September 16, 2013

PROJECT INFORMATION

04-0120F4
SFOBB SKYWAY BIKEPATH

SUBJECT

Skyway Bikepath Corrosion Investigation and Evaluation

INTRODUCTION

On August 17th, 2011, ponded water was discovered in one of the bike path panel compartments during routine field work by Caltrans (CT) Construction personnel. Preliminary investigations suggested that this problem existed in the majority of the panel compartments adjacent to the hinges. This discovery prompted a field investigation meeting between CT Construction & Material Engineering and Testing Services (METS).

METS was tasked with developing a means of identifying all panels which contained standing water. Further, METS was asked to identify the likely sources of water infiltration and evaluate the ongoing corrosion. Finally, development of mitigation procedures was requested for the panels with standing water inside to reduce or eliminate any adverse effects of the intruding water.

DISCUSSION

METS approached the water intrusion issue as a three step process. The first step in METS's investigation was to identify the panels with standing water. This was achieved by using an infrared camera to identify the water using a camera while aboard a boat in the water. The second step was to evacuate the standing water from inside the bike path panels. This was done by drilling holes in the bottom of the bike path panels which were known to contain water. The third step was to determine the source of the water intrusion, and evaluate potential measures to eliminate it. METS attempted to identify this pathway using a boresope, but was unable to conclusively determine a point source of infiltration. Ultimately, a fog investigation, conducted by an outside consultant, was able to positively identify three different air intrusion sources.

FLIR CAMERA INVESTIGATION

An investigation was conducted in December of 2011 with the use of a Forward Looking Infrared (FLIR) camera as a means to detect water inside of the panels. This detection method relies on the temperature differential across the bottom skin of the bike path panel caused by internally ponded water. The water inside a panel will act as a heat sink during quickly rising ambient temperatures

and thus have different temperature than the surrounding steel. The FLIR camera is capable of detecting even slight variations in temperature of objects.

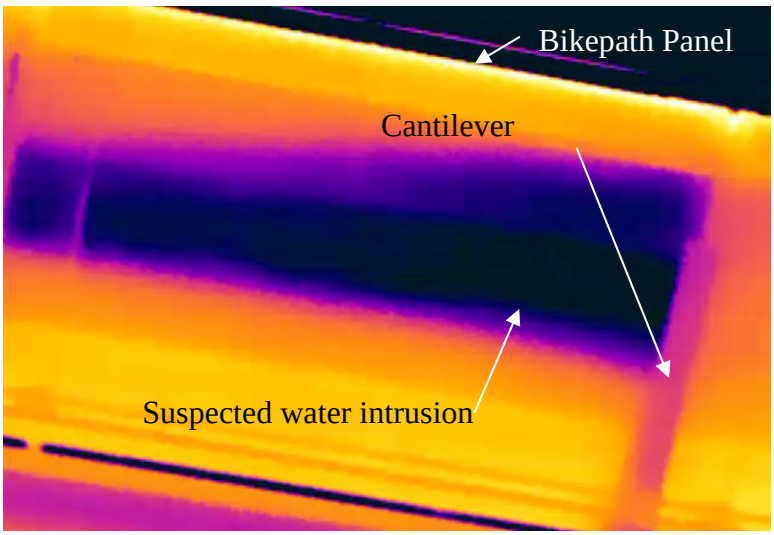


Figure 1: Typical infrared (IR) photo showing intrusion of water.

During the demonstration, the FLIR camera revealed that several panels appeared to have standing water on the Skyway portion of the bridge (**Appendix 1**). The shape and location of the low temperature areas in a typical image (**Figure 1**) proved to be an effective method to identify the problematic panels. No panels showed signs of standing water on the SAS bike path.

Individual panels with standing water were identified through radio communication between two persons; one using a FLIR camera from a boat, while another noted specific panels from the bike path. This information was then used for drilling holes in the bottom plate of the panels and draining the entrapped water. Thirty two (32) panels were drilled to verify and remove standing water. Petcocks were installed in each of these holes to facilitate future investigation and removal. The procedure and is included in **Appendix 2,** and the results and field notes of the water collection are included in **Appendices 4, 5 and 6.**

METS conducted additional FLIR camera investigations in December of 2012 and January of 2013 to determine if additional water had gathered in the bike path panels. Water was only detected in two places; inside two panels nearest to the SAS, which were inaccessible for drilling, and a few select panels immediately adjacent to the hinges. These panels, nearest the hinges, were subject to water infiltration due to the installation schedule of the sliding hinge plates. Water was allowed to enter during several rainstorms while the bolts connecting these plates were left uninstalled. Water from these panels has since been drained. These were the only two locations where water was detectable throughout the Skyway bike path. A description of these FLIR investigations performed is included in **Appendix 3.**

WATER SAMPLING

During drilling, the collected water was sampled to be tested for iron content and salinity. Three water samples were sent to Translab on October 12, 2011. The samples averaged 13.1 ppm Chlorides and 0 ppm Dissolved Iron. Typical chloride levels for sea water are 19,400 ppm. Therefore; these results indicate that the water is fresh water, and not sea water. The results of the testing are included in **Appendix 7** and summarized in **Table 1**.

Sample #	Chlorides, ppm	Dissolved Iron, ppm
Sample #1	**9.5**	**0**
Sample #2	**8.9**	**0**
Sample #3	**21**	**0**

Table 1. Water Samples Test Results

Additional water samples were taken during the field investigation in July 2013. The results of those samples were also indicative of a pure water source, such as condensation or precipitation. Those results are included in Wiss, Janney, and Elstner Associates's report (**Attachment A**).

BORESCOPE INVESTIGATION

METS also conducted a borescope investigation attempting to identify a pathway for water. The suspected water intrusion source was the anchor rod screw caps; however shop drawings show this to be not connected to main, air-tight compartments. The contract plans and shop drawings also confirm that there is no connection between compartments of the cantilever beam to the compartments of the bikepath panels. A General Electric XL Go borescope was inserted through several different holes drilled into the top surface of the bike path. An identification map showing the borescope's paths of insertion is seen in **Figure 2.** This figure also shows where weld access holes were discovered (green circles) which would allow air and water to pass throughout the compartments. Photographs of these weld access holes, taken with the borescope are seen in **Figures 3 through 8**. The access holes that were discovered provide a path for water from around the anchor rod sleeves throughout the diaphragm ledge above the cantilever beam. However, no apparent path was found which would trace water from the anchor rod cap threads into the main compartment. The standing water marked as 'Video Label Number 3' in **Figure 2** was manually poured in by METS during investigations to determine if the water would leave the chamber around the sleeve. This chamber was found to be watertight and the water will need to be removed at a later date.

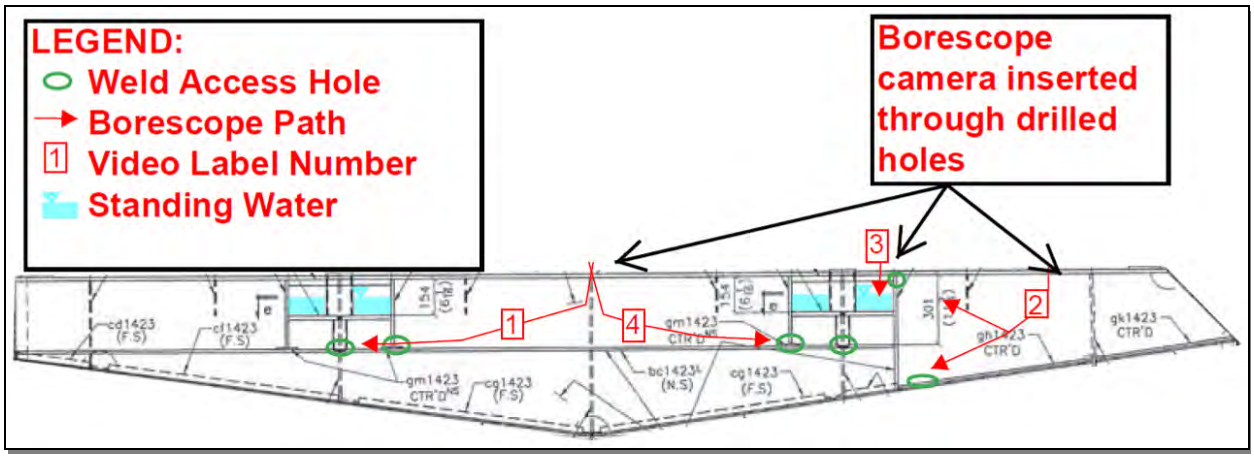


Figure 2. Borescope camera path identification map.

Figure 3. First weld access hole in camera path #1.

Figure 4. Gap between sleeve and soffit.

Figure 5. Weld access hole in camera path #4.

Figure 6. Weld access hole in camera path #3.

Figure 7. Top cope hole in camera path #2.

Figure 8. Weld access hole allowing water to enter into box sections which are intended to be air-tight.

FOG INVESTIGATION

Using all means and methods available, METS was initially unable to identify a pathway for water to infiltrate the main compartment of the box section. An outside consultant, Wiss, Janney, and Elstner Associates, Inc (WJE), was contracted to perform an investigation utilizing theatrical fog as a method of leak detection. After WJE was given an opportunity to review all previously gathered findings, a field investigation utilizing fog techniques was performed between June 10 and 13, 2013. A detailed report of all of their findings can be found in **Attachment A**. The fog testing was performed in accordance with the requirements of the drawing labeled "Skyway Bikepath Typical Panel Pressure Testing SK-01," which is included in **Appendix 8**.

The fog testing confirmed several suspicions and also revealed some new information. Three (3) active air intrusion sources were positively identified:

1) The cantilever beam bearing on the elastomeric pad (**Figure 9**).
2) The underside of the gap closure plate near the sleeve threads (**Figure 11**). The gap closure plates were found to be shimmed into place using ordinary washers as spacers. This would allow air to enter below this plate next to the anchor sleeve threads.
3) The threads of the anchor rod sleeve circular cap (**Figure 13**). Bubbles were seen during the investigation in 2 of the 4 panels tested.

The testing also confirmed that there is "communication" between all compartments within the panel. The sections which were designed to be air-tight after seal welding are able to exchange air and moisture with other compartments.

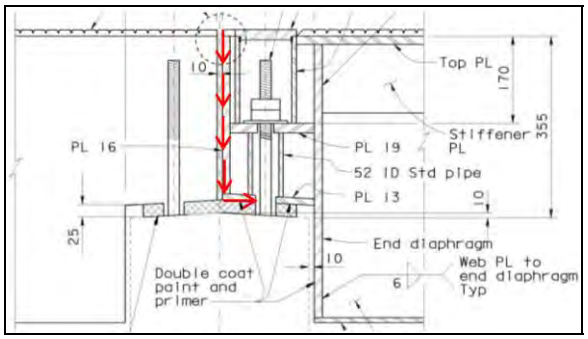


Figure 9. Air source at elastomeric pad.

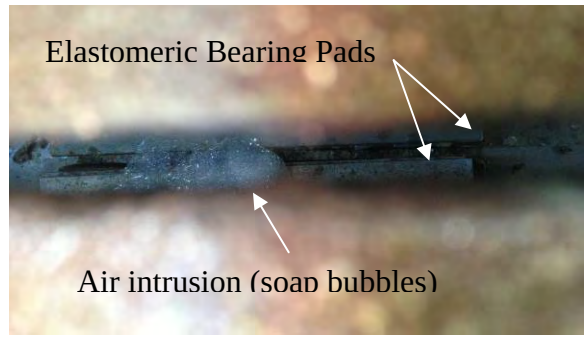


Figure 10. Air bubbles at bearing pads.

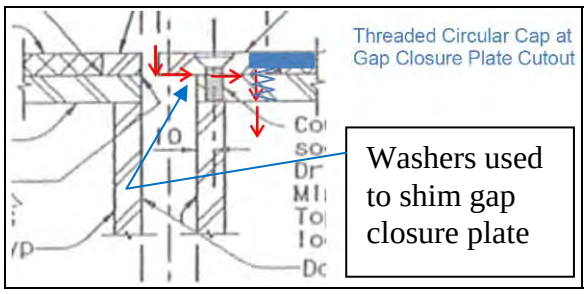


Figure 11. Air source at underside of gap closure plate near sleeve threads.

Figure 12. Bubbles at underside of gap closure plate.

