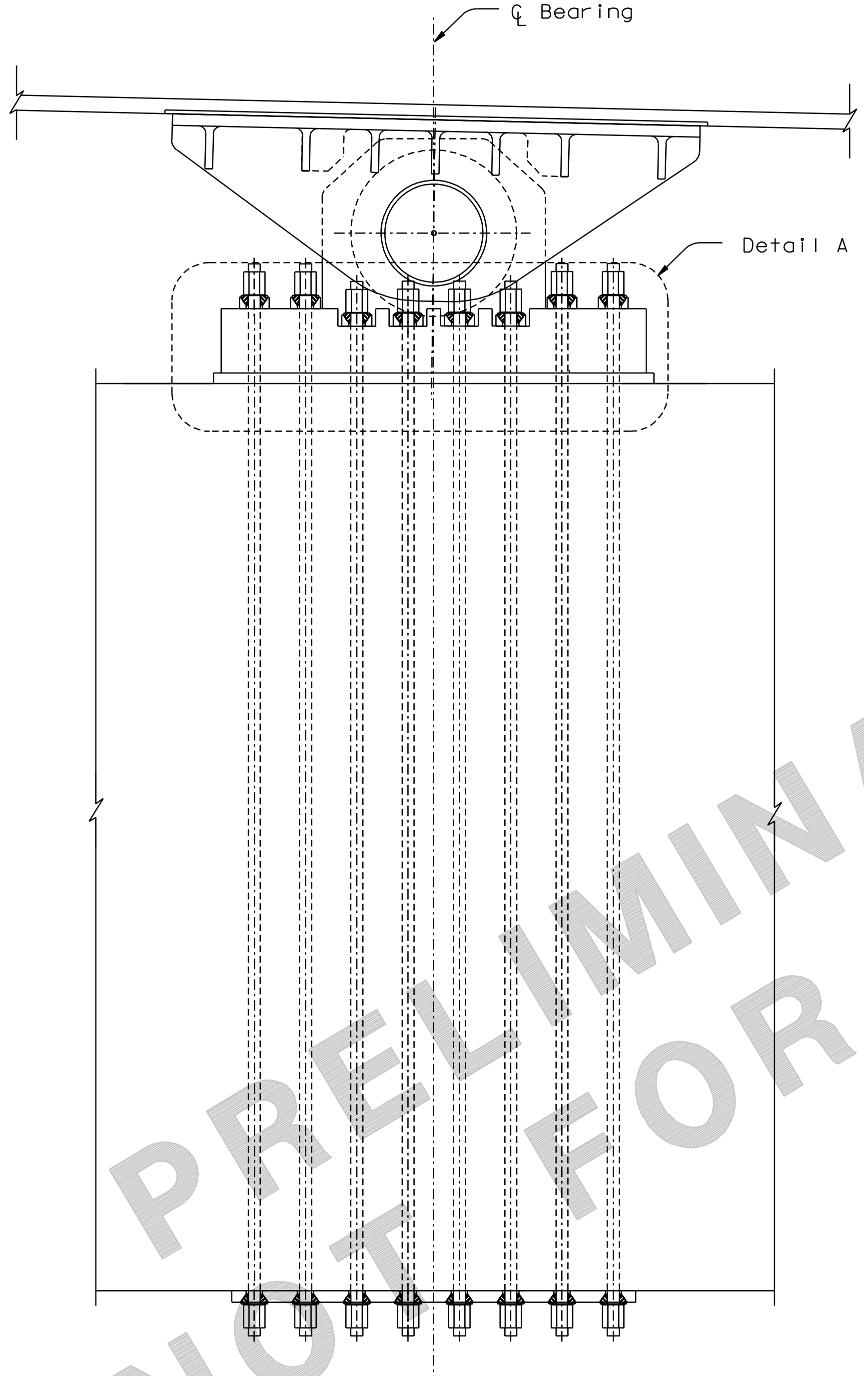


TOP HOUSING &
HOLD DOWN ASSEMBLY

HOLD DOWN ASSEMBLY
SECTION CUT

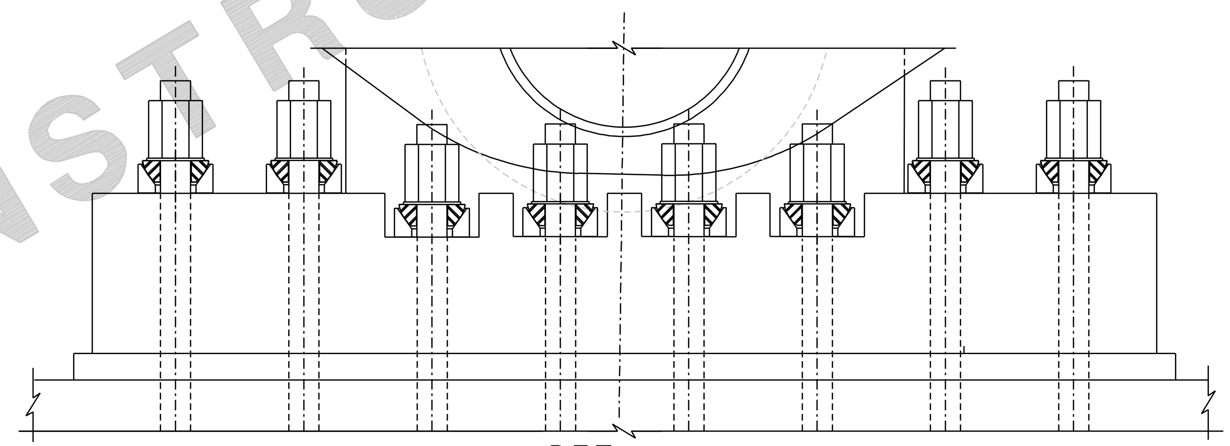


BEARING ASSEMBLY



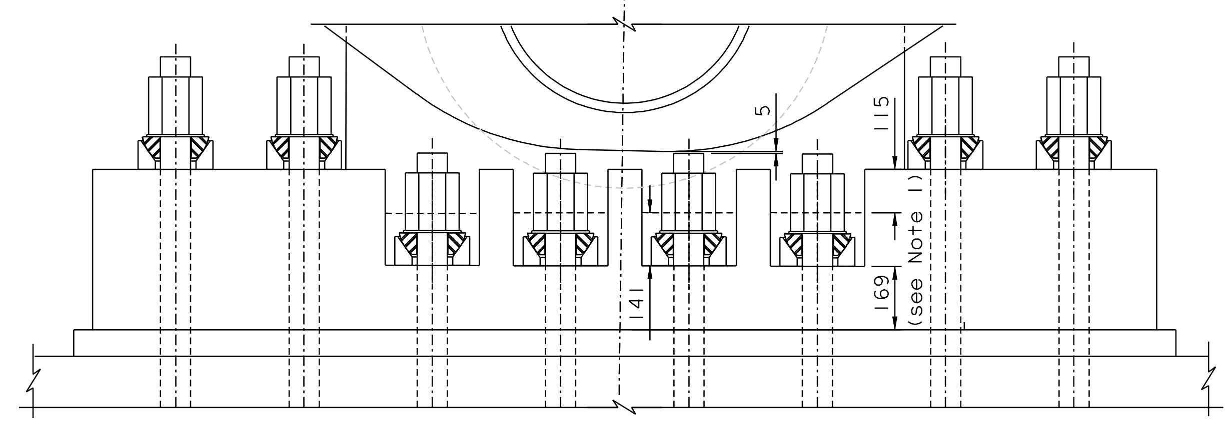
BEARING

1:25



DETAIL A

1:10



MACHINING SCHEME

1:10

Note:

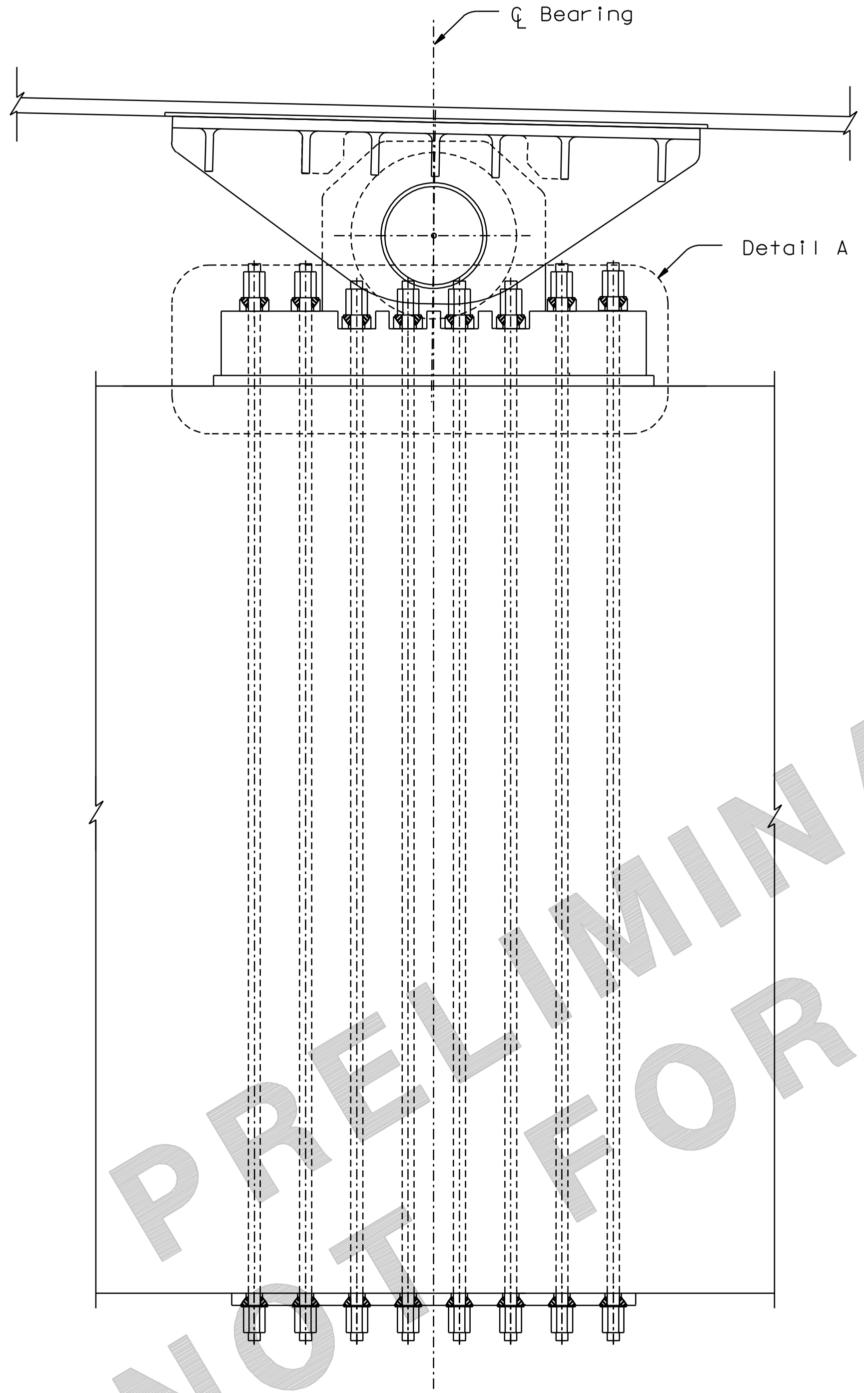
1. Machine recess holes by 169 Min to fit.

DSI

Date: 2013-04-29

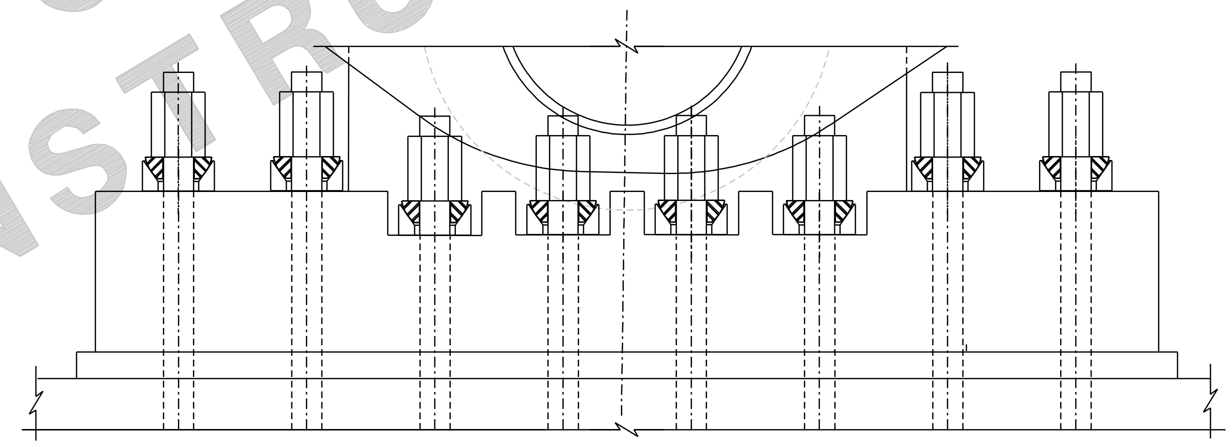
File Name: OPTION-B

SFOBB SAS (SAS) Project #04-0120F4



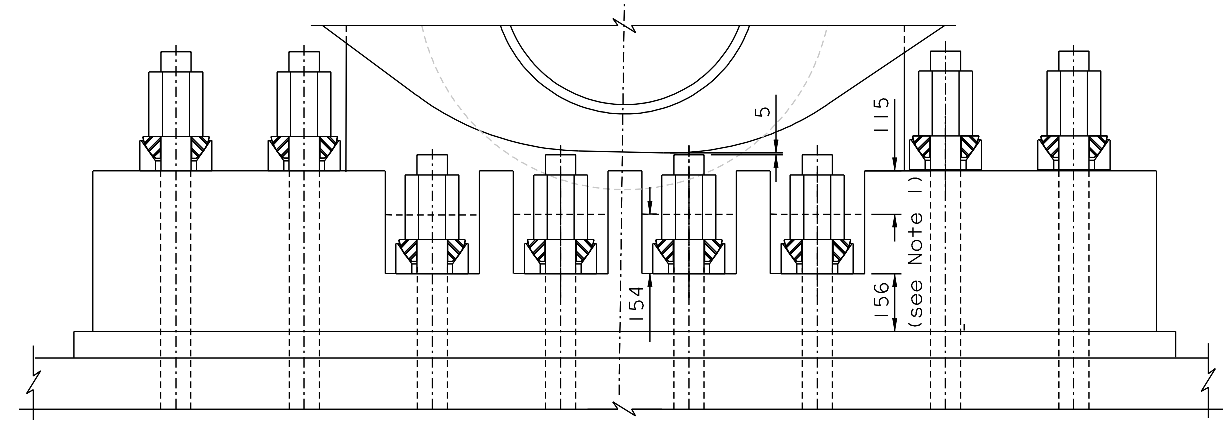
BEARING

1:25



DETAIL A

1:10



SECTION

1:10

Note:

1. Machine recess holes by 156 Min to fit.

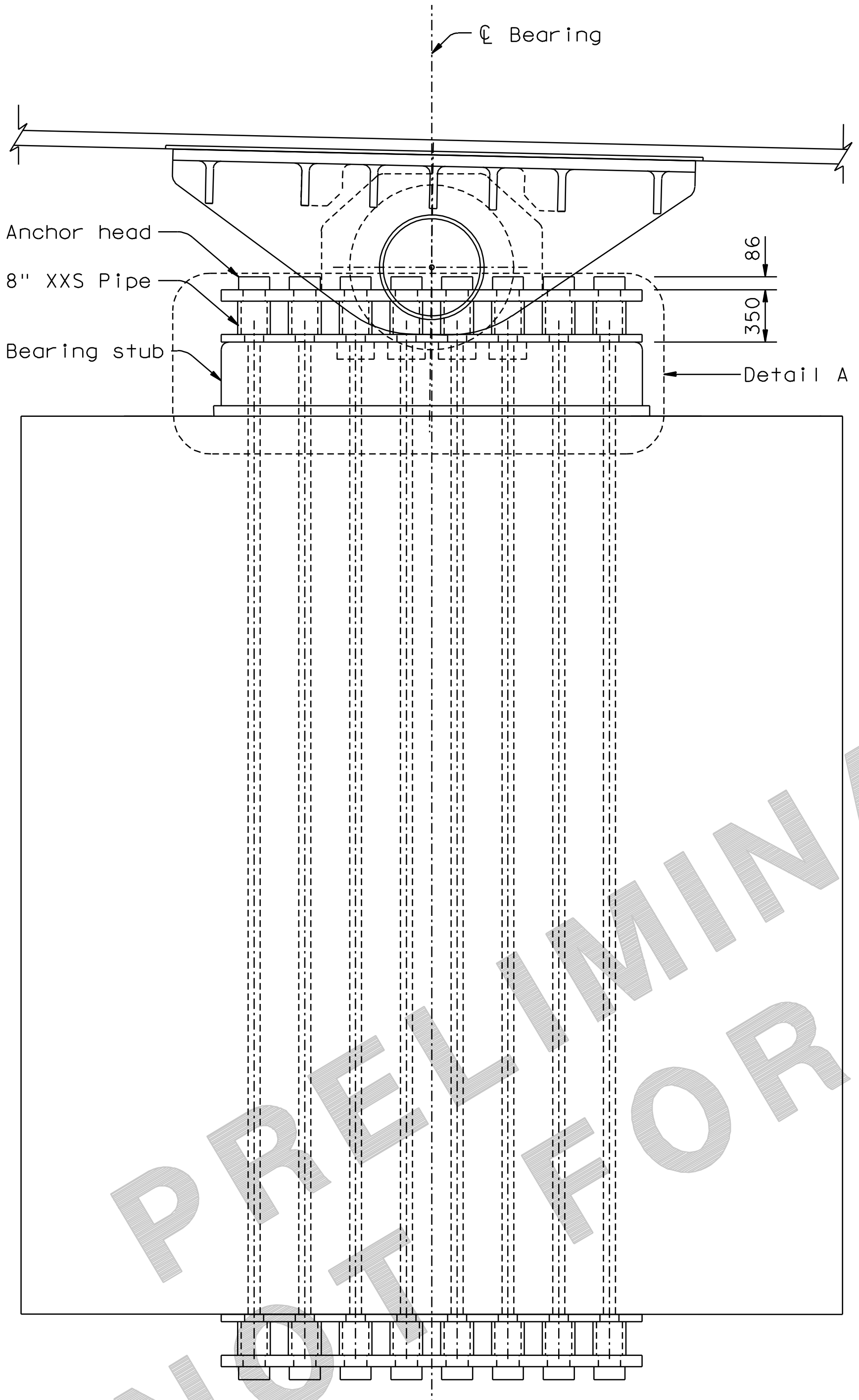
WILLIAMS RODS

Date: 2013-04-29

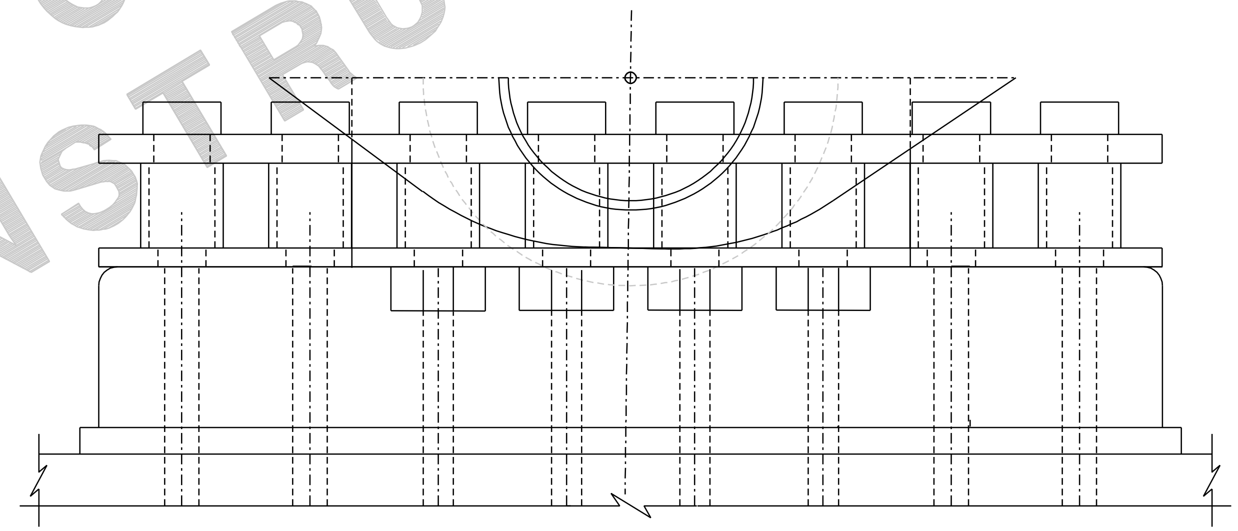
File Name: OPTION-C

SFOBB SAS (SAS) Project #04-0120F4

USERNAME => ALishansk DATE PLOTTED => 30 APR 2013 TIME PLOTTED => 16:11:45
FILE => I:\bb\04-0120I\sas\rfi updates\engineer update sketches\sh e2 shear keys retrofit\pier e2 bearing interference\option-c.d



BEARING
1:25



DETAIL A
1:10

PRESTRESSING STRANDS

Date: 2013-04-26
File Name: OPTION-A

SFOBB SAS (SAS) Project #04-0120F4

USERNAME => ALIshanski DATE PLOTTED => 30 APR 2013 TIME PLOTTED => 16:08:55
FILE => I:\bb\04-01200I\sas\rfi updates\engineer update sketches\sh e2 shear keys retrofit\pier e2 bearing interference\option-a.d