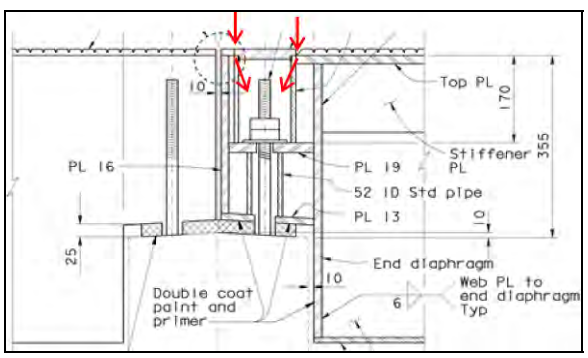


Figure 13. Air source at screw cap threads.

Figure 14. Bubbles from screw cap threads

While these active paths for air and moisture to enter have been identified, it is believed that the source of the majority of the water was accumulated during construction; either during fabrication, storage, transport, or during installation while the threaded caps had not yet been installed. The intrusion paths identified could not feasibly gather the magnitude in quantities of water found within the panels. As water has been subsequently drained, the panels have not accumulated similar quantities of water.

Several tests were performed to determine if any accelerated corrosion has occurred, or can be expected to occur due to the moist conditions inside the panels. The testing performed on 2 in. diameter coupons taken from the bottom soffit plate during testing revealed that there has been minimal section loss to date. Both the sludge-like corrosion products and the drained water gathered from inside the panels were tested and the results indicated that no sulfate- or chloride-accelerated corrosion is expected.

CONCLUSION

Based on the testing performed to date, METS has the same recommendations as those outlined in the report in **Attachement A**:

1.) Conduct biennial infrared camera surveys to detect any significant water ingress to box girders
2.) Dewater box girders known to hold water biennially and record extracted water volume. In addition, install valves at the lowest point of at least six box girders which are not known to contain water and include them as part of the dewatering program.
3.) Conduct a visual survey to evaluate the presence of damage or wear to the coating/overlay around the circular threaded caps in five years and biennially thereafter. If distress is observed, it should be addressed as soon as possible to minimize the ingress of water through the circular threaded caps.

WJE included a recommendation in their report to evaluate the installation of a sealant system at the joint between box girders for selected panels with known infiltration. METS believes that this point of ingress can be more effectively sealed. For this reason, METS recommends that Design, Construction, and Maintenance consider evaluating the injection of a sealant material throughout the anchor rod sleeve. This would seal off point of air ingress from any gaps near the elastomeric bearing pads.

Various components of the bikepath were modified during the course of the investigation. METS defers to Design for details of repairs to these locations, which are as follows:

1.) Six (6) holes drilled for fog testing investigation. The holes were drilled in field-determined locations that were measured to be a minimum of 8” away from the center line of any web stiffeners.
    a. 2” diam. hole, Panel #1309 B, E End S Center (1)
    b. 2” diam. hole, Panel #1309 B, E End S Center (2) S of (1)
    c. 2” diam. hole, Panel #1209 SR NW
    d. 2” diam. hole, Panel #1427 YR E End @ Center
    e. 2” diam. hole, Panel #1427 YR SW
    f. 2” diam. hole, Panel #1209 SR SE
2.) Seven (7) holes, 1/2” diameter with a 1” counterbore in the concrete overlay drilled in the top surface of Panel #1209SR. Also two (2) 1/2” diameter holes drilled into the anchor road screw caps on the same panel.

If you have any questions about this report or require further explanation please contact Structural Materials Representative Adam Kreger at 510-495-0932.

ADAM KREGER, P. E.
Structural Materials Representative
Division of Engineering Services, Materials, Engineering, and Testing Services.
Office of Structural Materials

cc: Gary Thomas, Keith Hoffman, Mazen Wahbeh.

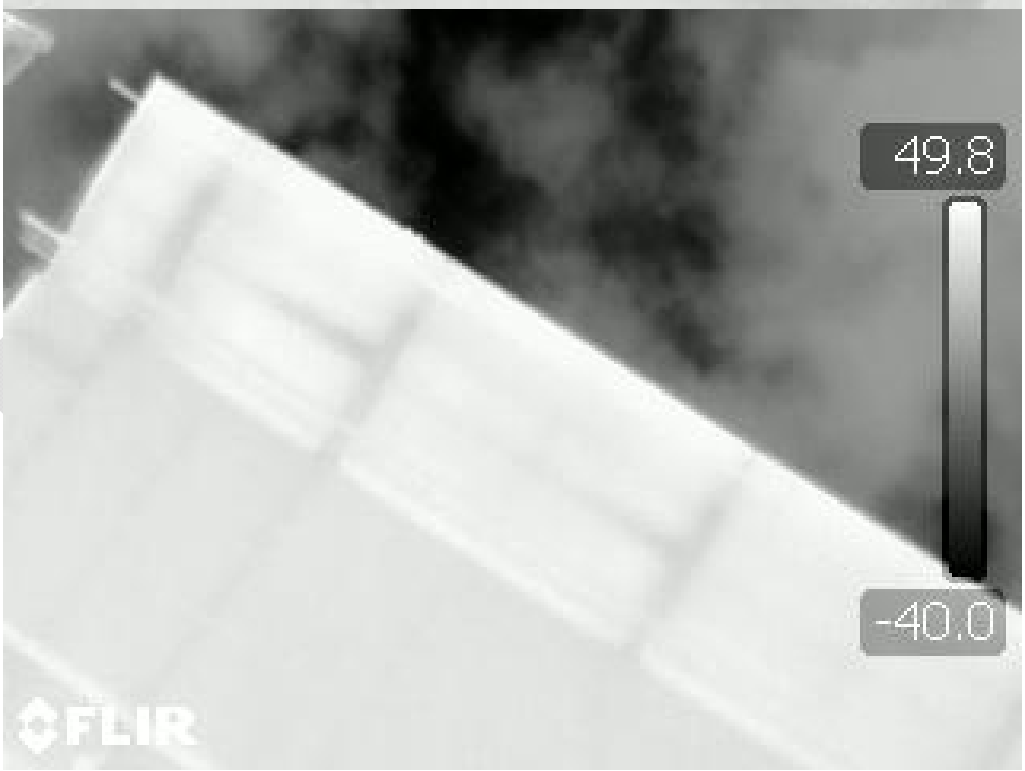
Appendices:
Appendix 1: FLIR Survey Performed 02-29-2012
Appendix 2: Water Containment and Collection Plan
Appendix 3: Preliminary FLIR Survey Performed 12-17-2012 & 01-15-2013
Appendix 4: Water Collection Log
Appendix 5: Water Collection Layout Sheets
Appendix 6: Panel Drainage Sheets
Appendix 7: Water Sample Test Results
Appendix 8: Skyway Bikepath Typical Panel Pressure Testing SK-01

Attachments:
Attachment A: "SAN FRANCISCO BAY BRIDGE – Evaluation of Water Ingress into Box Girders Supporting Bicycle Lane." July 30, 2013. Wiss, Janney, and Elstner Associates, Inc. Etchevvery, Leandro.

APPENDIX 1

Phase 1 & 2 FLIR T300 photos of bikepath panels identified with water intrusion. Performed by CT METS on 02-29-2012.


52.7
-40.0
FLIR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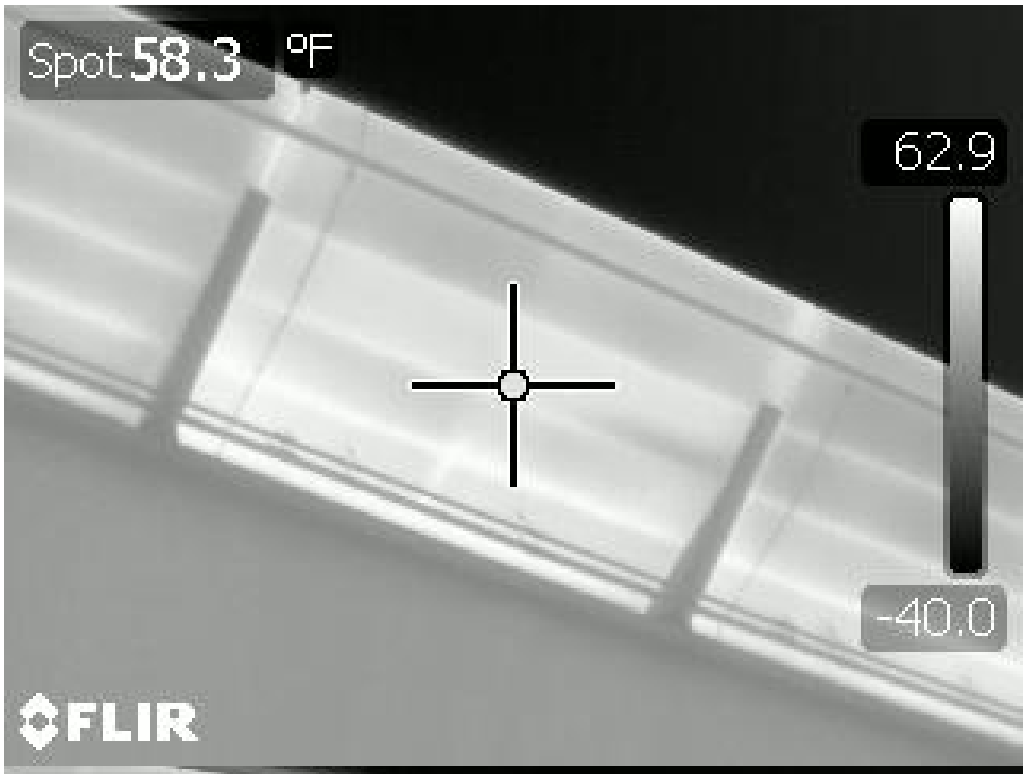
FLIR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FLIR


Spot 56.3 °F
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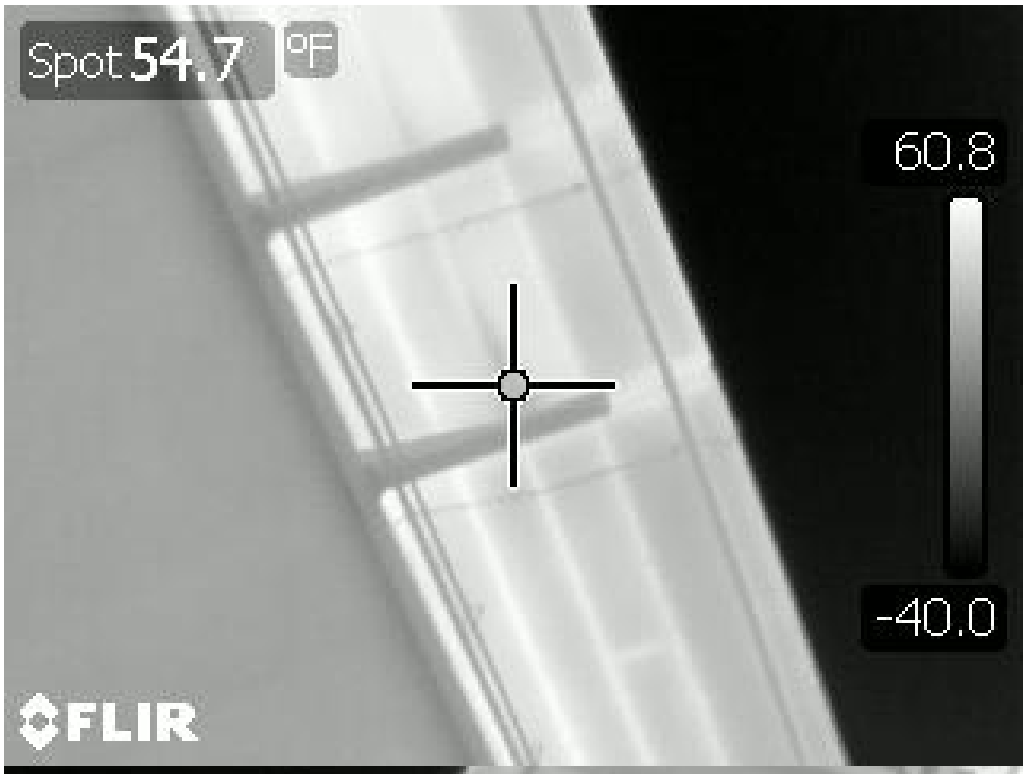
FLIR


Spot 54.7 °F
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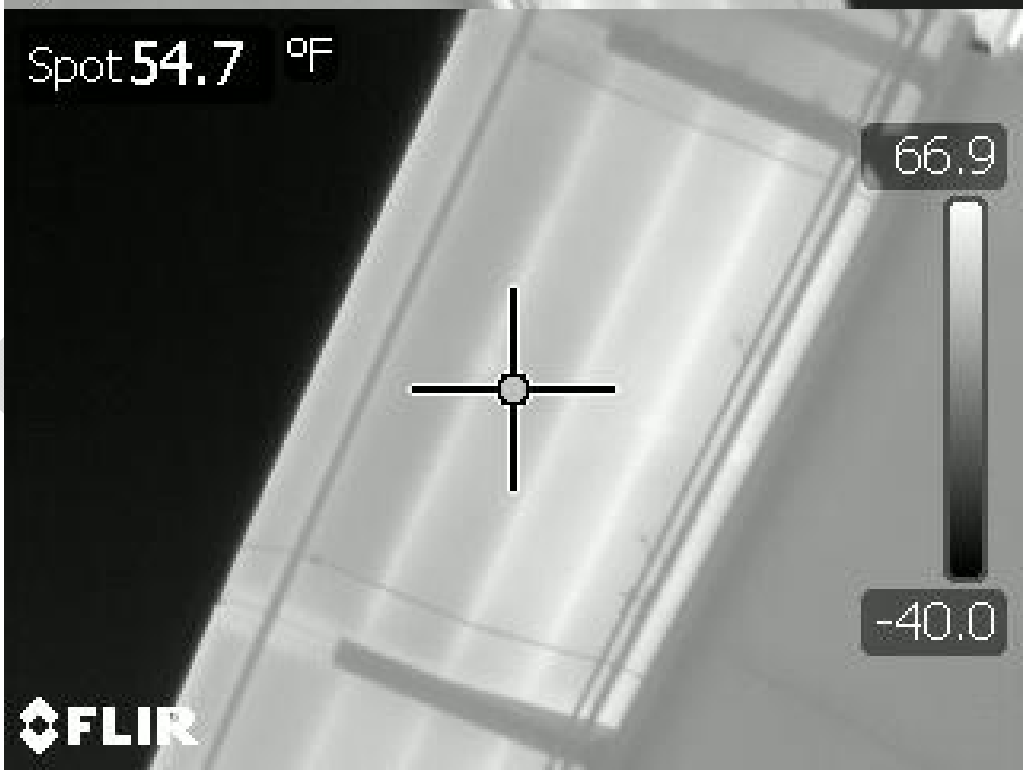
FLIR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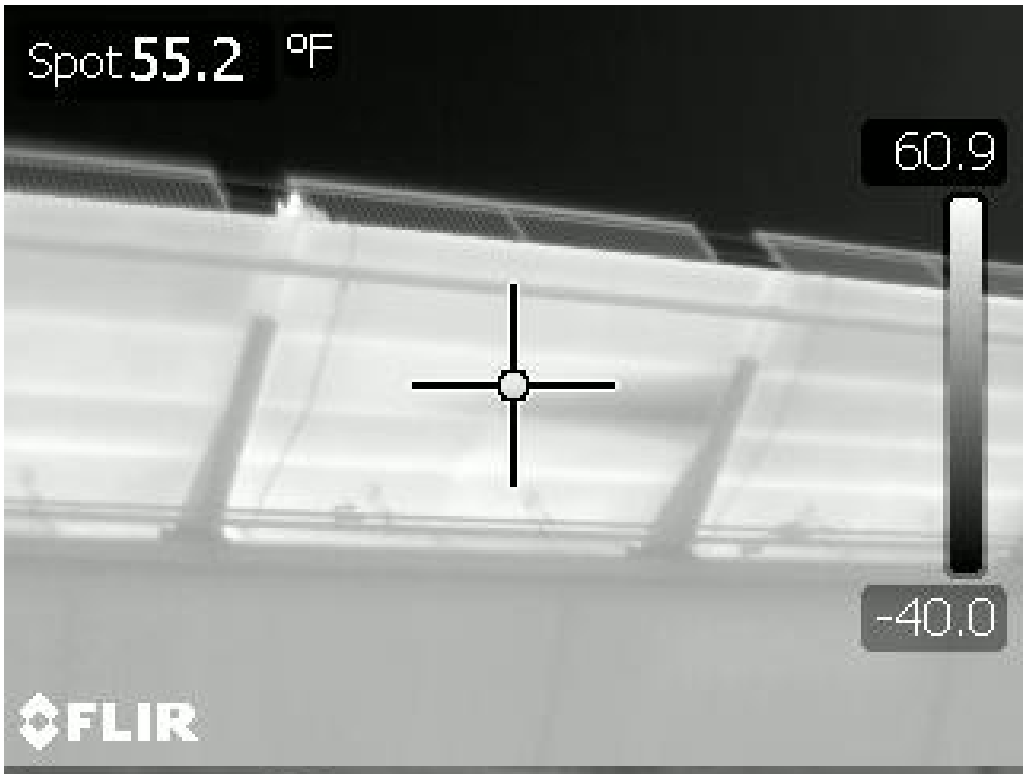
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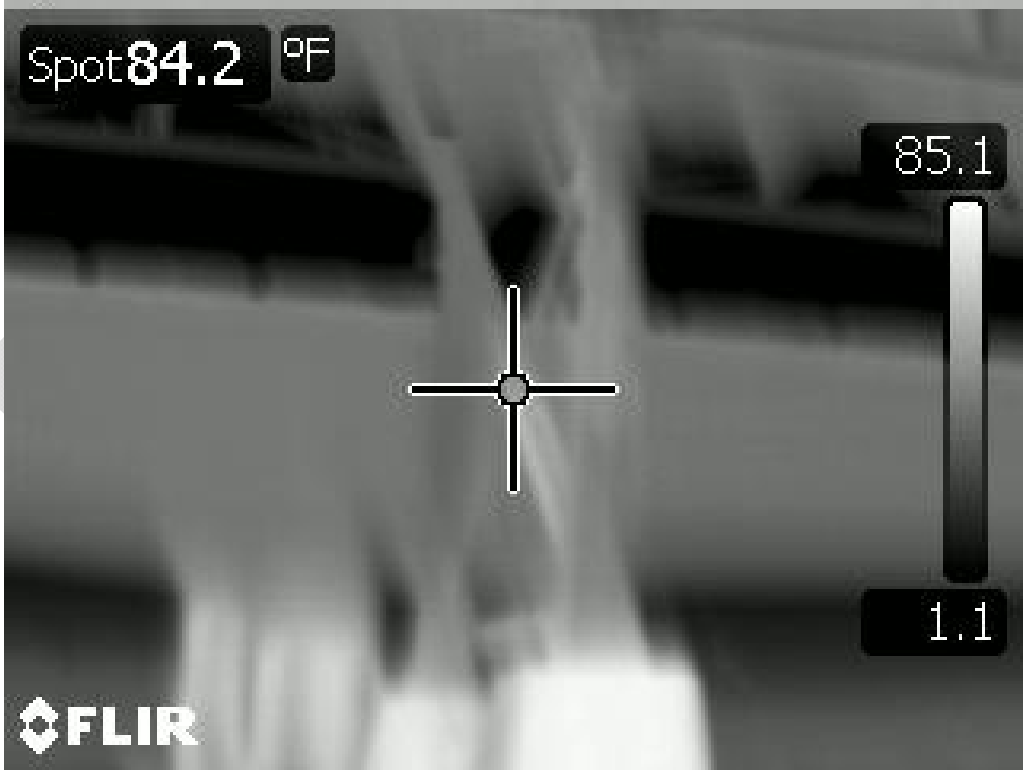
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1.1
FLIR


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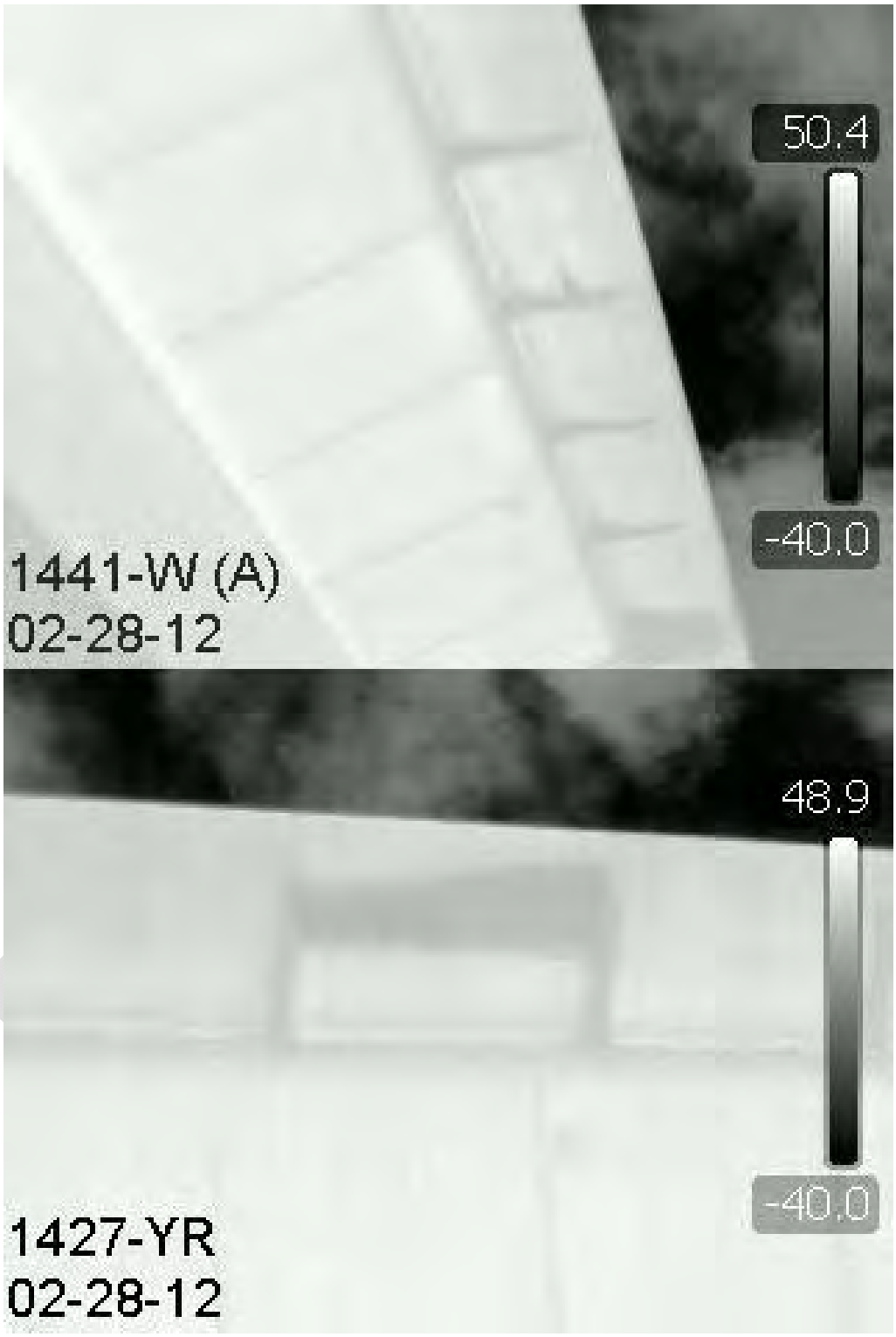
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-40.0
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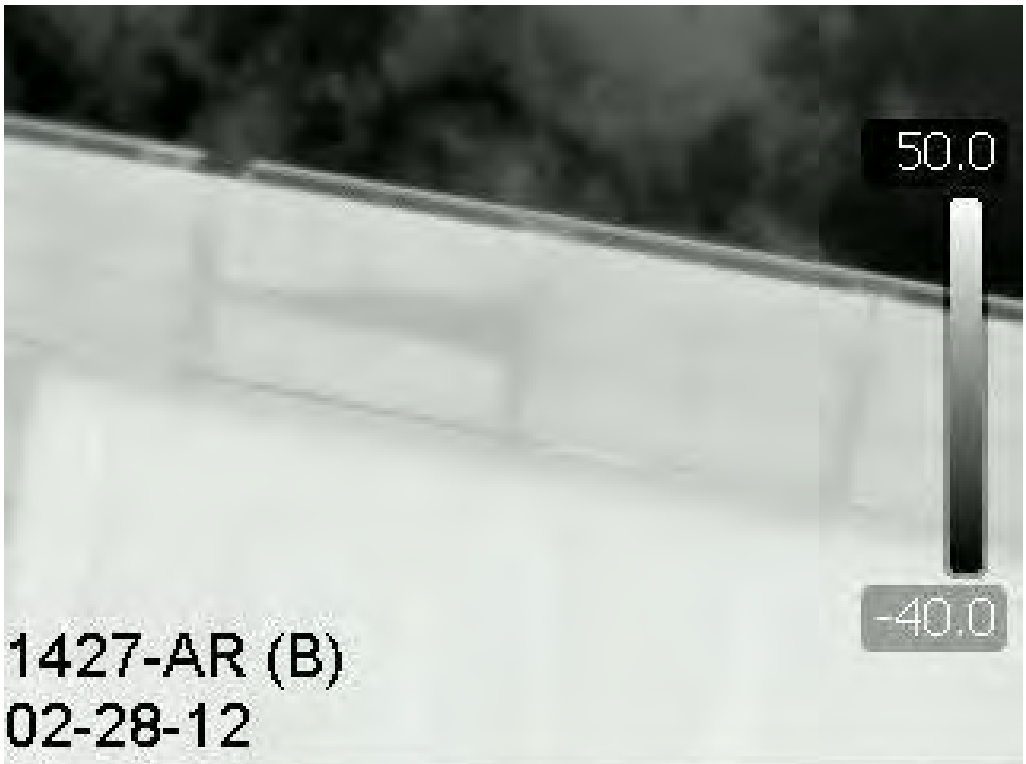
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1313-B
02-28-12