Location and Item		Component Description	Rod (no head) or Bolt (with head)	Supplier	Diameter (in)	Overall Length (ft)	Overall Length (mm)	Quantity Installed (not including spares)		De-Humidified Zone?	Tighten Method	Final Tension (fraction of Fu or UTS)	Date Tension or Loading Complete	Date Re-Inspected (by 4/8/13)	Date Re-Inspected (by 4/23/13)	Notes
E2 Bearings and Shear Keys	1	E2 Shear Key - Connect to Concrete - Above Column, Under OBG [S1, S2]	rod	Dyson	3	17.2	5235	60	96	No	Tension	0.7	3/5/2013	daily check	daily check	32 of 96 rods broke after tensioning, then tension level lowered
						10.0	3035	36								
	2	E2 Shear Key - Connect to Concrete - Above Bent Cap, Under Crossbeam [S3, S4]	rod	Dyson	3	21.9	6676	96	192	No	Tension	0.7	4/1/2013	daily check	daily check	
		E2 Bearing - Connect to Concrete - Under OBG [B1, B2, B3, B4]	rod	Dyson	3	22.6	6902	64			Tension	0.7	4/9/2013	daily check	daily check	
						22.2	6777	32								
	3	E2 Shear Key - Connect to OBG [S1, S2]	rod	Dyson	3	4.4	1337	96	320	No	Tension	0.7	9/12/2012	4/6/2013 4/8/2013	4/17/13 to 4/23/13	
						1.8	537	64								
		E2 Shear Key - Connect to Crossbeam [S3, S4]	rod	Dyson	3	4.3	1312	96								
						1.7	512	64								
	4	E2 Bearing - Connect to OBG [B1, B2, B3, B4]	rod	Dyson	2	3.6	1105	224		No	Tension	0.7	9/12/2012	4/6/2013	4/17/13 to 4/23/13	
	5	E2 Bearing Assembly Bolts (Spherical Bushing Halves)	rod	Dyson for Lubrite for Hochang	1	2.4	733	96		No	Tension	0.61	July 2009	not accessible	not accessible	Connect 2 halves of the spherical bushing assembly housing together at Lubrite; rods are internal to bearings and **all rods are not accessible** after bearing assembly at Hochang (December 2009 & January 2010); rods tensioned to 0.7 Fy.
	6	E2 Bearing Assembly Bolts (Retaining Rings)	Socket Head Cap Screw	Dyson for Hochang	1	0.2	55	336		No	snug + 1/4 turn	~0.4	January 2010	4/6/2013 (for 32 accessible bolts)	4/23/2013 (for 32 accessible bolts)	Bolts thread into drill and tap holes to attach retaining rings that secure the Lubrite spherical bushing assembly in the bottom housing; bolts are mechanically galvanized, not hot dip galvanized; bolts are internal to bearings and not accessible after bearing assembly at Hochang, except for a small number of bolts in limited areas -> **32 of 336 bolts are accessible**.
Cable Anchorage	7	PWS Anchor Rods - PWS Socket to Anchorage	rod	Dyson	3-1/2	27.9 to 31.8	8500 to 9700	274		Yes	Load Transfer	0.26	9/26/2012	4/6/2013	4/20&22/2013	With DL after load transfer (current condition)
												0.29	N/A	N/A	N/A	With DL + Added DL
												0.32	N/A	N/A	N/A	Service Load (Group 1)
												0.35	N/A	N/A	N/A	SEE (Seismic)
Top of Tower	8	Tower Saddle Tie Rods	rod	Dyson	4	6.0 to 17.5	1840 to 5325	25		Yes	Tension	0.41	7/14/2012	4/6/2013	4/19/2013	Tensioned to 0.5 Fy
	9	Turned Rods at Tower Saddle Segment Splices	rod	Dyson	3 @ Threads [~3-1/16 @ Shank]	1.5	463	100	108	Yes	Tension	0.45	4/6/2011	4/6/2013	4/19/2013	Located at the 2 field splices connecting the 3 tower saddle segments; 100 rods tensioned prior to saddle erection; 8 rods only snug tight after tie rod tensioning due to conflict with tie rods.
						1.4	415	8			snug	~0.1	7/14/2012			
	10	Tower Saddle to Grillage Anchor Bolts	Hex Bolt	Dyson	3	1.2	360	90		Head Yes, Nut No	snug	~0.1	3/25/2013	4/6/2013	4/19/2013	Snug tightened before and after load transfer
	11	Tower Outrigger Boom (for Maintenance) at Top of Tower	Hex Bolt	Dyson	3	2.1	630	4		No	snug	~0.1	July 2012	4/6/2013	4/19/2013	Act as pins for swinging out and then securing the maintenance outrigger boom at the top of 2 of 4 tower head chimneys. At each boom, one bolt is loaded and other bolt is unloaded in the current boom position. The currently unloaded bolt will be installed snug tight when the boom is swung out for use (future position).
Bottom of Tower	12	Tower Anchor Rods - Tower at Footing (3" Dia)	rod	Vulcan Threaded Products for KOS for KFM (04-0120E4)	3	25.6	7789	388		Yes	Tension	0.48	4/17/2013	N/A	4/20/2013 4/22/2013	Tensioned to 1800 kN = 404.7 kips Tension before and after load transfer
	13	Tower Anchor Rods - Tower at Footing (4" Dia)	rod		4	25.7	7839	36		Yes	Tension	0.37	4/17/2013	N/A	4/20/2013 4/22/2013	Tensioned to 2530 kN = 568.8 kips Tension before and after load transfer
East Saddles	14	East Saddle Anchor Rods	rod	Dyson for JSW	2	2.6	800	32		Yes	snug	~0.1	May 2010	4/7/2013	4/21/2013	specified gap under nut/washer at one end of rod and 2 nuts snug against each other at other end of rod -> snug tight for portion of rod
	15	East Saddle Tie Rods	Hex Bolt	Dyson	3	4.7	1420	18		Yes	snug	~0.1	4/13/2012	4/7/2013	4/21/2013	Snug tightened before load transfer
East Cable	16	B14 Cable Bands - Cable Brackets - at East End of Bridge - Strongback Anchor Rods	rod	Dyson	3	10.3 to 11.1	3129 to 3372	24		No	Tension	0.16	2/8/2013	4/7/2013	4/21/2013	neoprene between strongback and cable band is in the grip
W2 Bent Cap	17	W2 Bikepath Anchor Rods	rod	Dyson	~1-3/16 [Metric M30]	1.5	460	43		No	Not Determined Yet		N/A	N/A	N/A	Details for bikepath connections are being redesigned and are not final. The 18 anchor rods at the bottom connections will be abandoned. The 25 anchor rods at the top connections will be used and supplemented with additional anchor rods. These rods will be tensioned on the separate YBITS-2 Contract.

2008 A354 Gr. BD Anchor Rods [96 Rods]

Performed testing on a total of 2 anchor rods. Refer to fracture analysis report dated 04/28/13 for details.

1. Boroscopic Inspection of 3 rod holes
   - Presence of water at the bottom of rod hole (1 Wet, 2 Dry)

2. Visual Observations
   - Brittle fracture
   - Crescent shape crack initiation features

3. Mechanical Testing - Contract compliant

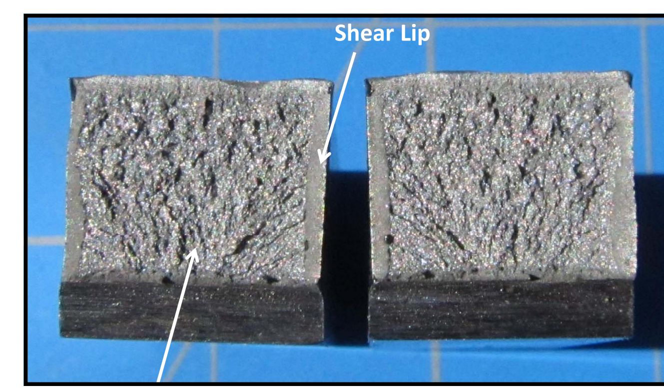
505 Sample Tensile Test Results				
Identification	S2-A6 #12	S2-A6 #2	S1-G1 #11	ASTM A354 Gr BD Requirement
Yield Strength (psi)	149,000	146,000	136,000	115,000 min.
Tensile Strength (psi)	170,000	168,000	159,000	140,000 min.
Elongation in 2" Gage (%)	15.5	14	15	14 min.
Reduction of Area (%)	46.0	48.0	48.4	40 min.

4. Chemical Testing - Contract compliant

Spectrochemical Analysis (Reported as Wt. %)						
		S2-A6 #12	S1-G1 #11	Mill Test Report[1]	Mill Test Report[2]	Requirement ASTM A354 Gr BD
Aluminum	Al	<0.005		0.001	0.001	
Carbon	C	0.40	0.43	0.41	0.41	0.33 -0.55
Chromium	Cr	0.97	0.98	0.98	0.98	
Cobalt	Co	0.01	0.01	0.007	0.007	
Copper	Cu	0.22	0.22	0.20	0.20	
Iron	Fe	Balance	Balance			
Manganese	Mn	0.93	0.93	0.92	0.92	0.57 min.
Molybdenum	Mo	0.16	0.15	0.16	0.16	
Nickel	Ni	0.10	0.10	0.10	0.10	
Phosphorus	P	0.012	0.012	0.014	0.014	0.040 max.
Silicon	Si	0.24	0.23	0.23	0.23	
Sulfur	S	0.034	0.039	0.034	0.034	0.045 max.
Titanium	Ti	<0.005	<0.005	0.002	0.002	
Tungsten	W	<0.005	<0.005			
Vanadium	V	0.03	0.03	0.030	0.030	
Zirconium	Zr	<0.005	<0.005			

5. Charpy Testing - No contract requirements

Charpy V-Notch Impact Energy Test Results (ft-lb)			
Identification	**S2-A6 #12**	**S2-A6 #2**	**S1-G1 #11**
Test Temperature	70°F	70°F	40°F
Sample 1	18	15	13.5
Sample 2	18	14	13
Sample 3	17	15	14
Average	17.7	14.7	13.5