49.7
-40.0
1309-PR
02-28-12


49.1
-40.0
1309-DR
02-28-12


58.5
-40.0
1309-BD &
1309-CR
02-28-12


48.5
-40.0
1309-B
02-28-12


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1309-AZR &
1209-TR
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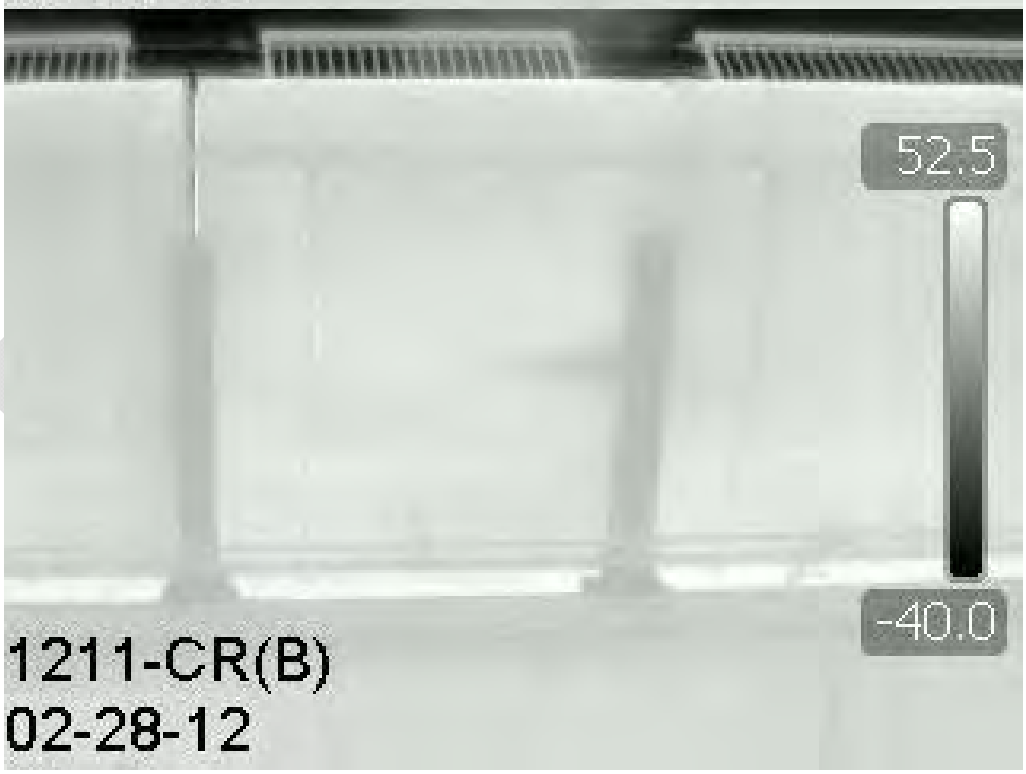
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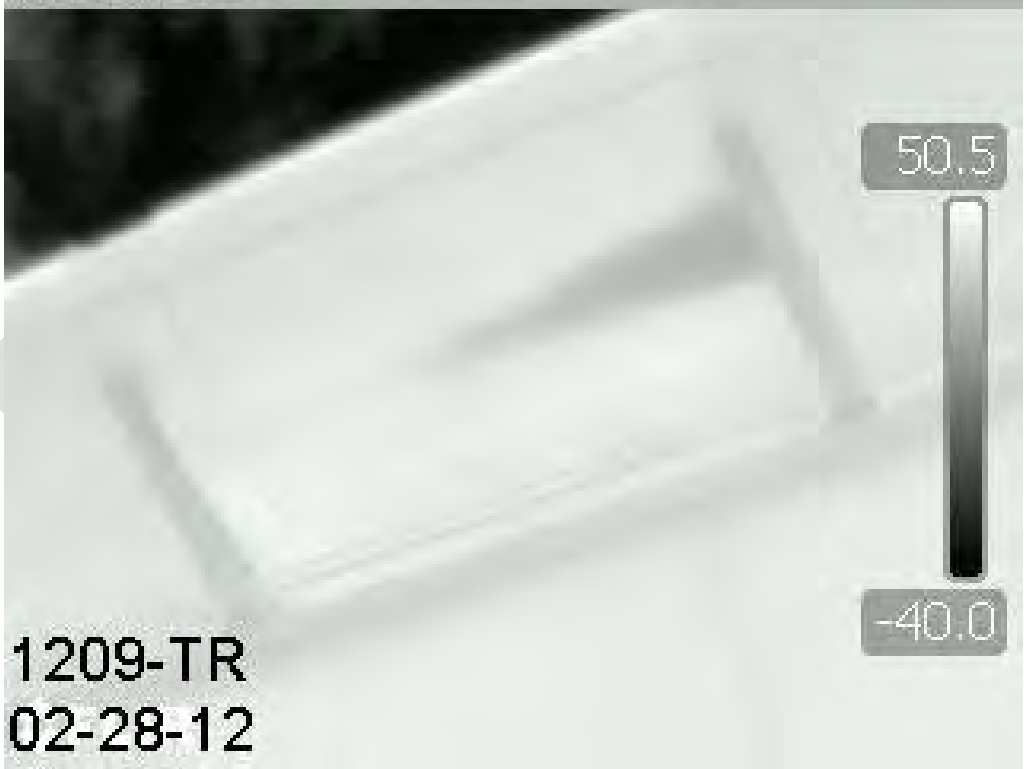
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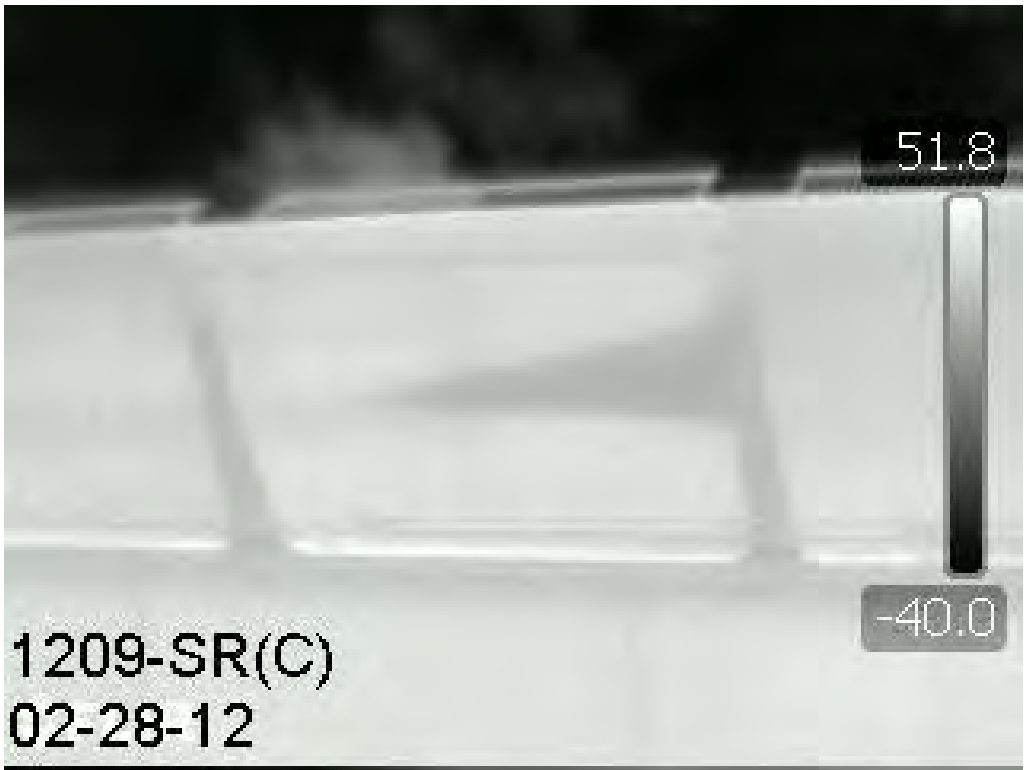
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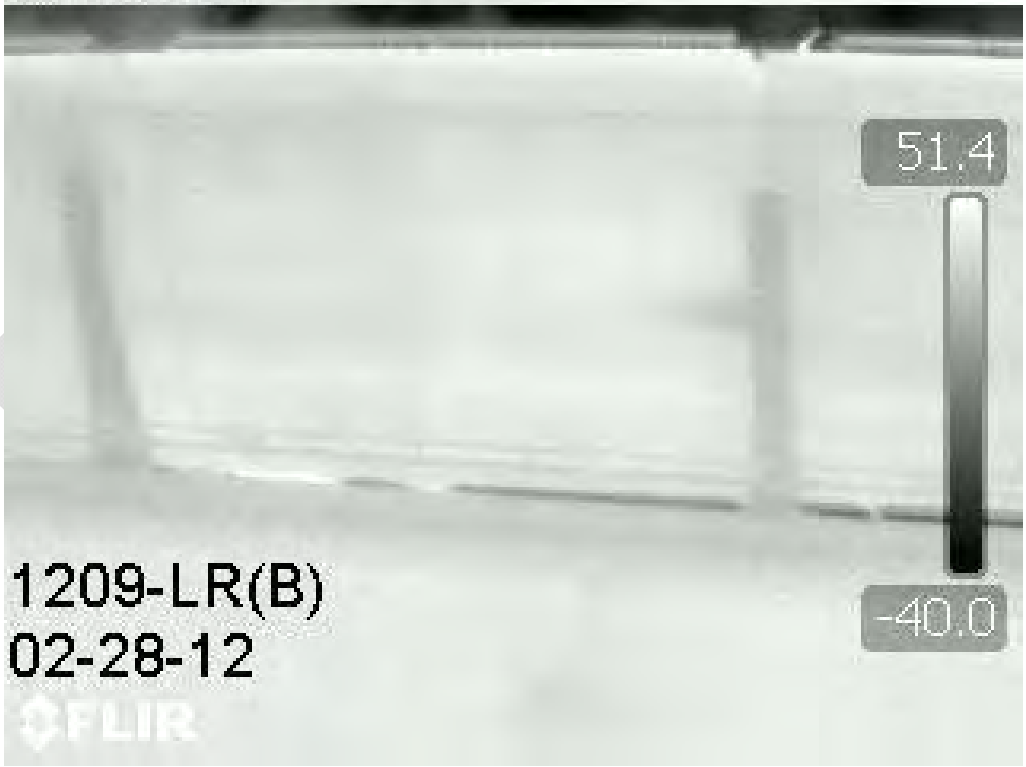
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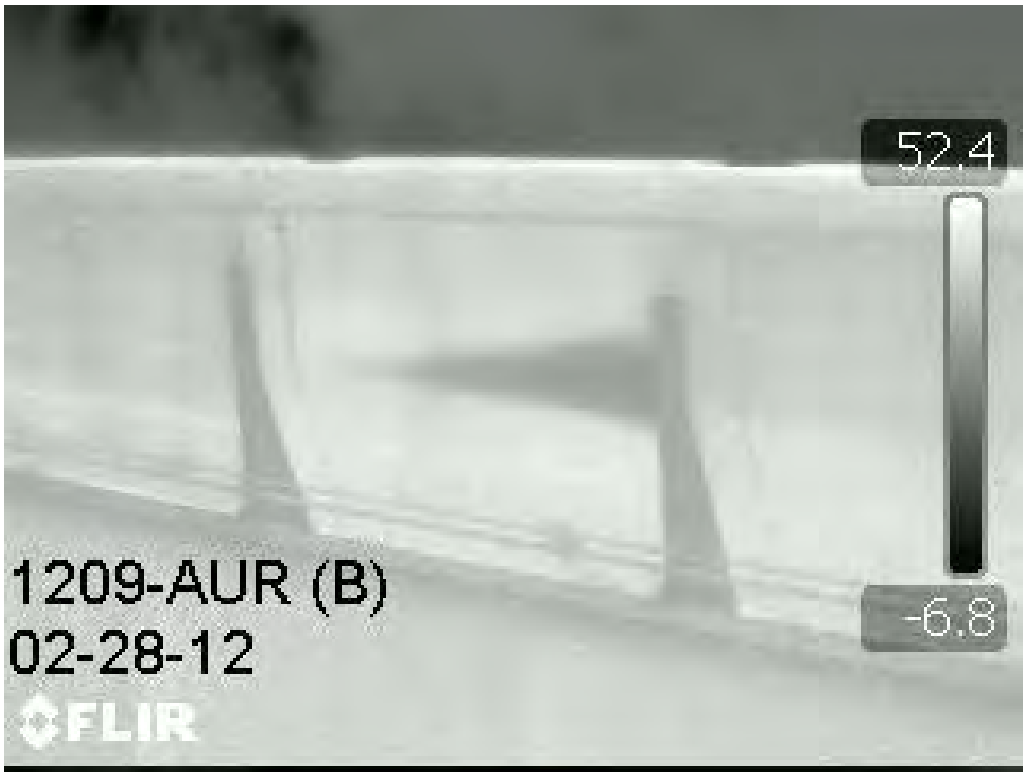
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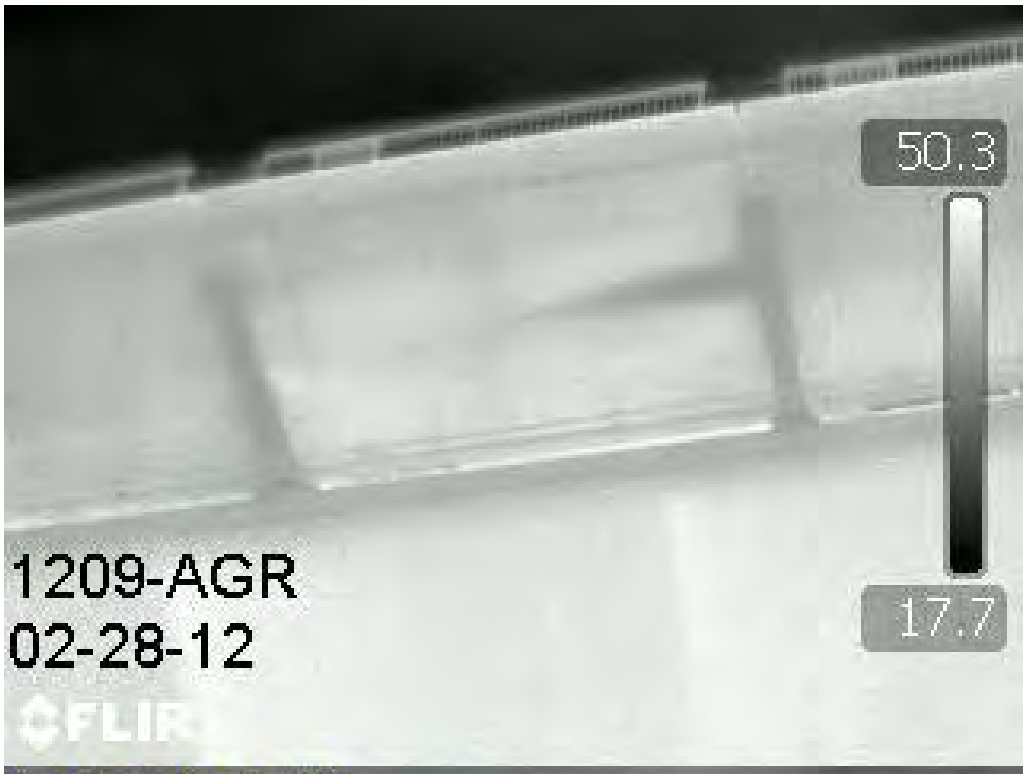
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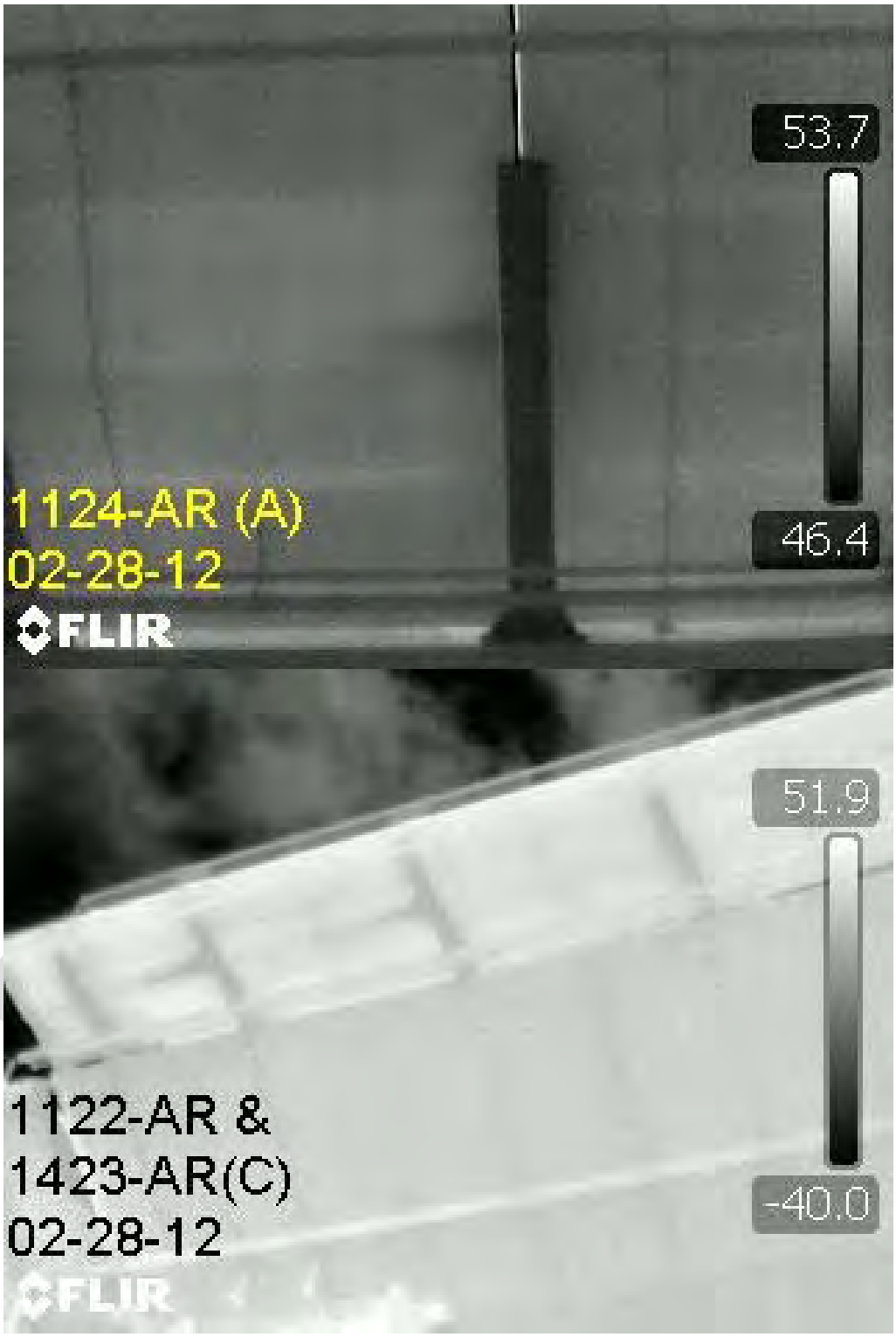
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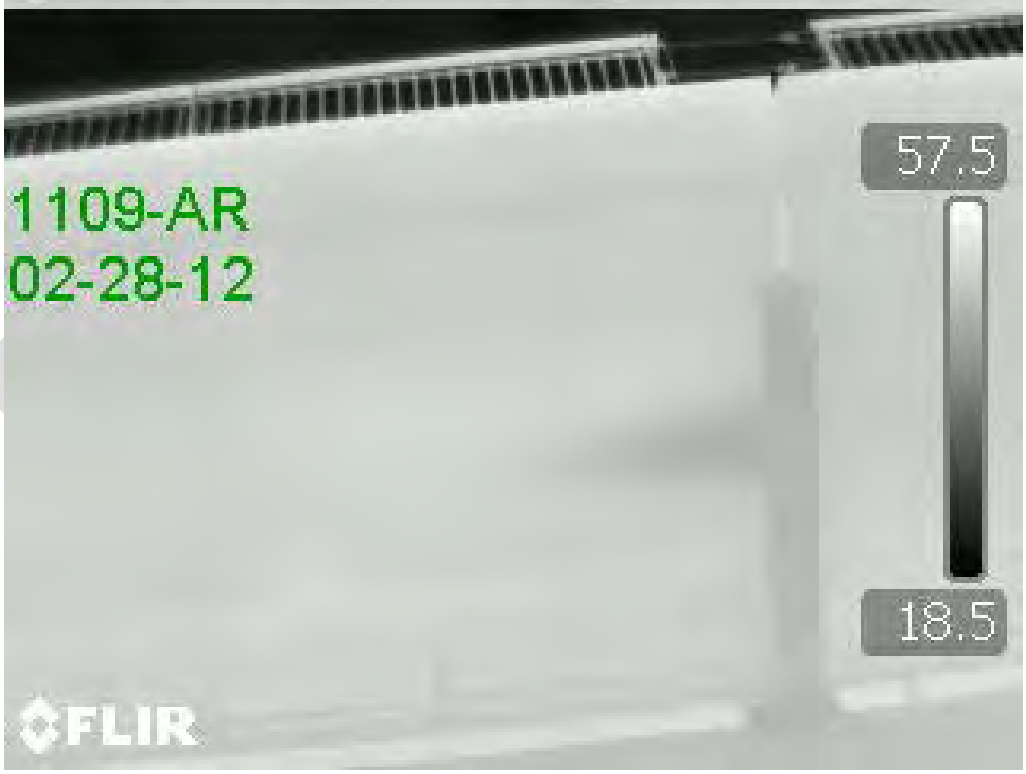
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57.5
18.5
FLIR

APPENDIX 2

Water Containment and Collection Plan for Trapped Water in Bike Path Panels

The purpose of this Water Containment plan is to eliminate possibility of discharge of any water collected from the bike path panels to the adjacent waterways. It is also intended to minimize the amount of spills and leakage and provide a secondary containment during the process to ensure that in case of any leaks or spills the water will be contained and returned to the collection system.
No discharge is anticipated and collected water will be hauled offsite to EMUD approved facility.
No operation shall be scheduled within 24 hour of any rain event. Minimum of 24 hour dry window is required for this operation.