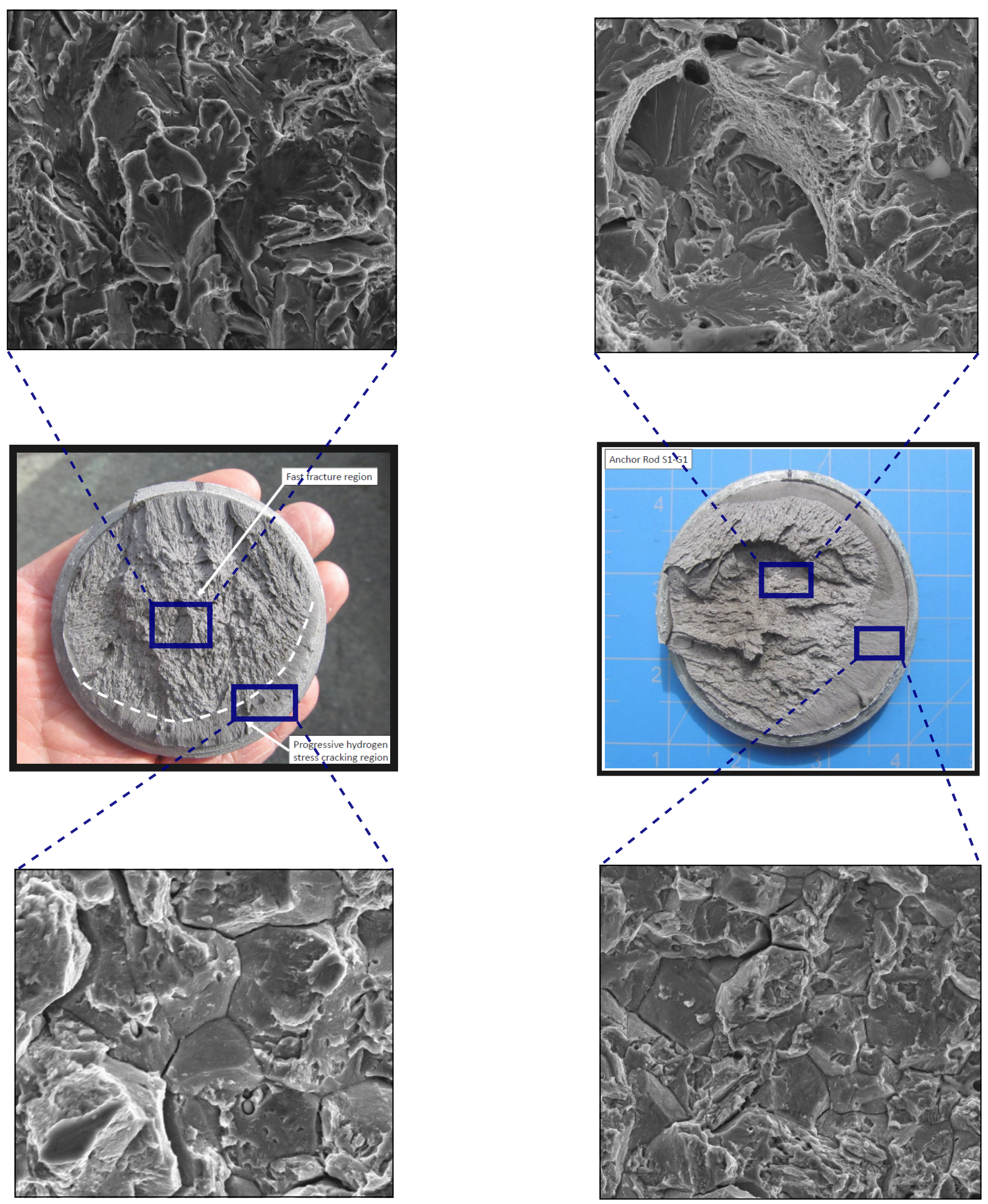


2008 A354 Gr. BD Anchor Rods [96 Rods] - Continued

6. Fracture Analysis - Microscopic Inspection

Sample 1
S2-A6 #12

Sample 2
S1-G1 #11

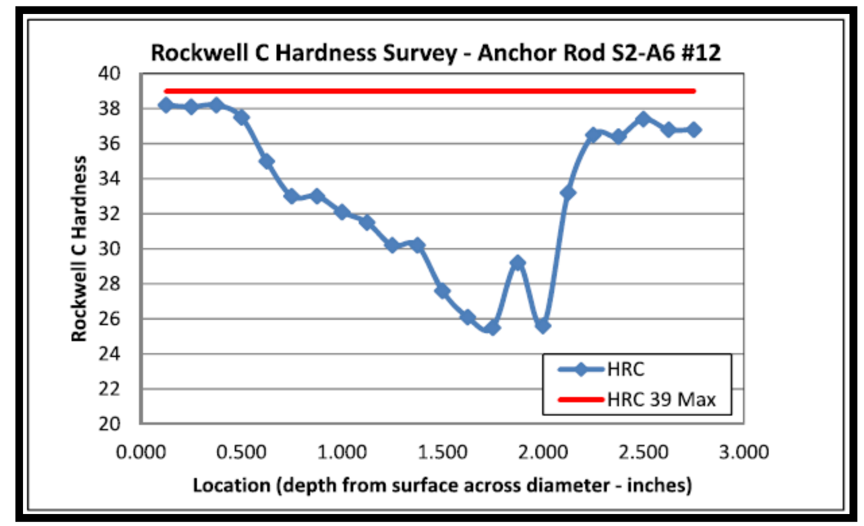


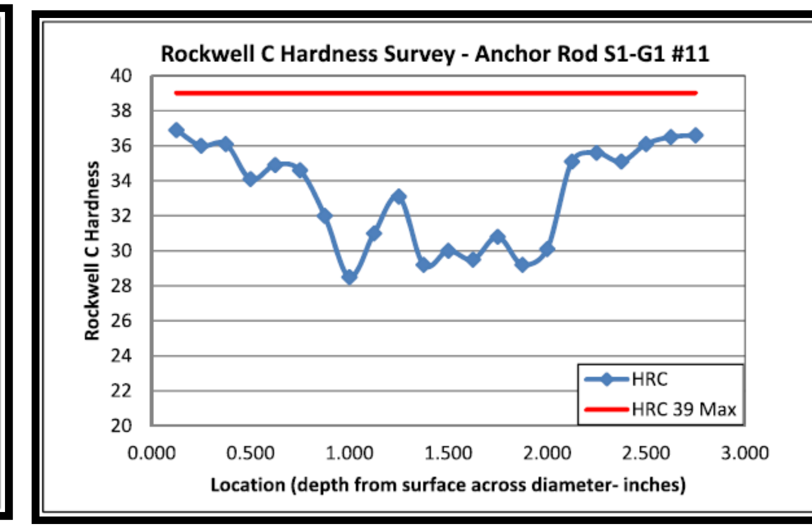
Cleavage Cracking

Intergranular Cracking

7. Hardness Testing

- Contract compliant, hard on exterior





8. Water Samples - In process

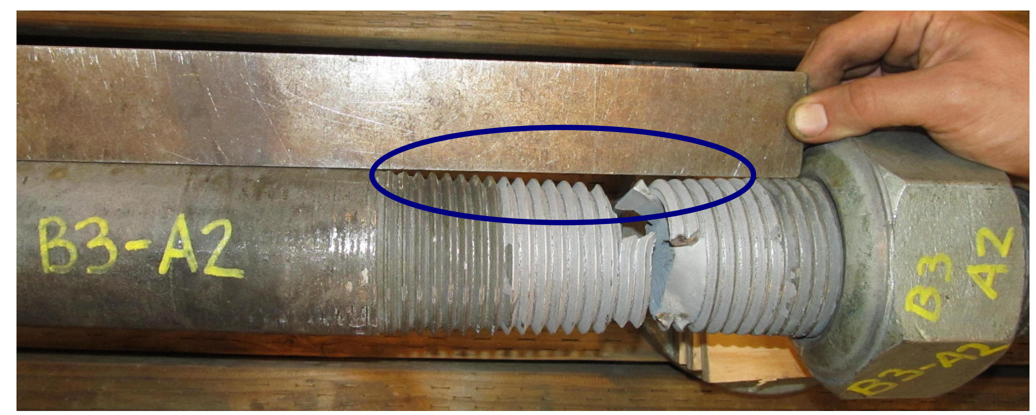
2010 A354 Gr. BD Anchor Rods [192 Rods]

1. In-Situ Tensioning of 192 rods. Rods tensioned starting on 03/30/13. No failures to date.
2. Test 4 full-size sample rods.