55-gallon Drum collection system:

55-gallon collection system consists of an on-off isolation valve and a hose long enough to reach 4" below the top of the 55-gallon drum. The piping system is sealed and purchased as a whole with minimum field modification. The hose-valve system should be installed after the drum and containment procedures are in place. Pipe alignment will be a direct vertical line from the bikepath panel to the top of the 55-gallon drum. No fittings and angles points are anticipated. The system is not pressurized and is under control with isolation valve on top.
The 55-gallon drum will be located on the bike path travelers underneath the subject bike path panel. The system will be placed in a secondary containment to prevent spills and leaks from migrating into adjacent areas. Secondary containment shall be have enough capacity for 50% more than anticipated water volume for the panels. Secondary containment may consist of drip pans or other forms of barrier system sealed on all sides. Drip pans must be placed under all stationary equipment and vehicles located over travelers that remain idle for more than one hour.
Being in such close proximity to a watercourse, the system described, BMP's mentioned here, and others implemented with it, must be installed correctly and maintained to prevent any discharge. Any incident of discharge requires submittal of a Notice of Non-Compliance to the Engineer.

Transmission system:

Transmission system consists of a ¾" sump pump and 25 to 50 ft of flexible ¾" hose. The hose is connected to the sump pump at one end and to a discharge manifold on the other end. Hose shall be of industrial quality, and resistant to cuts or tears. Water hose curvature radius shall be accounted for to be able to create a smooth transition from 55-gallon drum to the 250-gallon water tank top opening. Provisions shall be considered to eliminate any chance of spills at the water entrance at top of the 250-gallon Water Tank.

275-gallon Water Tank:

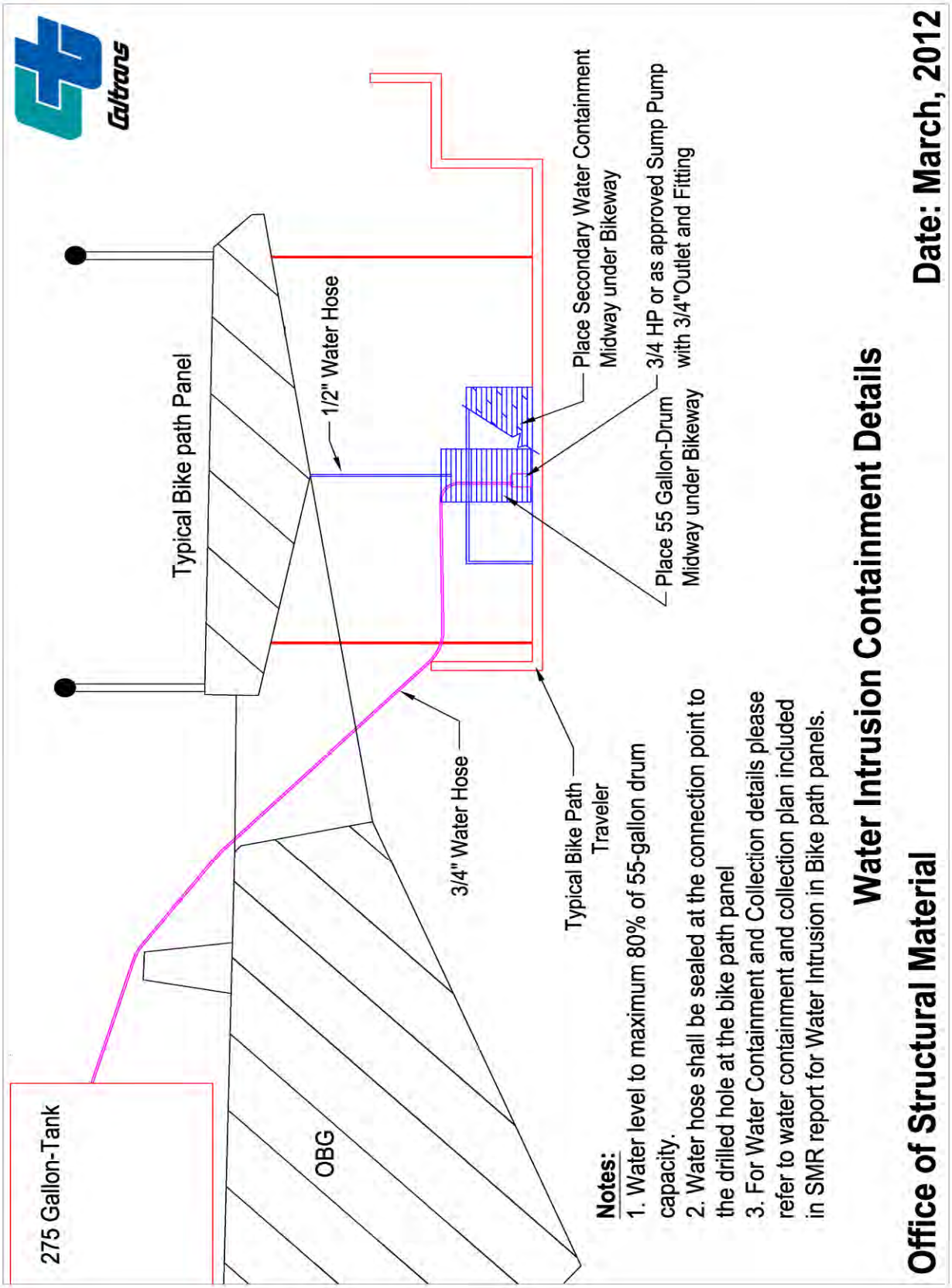
275-gallon Water Tank consists of a vehicle with a 275-gallon tank. The tank may be installed on the vehicle or be secured on a flatbed. In any case, the tank must be secured properly and have apparatus for sealing the top opening. The tank should have a sump location with provisions for a sump pump with a ¾" hose to pump out the retained water. 275 Gallons Water Tank vehicle shall be stationed with a temporary water tank area as described below.

Caltrans owned BAKER tank at the Burma road storage area:
BAKER tank is a stationary tank, located at the Burma road storage area. Tank should have provisions to pump the collected water out. The BAKER tank shall be stationed in a temporary water tank area as described below.

Temporary Water Tank Area:
Temporary Water tank area must be properly identified and located away from storm drain inlets, drainage facilities, and watercourses. It must be paved and have a 4" berm to contain runoff and prevent run-on. It must be equipped with a sump for the collection and disposal of any spilled or leaked water.

Inspection and maintenance
Inspect collection system component at the beginning of the operation, on an hourly basis within the operation and after operation is completed. No operation shall be scheduled within 24 hours of any rain event. Inspection shall be for damaged containments, linings, sediment buildup, trapped debris, and construction access. Ensure that debris is removed and linings are repaired promptly. The exterior of vehicles and equipment in wet areas of the collection system should be free of petroleum residues and sealed so as to prevent leakage of fuels and oils into the water body if submerged.
All inspections shall be performed by qualified personnel who have experience in the inspection and working with Stormwater collection systems.

Water Quality
Collected water from this operation will be tested for level of metals and toxic matters. Water toxicity test may also be required. Based on test from the first samples the plan shall be reviewed before operations can continue. Any possibility of toxicity shall be addressed in this review.


Caltrans
Typical Bike path Panel
1/2" Water Hose
Place Secondary Water Containment
Midway under Bikeway
3/4 HP or as approved Sump Pump
with 3/4"Outlet and Fitting
Place 55 Gallon-Drum
Midway under Bikeway
3/4" Water Hose
Typical Bike Path
Traveler
275 Gallon-Tank
OBG
Notes:
1. Water level to maximum 80% of 55-gallon drum capacity.
2. Water hose shall be sealed at the connection point to the drilled hole at the bike path panel
3. For Water Containment and Collection details please refer to water containment and collection plan included in SMR report for Water Intrusion in Bike path panels.
Water Intrusion Containment Details
Office of Structural Material
Date: March, 2012

APPENDIX 3

FLIR T300 photos of bikepath panels identified with water intrusion. Performed by CT METS on 12-17-2012 and 01-15-2013.

On 12/17/12, METS personnel conducted an infrared camera investigation, using a FLIR T300 camera. A boat was driven from the beginning of the bike path in Oakland to the end of the Skyway transition structure to the SAS while the infrared camera was aimed the bike path. Water intrusion could not be detected throughout the length of the bridge, with the exception of the final two panels nearest the SAS structure. Water in these panels was discovered in previous surveys but was never emptied due to inaccessibility. Detecting water in these locations confirms that if standing water was present throughout all of the panels, it would have shown up on the camera. As such, it appears that no more water has intruded the bike path panels after being drained after the prior survey.

On 1/15/13, METS personnel conducted an infrared camera investigation, using a FLIR T300 camera. The infrared camera was aimed the bike path while the boat was driven from the end of the Skyway transition structure of the SAS to the beginning of the bike path in Oakland. Water intrusion could not be detected throughout the length of the bridge with the only exceptions being in the expansion joint panels. Water was also witnessed in the final two panels nearest the SAS structure where it is known to exist.

Figure 1. Typical Bikepath view on 1-15-13

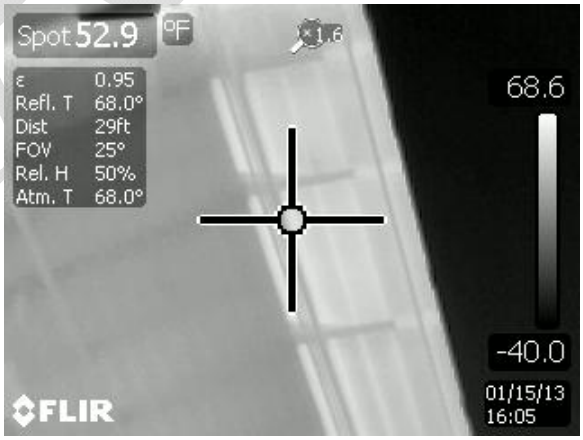


Figure 2. Typical Bikepath view on 1-15-13

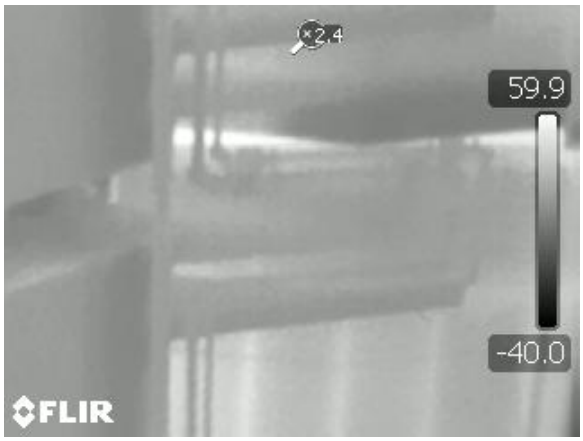


Figure 3. Water suspected in expansion joint panels

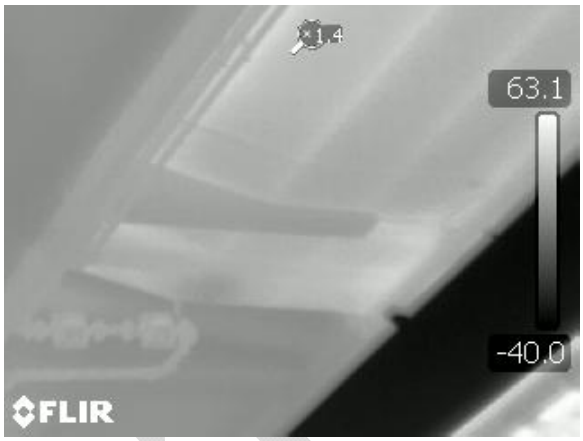


Figure 4. Water suspected in expansion joint neareast OTD

Figure 5. Typical panel with suspected water on 2-28-12 inspection

APPENDIX 4

Water Collection Log

	Skyway bikepath panel water removal investigation results				
	As of:	6/26/2012	2/11/2013	6/14/2013	
Sequential panel number	Panel Serial No. (stamped into panel)	Total Amount of Water Removed (Gallons)	Total Amount of Water Removed (Gallons)	Total Amount of Water Removed (Gallons)	Comments
2	1422AR	No Access…Unable	7 Gal (drilled 5/30/13)	0	
3	1423AR	No Access…Unable	1 Gal (drilled 5/29/13)	0	
4	1424AR	-	-	0	Not on list- mistakenly drilled.
10	1427AR	88	2 cups	2 Gal	
22	1427KR	3	0	0	
27	1427N	128	1 quart	1/2 Gal	
40	1427YR	330	1 cup	1 Gal	
81	1441W	8	0		
85A	No Number	49	.5 cup		1st Panel West of Hinge B
85B	No Number	0	1 cup		1st Panel East of Hinge B…had concerns and drilled.
87	1309B	39	1 Gal	0	
89	1309DR	2	0	0	
94	1209Q	16	0	3/4 Gal	
97	1309LR	8	0	0	
136	1209U	8	0	0	
140	1209AGR	3	3 Gal	0	
144	1309BD	4	0	0	
145	1311CR	9	.5 cup	1/2 cup	
155	1313B	1	0	0	
165A	1315AR	102	1 quart	1 cup	1st Panel West of Hinge C
167	1209SR	2	0	3/4 Gal	METS Test Panel
171	1209F	0	0	0	
182	1309AZR	46	1 quart	6 cups	
184	1209TR	27	2 cups	5 cups	
193	1209LR	2	0	0	
215	1209AUR	28	.5 cup	3 cups	
223	1211CR	2	0	0	
239A	1215AR	120	10 gal	8 Gal	1st Panel West of Hinge D
245	1109AR	6	0	0	
253	1111AR	1	0	0	
257	1124AR	2	1 cup	0	
263	1121AR	0	0	0	Not on list…had concerns and drilled.
264	1112AR	70	4 gal	1 Gal	1st Panel West of Hinge E

Appendix 5
Water Collection Layout Sheets

LOCATIONS OF WATER IN SKYWAY BIKEPATH
FIT INVESTIGATION 2/28/12
LOCATIONS IDENTIFIED AS H20

1 of 15

INDEX OF SHEETS

THE STANDARD PLANS LIST APPLICABLE TO THIS CONTRACT IS INCLUDED IN THE NOTICE TO CONTRACTORS AND SPECIAL PROVISIONS BOOK.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

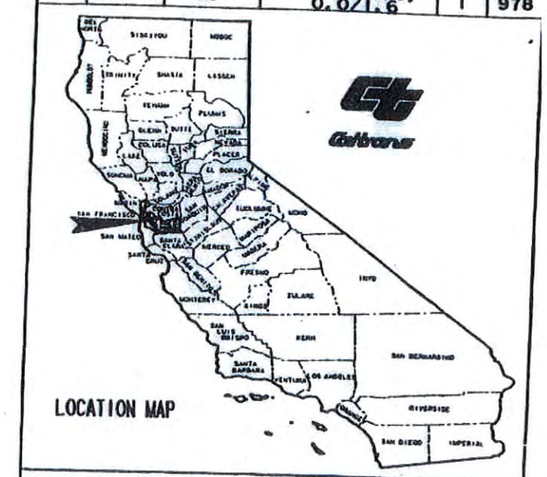
ACIM-080-1(085)8N

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	SF, Ala	80	13.9/14.3, 0.0/1.6	1	978

PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY

IN THE CITY AND COUNTY OF SAN FRANCISCO AND ALAMEDA COUNTY IN SAN FRANCISCO AND OAKLAND FROM 1.3 km TO 3.3 km EAST OF THE YERBA BUENA ISLAND TUNNEL EAST PORTAL

To be supplemented by Standard Plans dated July, 1999



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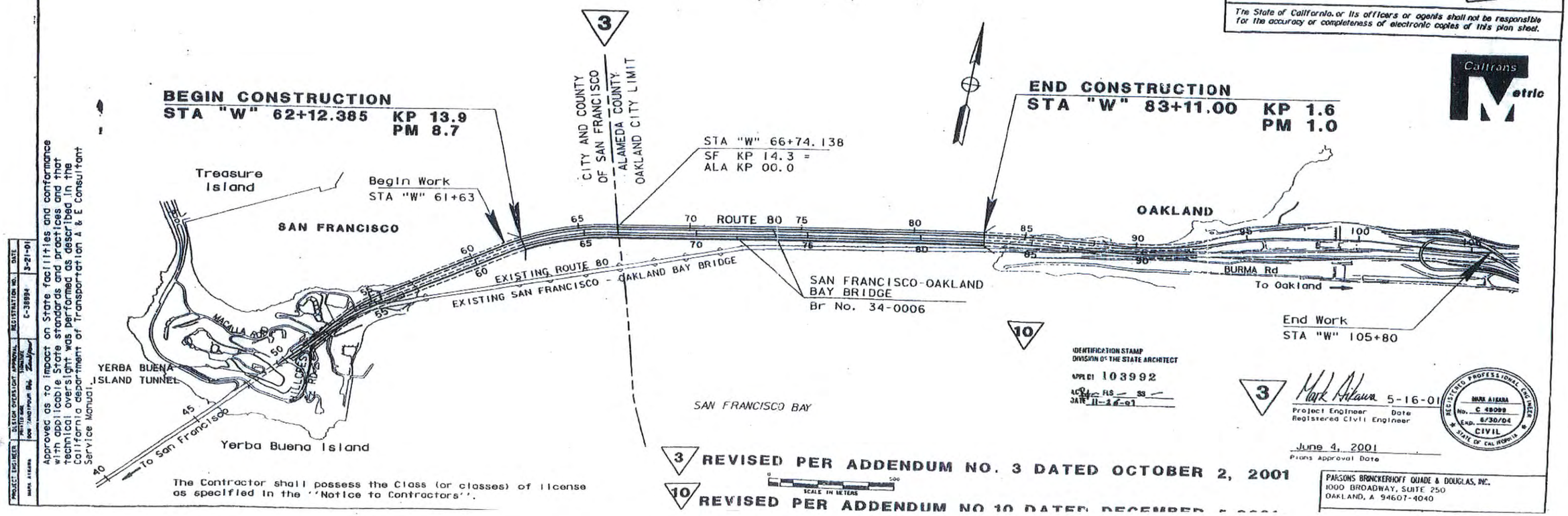


Approved as to impact on State facilities and conformance with applicable State standards and practices and that technical oversight was performed as described in the California department of Transportation A & E Consultant Service Manual.

PROJECT ENGINEER	DISTRICT OVERSIGHT APPROVAL	REGISTRATION NO.	DATE
MARK AIKAWA	DOUGLAS WHITTIER	C-38994	3-21-01

The Contractor shall possess the Class (or classes) of license as specified in the "Notice to Contractors".

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
APPLICATION 103992
ACCESS FLS — SS —
DATE 11-2 6-01

Mark Aikawa 5-16-01
Project Engineer Date
Registered Civil Engineer

REGISTERED PROFESSIONAL ENGINEER
MARK AIKAWA
No. C 48099
Exp. 6/30/04
CIVIL
STATE OF CALIFORNIA

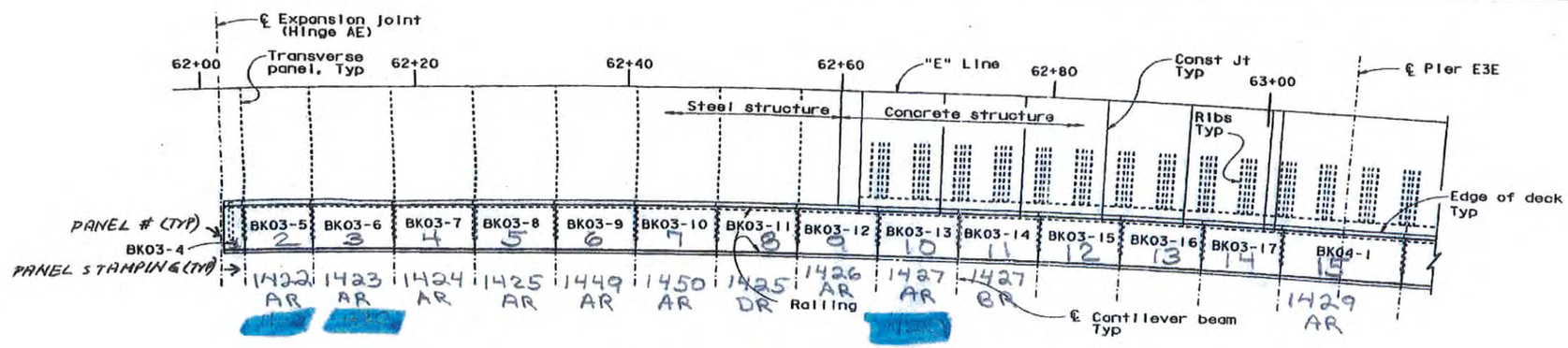
June 4, 2001
Plans Approval Date

3 REVISED PER ADDENDUM NO. 3 DATED OCTOBER 2, 2001

10 REVISED PER ADDENDUM NO 10 DATED DECEMBER 5, 2001

PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.
1000 BROADWAY, SUITE 250
OAKLAND, A 94607-4040

(2)



PARTIAL PLAN (BIKEPATH SPAN E3E)

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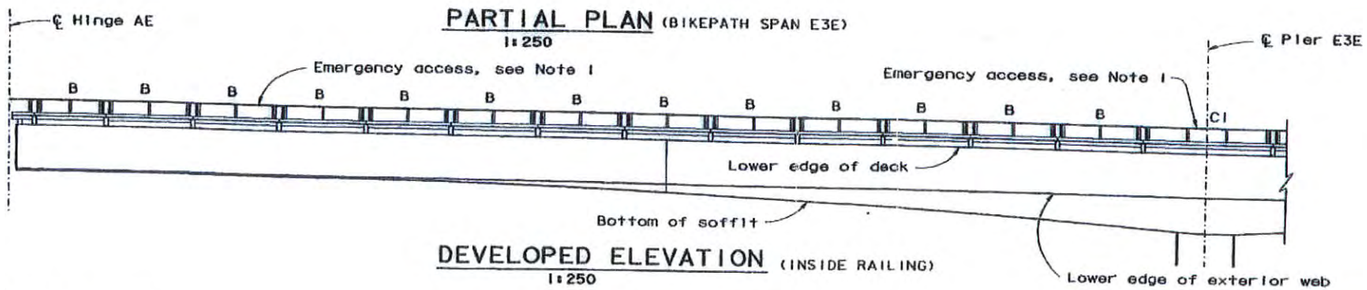

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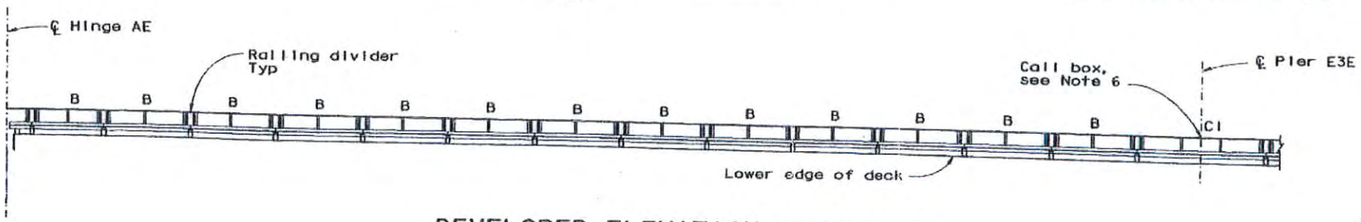
1:250



DEVELOPED ELEVATION (OUTSIDE RAILING)

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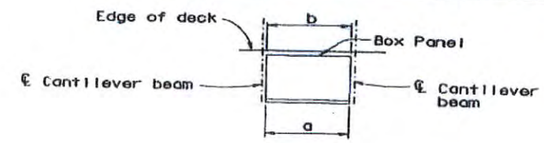

PLAN

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK03-4	6	Note 5	Note 5
BK03-5	1	5278	5302
BK03-6	1	7556	7591
BK03-7	1	7556	7591
BK03-8	1	7556	7591
BK03-9	1	7556	7591
BK03-10	1	7556	7591
BK03-11	1	7556	7591
BK03-12	1	7556	7591
BK03-13	1	7556	7591
BK03-14	1	7556	7591
BK03-15	1	7556	7591
BK03-16	1	7556	7591
BK03-17	1	7556	7591
BK04-1	3	11339	11391

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK03-5 — Bikepath, Span No., Panel No.
5. See "Bikepath Details" sheets.
6. For call box details, see "Road Plan" sheets.