A. Mechanical Testing

Sample ID	Sample Diameter	Testing Ultimate Load	Min. ASTM Ultimate Load	Ultimate Tensile Strength	Min. ASTM Ultimate Tensile Strength	Elongation
S3-E7	3”	942.6 Kips	835.8 Kips	157.9 ksi	140 ksi	Not tested
S4-D7	3”	945.2 Kips	835.8 Kips	158.3 ksi	140 ksi	Not tested
B3-A2	3”	945.4 Kips	835.8 Kips	158.3 ksi	140 ksi	Not tested
B4-A7	3”	945.8 Kips	835.8 Kips	158.4 ksi	140 ksi	Not tested

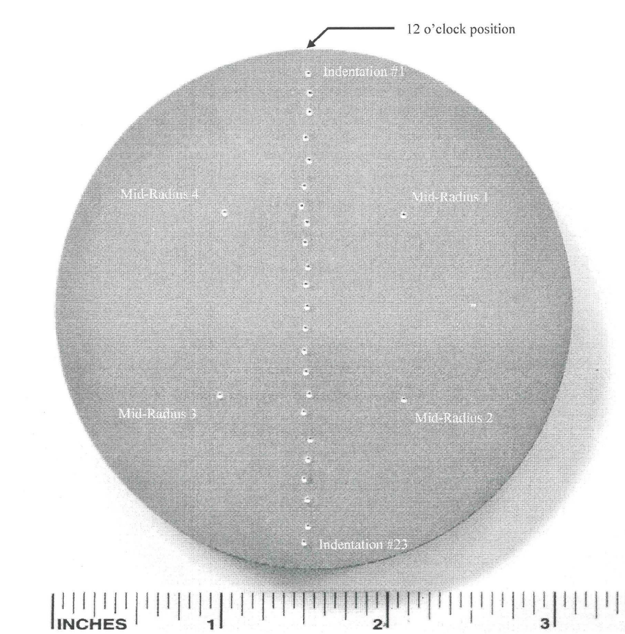
B. Visual Observations
- Ductile failure
- Visible reduction in area

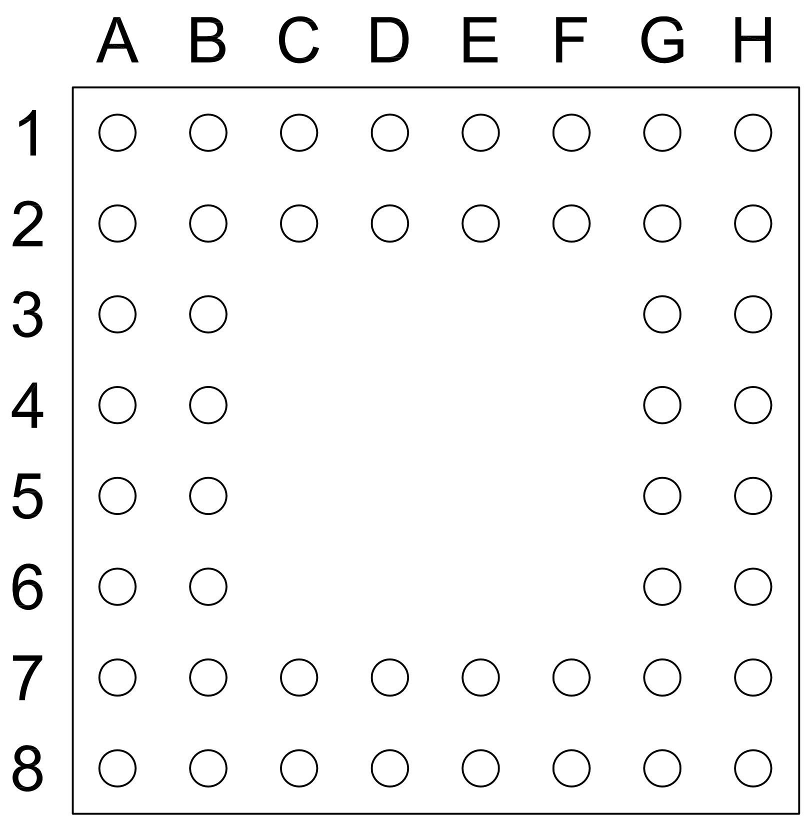


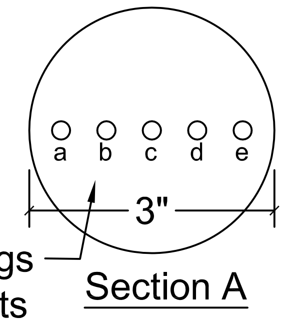
C. In-Process Testing
a- Charpy Testing
b- Reduced Section Tensile Testing
c- Hardness
d- Spectro-Chemical Analysis

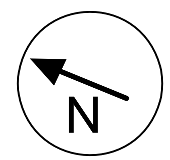
3. In-Situ Hardness Testing: See Page 4/5 for details.

4. Wet Test developed by Dr. Herb Townsend, Dr. Karl Frank, and Doug Williams - See Page 5/5 for details.









SHEAR KEY S3
ANCHOR ROD LAYOUT

Row	Reading	A	B	C	D	E	F	G	H
1	a	35	35	32	33	34	31	33	31
1	b	35	32	32	32	32	34	31	32
1	c	32	32	32	37	33	32	33	30
1	d	37	33	32	34	33	35	31	33
1	e	33	34	33	33	36	35	32	34
2	a	31	34	32	32	NA	32	37	35
2	b	33	32	31	31	NA	31	31	33
2	c	31	37	31	35	NA	32	31	33
2	d	31	32	32	33	NA	30	32	31
2	e	31	33	33	32	NA	35	34	33
3	a	33	31					33	34
3	b	31	32					33	33
3	c	32	33					32	35
3	d	31	31					33	34
3	e	33	31					34	32
4	a	32	35					31	34
4	b	31	31					32	33
4	c	32	34					31	32
4	d	33	34					32	34
4	e	32	34					32	32
5	a	33	31					32	34
5	b	31	32					32	35
5	c	32	33					31	36
5	d	35	31					33	34
5	e	35	35					33	34
6	a	35	33					32	32
6	b	33	32					32	33
6	c	34	32					32	35
6	d	31	31					32	34
6	e	35	31					32	32
7	a	33	37	31	38	NA	33	31	32
7	b	33	31	31	32	NA	32	30	33
7	c	31	32	33	37	NA	33	33	33
7	d	34	35	34	32	NA	30	33	33
7	e	34	36	34	34	NA	31	34	33
8	a	31	32	34	35	31	32	32	32
8	b	32	31	32	35	32	32	36	34
8	c	32	32	36	32	31	31	32	33
8	d	31	36	34	32	31	31	30	33
8	e	32	35	33	38	32	34	31	33

MEASUREMENT LOGISTICS:
1) Recorded ambient temperature (Deg. F): 55 F
2) Equipment Utilized: Krautkramer MIC 10 Hardness Tester
3) Measurements Standard: Rockwell C standard

GENERAL PROCEDURE:

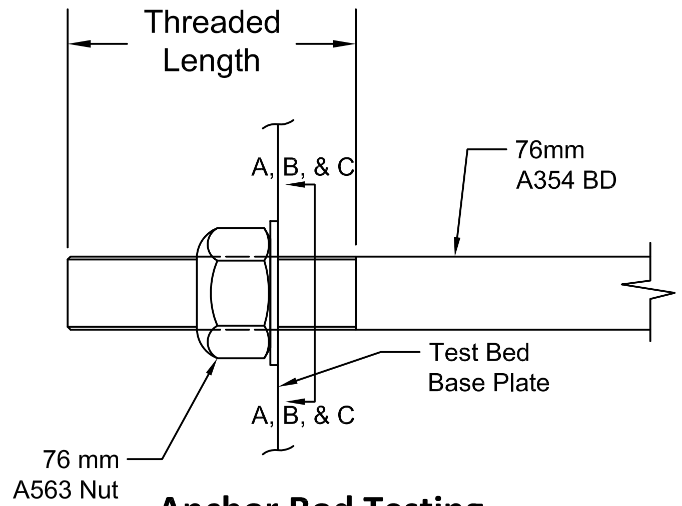
1) Galvanizing was ground off the top surface of the rods using a grinder.
2) Suitable sand paper was lightly applied after grinding to achieve a surface profile of 15 μm or less per ASTM A1038.
3) A profile meter was utilized to ensure surface roughness is acceptable.
4) The surface was free from oil, grease, dust, rust, and surface coatings.
5) Measurements were taken as shown on Section A above.
6) After measuring the hardness on each rod, the equipment readings were verified against a certified hardness reference block by taking 2 additional measurements.

GENERAL NOTES:

Note 1: Field hardness equipment is subject to greater variability than lab equipment. In addition,factors including wind and difficult access conditions can contribute to such variability.

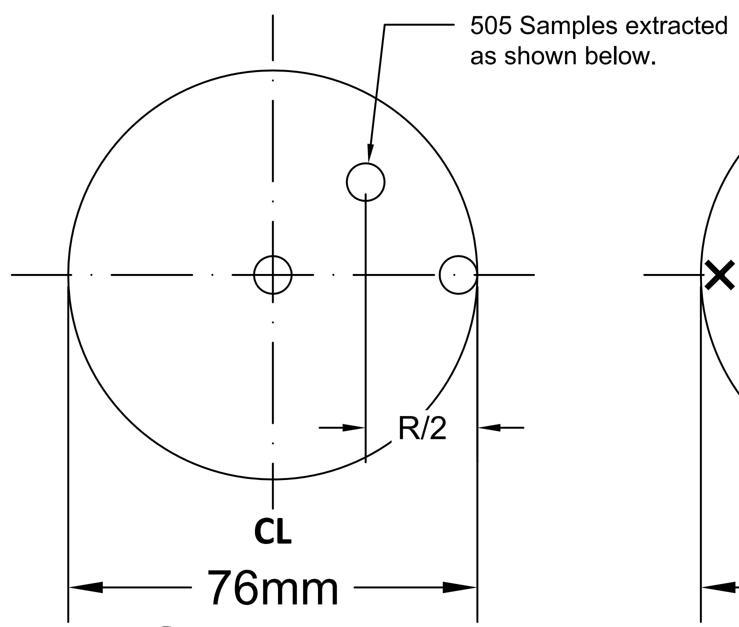
Note 2: Some of the rods tested in this report may have been cut at the ends after heat treatment. Cutting the rods will remove the hardened exterior layer. This will result in a decrease in the measured hardness.

Revision No:	By:	Date:	
			SELF-ANCHORED SUSPENSION BRIDGE
			E2 Shear Key Hardness Readings - 192 Rods (Fabricated in 2010)
			Drawn By: EM
			Date: 4/24/2013
			SHEET NUMBER: SK-03



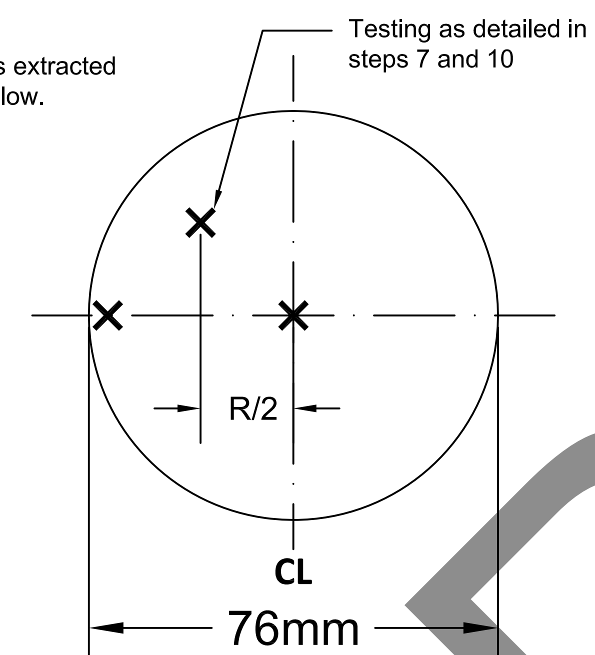
Anchor Rod Testing

(Test Setup)



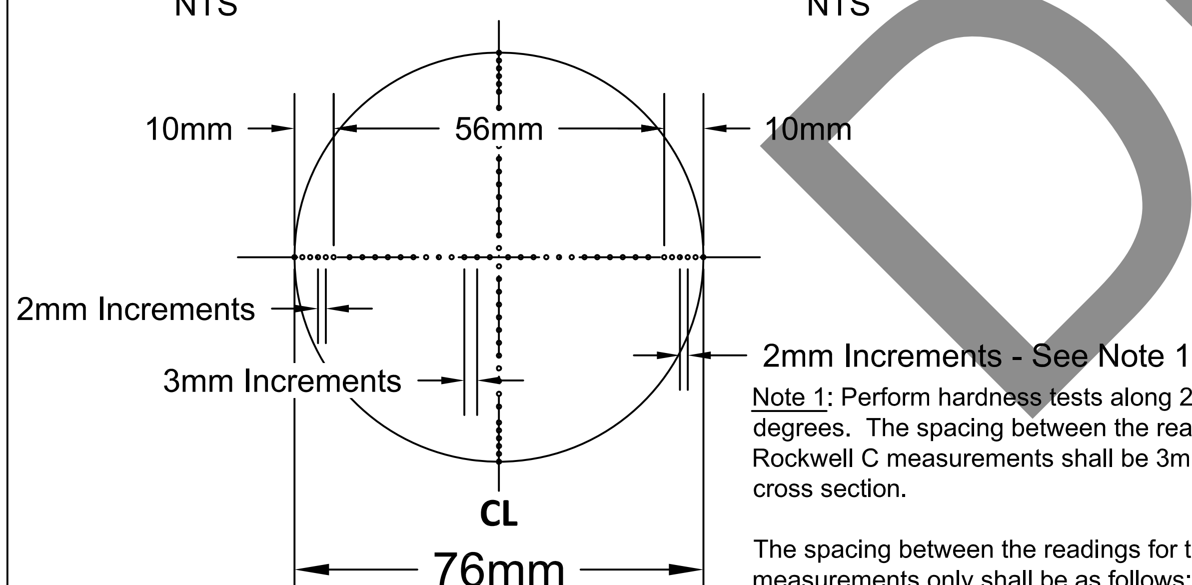
Section A

NTS



Section B

NTS



Section C

NTS

Note 1: Perform hardness tests along 2 traverses @ 90 degrees. The spacing between the readings for the Rockwell C measurements shall be 3mm for the entire cross section.

The spacing between the readings for the Knoop measurements only shall be as follows:

- 2mm increments for the first 10mm from the exterior.
- 3mm increments in between.

Anchor Rod Wet Test (192 Rods)

This testing protocol was developed with the assistance of Dr. Herb Townsend, PhD,PE, Dr. Karl Frank, PhD,PE and Mr. Doug Williams, PE.

Sample Selection: Rod selection shall be as determined by the Design Joint Venture; 4 rods total.

Testing Protocol:
(Tests listed below to be performed by an independent testing laboratory accredited per ISO 17025 or approved by Caltrans).

1. Prior to extraction, ABFJV shall reload the selected rods up to 0.75Fu and maintain the load for 24 hours.
2. After 24 hours, the rods shall be extracted and nondestructively tested.
3. Rods shall be cleaned to remove all contaminants and lubricants from the threads.
4. Each rod shall be Ultrasonically Tested and Magnetic Particle Tested to identify existing cracks.
5. The samples shall be transported to the selected testing facility where the slow loading tests in a 3.5% NaCl solution will be performed as follows:

%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

** The testing facility shall record the strain using a strain gauge, in addition to keeping a tabulated record showing the applied load vs measured strain vs time.

6. After maintaining the load at 0.85 Fu for 5 days (120 hours) as shown above, load the samples to failure.
7. Transport the fractured sections to the fracture analysis lab for further assessment.
8. Perform Charpy V-Notch testing of broken rods at room temperature and at 70 degrees, per Section B.
9. Perform reduced section tensile tests (.505 diameter) of the broken rods as close to the fracture surface as possible. Tensile tests to be performed as detailed in Section A.
10. Perform Rockwell C hardness and Knoop (Micro-hardness) testing per Section C, and no closer than 1 rod diameter from the ends of each rod.
11. Perform chemical analysis of broken rods at the threaded area and at the shank. Chemical tests to be performed as detailed in Section B.
12. Perform scanning electron microscopy - examination of fracture features on broken rods.
13. Perform Micro-structural examination of broken rods at the threaded area.
14. Analyze the chemistry of the coating and provide % of components. Include information on any % or trace amount of tin and bismuth.

Revision No:	By:	Date:

SELF-ANCHORED SUSPENSION BRIDGE

E2 Bearings & Shear Keys - Testing Protocol

Drawn By:	BD	SHEET NUMBER	SK-01 - Wet Test
Date:	4/30/2013		

TOLL BRIDGE PROGRAM
OVERSIGHT COMMITTEE

CALTRANS BAY AREA TOLL AUTHORITY CALIFORNIA TRANSPORTATION COMMISSION

TBPOC MEETING MINUTES

May 1, 2013, 2:00 PM – 5:00 PM
Director's Conference Room, 1120 N Street
Sacramento, CA

Attendees: TBPOC Members: Steve Heminger (Chair), Andre Boutros, and Malcolm Dougherty
PMT Members: Tony Anziano, Andrew Fremier, and Stephen Maller
Participants: Ade Akinsanya, Bill Casey, Michele DiFrancia, Rich Foley, Andrew Gordon, Ted Hall, Keith Hoffman, Beatriz Lacson, Richard Land, Peter Lee, Brian Maroney, Steve Matty, Dina Noel, Trish Stoops, Ken Terpstra, and Mazen Wabeh
Guests: BTH: Brian Kelly, Gareth Lacy; TY Lin:/M&N: Bob Dameron, Dennis Jang, Marwan Nader, Eric Nichol, Alvaro Piedrahita, Daniel Turner, Hayal Tazir, Ashley Takata; ABF: Brian Petersen; Peer Review Panel: John Fisher and Frieder Seible (via phone)

Convened: 2:25 PM

<table>
<tr><th colspan="2">Items</th><th>Action</th></tr>
<tr><td>1.</td><td>CHAIR'S REPORT
The Chair requested a moment of silence for Robert Jones and Sean Baker, Department employees who lost their lives in the line of duty last week.
The Chair expressed sentiments about the 16 years that he has been involved in this project.
We need to gain public confidence that we can deliver a safe bridge. Open the bridge as quickly as we can, but not if we are not ready.</td><td></td></tr>
<tr><td>2.</td><td>PROGRESS REPORTS
a. 2013 First Quarter Project Progress and Financial Update
Cover letter to Legislature needs to be revised.
P. Lee indicated that the deadline for transmitting this report to the Legislature is May 14, 2013.</td><td>The TBPOC deferred action on this item until next week.</td></tr>
</table>

(Continued)

Items		Action
3.	**SAN FRANCISCO-OAKLAND BAY BRIDGE UPDATES** a. Status Update on Anchor Rods 1. Retrofit strategy for 2008 rods – scope/schedule/budget, with PMT recommendation 2. Replacement strategy, if necessary, for 2010 rod 3. Additional inspection or testing of other SAS rods 4. History of rods and design selection 5. Bidder inquiries, per original and 2nd bids 6. Bridge opening LDW, per answers to Q1 – Q5 • The Chair indicated that he had a lot of questions, some of which pertained to: 1) E2 bolts bearing any loads; 2) Other U.S. fabricators willing to supply A354 BD bolts other than Dyson; 3) Particle testing (a) Magnetic testing; (b) Per Dyson CEO, there was a requirement to do magnetic particle testing on 2010 bolts; 4) What to do with the metallurgical report. • Copies of reference booklets on Retrofit Alternatives for Shear Keys S1 & S2, Progress Issue 4/30/2013, with pertinent drawings and matrices, were handed out. o <u>1. Retrofit strategy for 2008 rods</u> B. Maroney referred to page 2 of the booklet and with the help of a mockup of the SAS Pier E2 bearings and shear keys, and bolt samples, demonstrated Alternatives BD (Steel Collars) and C (Pre-stressed Collars), described the major steps required for each alternative and compared the pros and cons for each.	

(Continued)

Items	Action
➢ At 65% design, estimated cost (with contingency and mark-up) for Alt. BD is $16 million and for Alt. C, $5 million. ➢ Alt. BD requires more work and a lot of steel and coring; Alt. C requires less coring and is five times stronger than normal steel. ➢ B. Maroney/M. Nader agreed that Alt. C is faster and requires less work than Alt. BD. While both options work, cost advantage, potential schedule benefits, complexities, and confidence level all seem to favor Alt. C. o Recommendation: ➢ B. Petersen indicated that design details change every day. While Alt. BD was an early frontrunner, recent input received leaves them leaning towards Alt. C; but the process is not over and there is more work to be done before a decision can be made on which option to implement. ➢ The Peer Review Panel members have just received the plans, which they will study over the weekend. A conference call is scheduled for Monday, May 6, with B. Maroney and team. Preliminary indication is they are not leaning toward Alt. BD. ➢ Having just received the information, the PMT indicated they require more time to study the data before presenting their recommendation as a group. o Discussion items included: when to purchase materials, source(s) of steel, quality of steel, availability of quantity of steel required, source of PT strands. o <u>2. Replacement strategy for 2010 rods</u> B. Maroney referred to the last 5 pages of the reference booklet that cover testing of 2008 A354 BD anchor rods (96) vs. testing of 2010 A354 BD anchor	• ABF, the Peer Review Panel, and the PMT to present their recommendations to the TBPOC at their May 7 conference call.

(Continued)

Items	Action
rods (192). ○ Discussion items included: tests (mechanical, chemical, charpy, etc.) performed on two 2008 anchor rods; in-situ tensioning of 192 2010 rods, testing of four full-size sample rods (e.g., mechanical, wet test, in-situ hardness, etc.); test results, schedule. ➢ Testing the 3-inch and 2-inch rods and correlating the 2010 rods on the bridge will take 23 days plus two weeks (best case scenario), which is looking at July 2013 for test results. ➢ If replacing the 2010 bolts, the Chair queried as to when to replace them – before or after bridge opening. ➢ Peer Review Panel member J. Fisher indicated that the bulk of those bolts will not fail in the near-term; the tests will reveal if they will fail in the long-term. He stated that it would be a sensible strategy to replace the 2010 bolts after bridge opening. ➢ In response to the Chair's query regarding replacement bolts, B. Maroney referred to the yellow page section of the reference booklet entitled, "E2 Shear Keys (S3 & S4) and Bearings Connection to E2 Capbeam, Equivalent Substitution, 192 Rod Replacement Alternatives (2010), (To be considered in the event that test results indicate that change of existing rods is advisable)", which showed a matrix of replacement options with pros and cons, and lead time among other information. ○ <u>3. Other rods on the bridge</u> The Chair indicated that he had received preliminary (QC/QA) information from T. Anziano. He inquired as to whether any testing needed to be done. B. Maroney replied that we do not have solid test data. ○ Discussion items included: establishing a curve to evaluate locations on the	

(Continued)

	Items	Action
	bridge, list of bolts sheet (whether galvanized or pickled), any other galvanized A354 BD bolts in other toll bridges. ○ <u>4. History of rods and design selection</u> <u>5. Bidders inquiries</u> In response to the Chair's query on the availability of documents for Items 4 and 5, T. Anziano reported that the PS&E package is in hand but have no solid data yet. ○ <u>6. Opening the bridge</u> The Chair noted that we have two retrofit strategies; the question was posed as to which option will contribute towards opening the bridge on time. ➢ B. Peterson indicated that no analysis have been made yet. They are now poised to do some study. ○ The Chair announced that the group will reconvene at a conference call on Tuesday, May 7, at 8:00 AM, on the questions as to whether the 2008 anchor rod issue will be resolved before bridge opening, and should the 2010 anchor rods be replaced after bridge opening, among others.	• Staff to schedule a TBPOC conference call on Tuesday, May 7, 8:00 AM – 9:00 AM.
6.	**OTHER BUSINESS** • N/A	

Adjourned: 4:40 PM

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TBPOC MEETING MINUTES
May 1, 2013, 2:00 PM – 5:00 PM

APPROVED BY:

6/6/13

STEVE HEMINGER, TBPOC Chair
Executive Director, Bay Area Toll Authority

Date

6/6/2013

ANDRE BOUTROS,
Executive Director, California Transportation Commission

Date

6/6/2013

MALCOLM DOUGHERTY
Director, California Department of Transportation

Date