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF, Ala	80	13.9/14.3, 0.0/1.6	771	978

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R.S. Bagha
DESIGN OVERSIGHT
SIGN OFF DATE 11/17/00

DESIGN BY P. Chou CHECKED C. Werts
DETAILS BY A. Lishansky CHECKED C. Werts
QUANTITIES BY L. Greer CHECKED J. Leventini

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Sajid Abbas
PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.9/14.3

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 1

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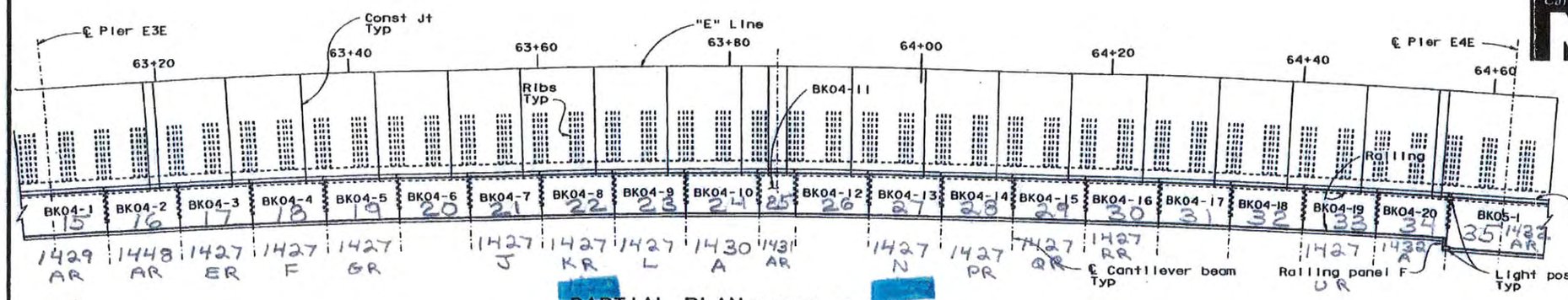

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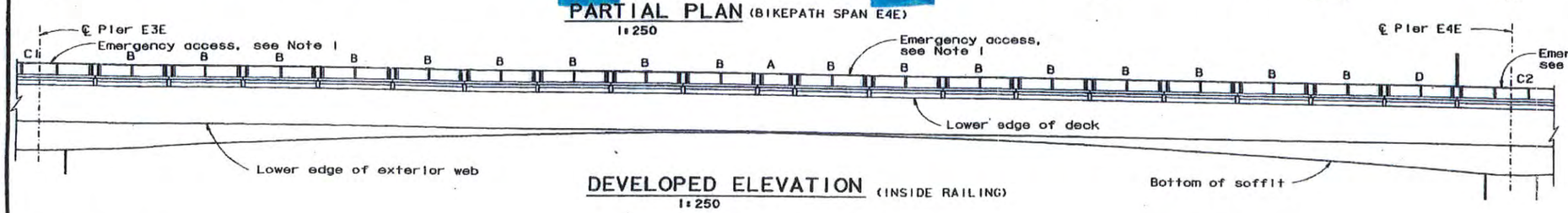

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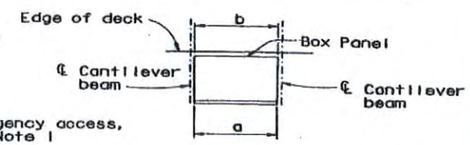

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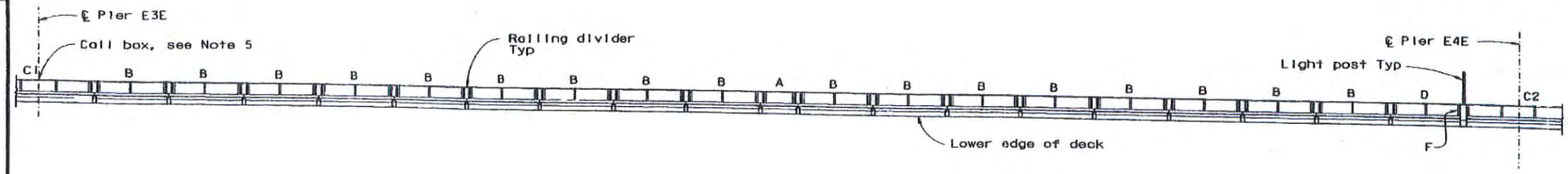

DEVELOPED ELEVATION (OUTSIDE RAILING)
1:250

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK04-1	3	11339	11391
BK04-2	1	7556	7591
BK04-3	1	7556	7591
BK04-4	1	7556	7591
BK04-5	1	7556	7591
BK04-6	1	7556	7591
BK04-7	1	7556	7591
BK04-8	1	7556	7591
BK04-9	1	7556	7591
BK04-10	1	7556	7591
BK04-11	2	3773	3791
BK04-12	1	7556	7591
BK04-13	1	7556	7591
BK04-14	1	7556	7591
BK04-15	1	7556	7591
BK04-16	1	7556	7591
BK04-17	1	7556	7591
BK04-18	1	7556	7591
BK04-19	1	7556	7591
BK04-20	1	7556	7591
BK05-1	4	11339	11391

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK04-1
   Bikepath — Span No. — Panel No.
5. For call box details, see "Road Plan" sheets.

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	DETAILS BY A. Lishansky	CHECKED C. Werts			KILOMETER POST 13.9/14.3, 0.0/1.6
	QUANTITIES BY L. Greer	CHECKED J. Leventini			

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 2

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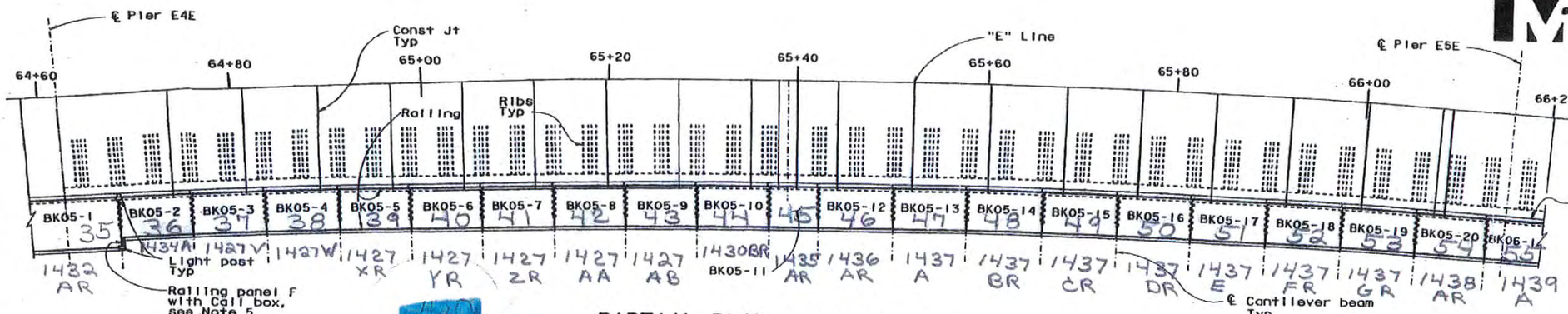

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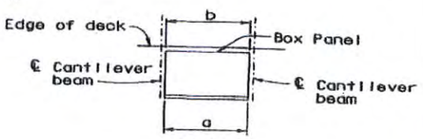

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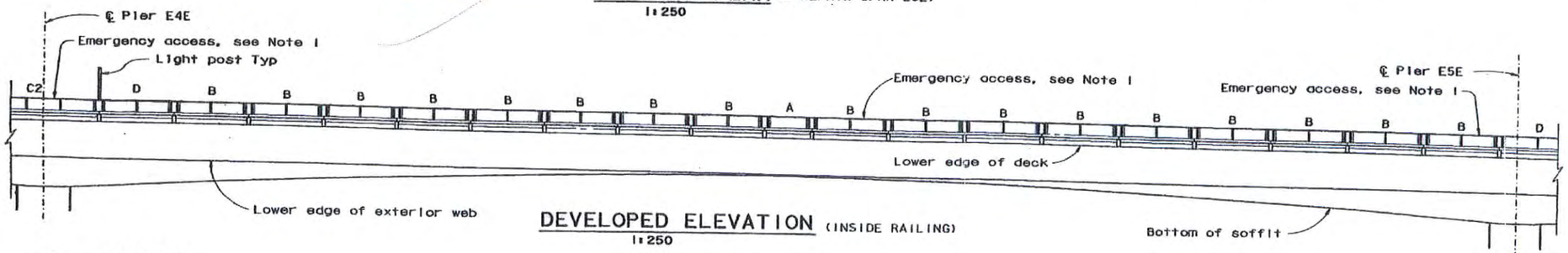

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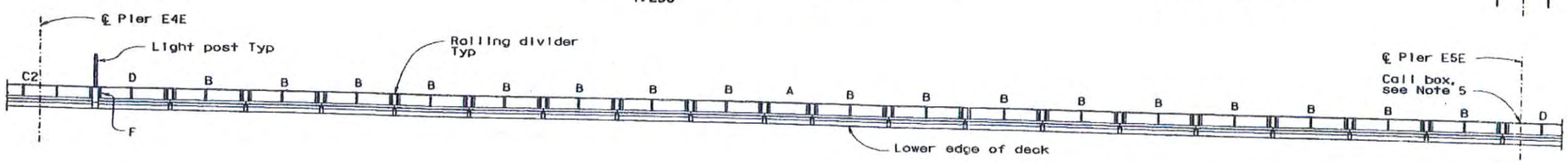

DEVELOPED ELEVATION (OUTSIDE RAILING)
1:250

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK05-1	4	11339	11391
BK05-2	1	7556	7591
BK05-3	1	7556	7591
BK05-4	1	7556	7591
BK05-5	1	7556	7591
BK05-6	1	7556	7591
BK05-7	1	7556	7591
BK05-8	1	7556	7591
BK05-9	1	7556	7591
BK05-10	1	7556	7591
BK05-11	2	4753	4827
BK05-12	1	7853	7892
BK05-13	1	7853	7892
BK05-15	1	7853	7892
BK05-15	1	7853	7892
BK05-16	1	7853	7892
BK05-17	1	7853	7892
BK05-18	1	7853	7892
BK05-19	1	7853	7892
BK05-20	1	7853	7892
BK06-1	1	7853	7892

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK05-1 — Bikepath, Span No., Panel No.
5. For call box details, see "Road Plan" sheets.

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A.S. Bagha, DESIGN OVERSIGHT, SIGN OFF DATE 11/17/00	DESIGN	BY P. Chou	CHECKED C. Werts
	DETAILS	BY A. Lishansky	CHECKED C. Werts
	QUANTITIES	BY L. Greer	CHECKED J. Leventini

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Sajid Abbas, PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.9/14.3

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 3

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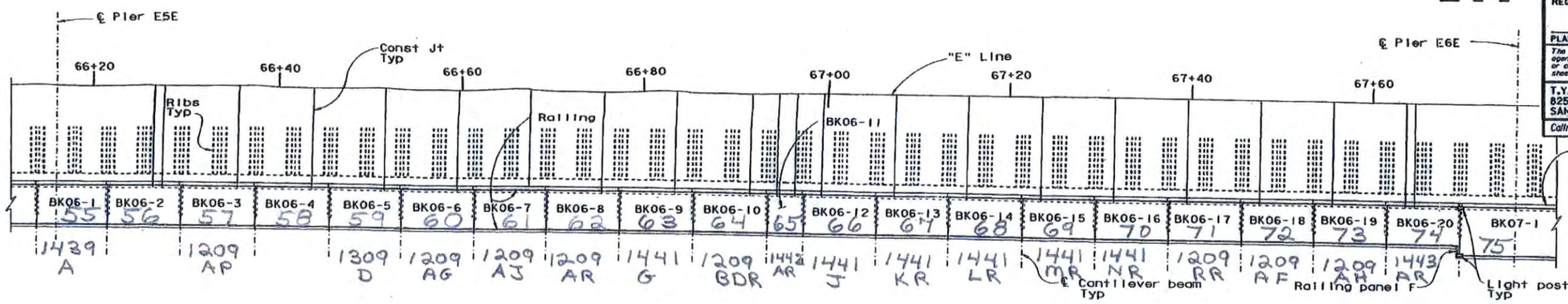

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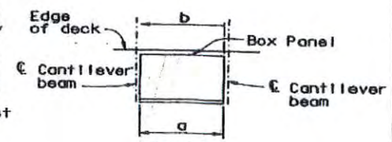

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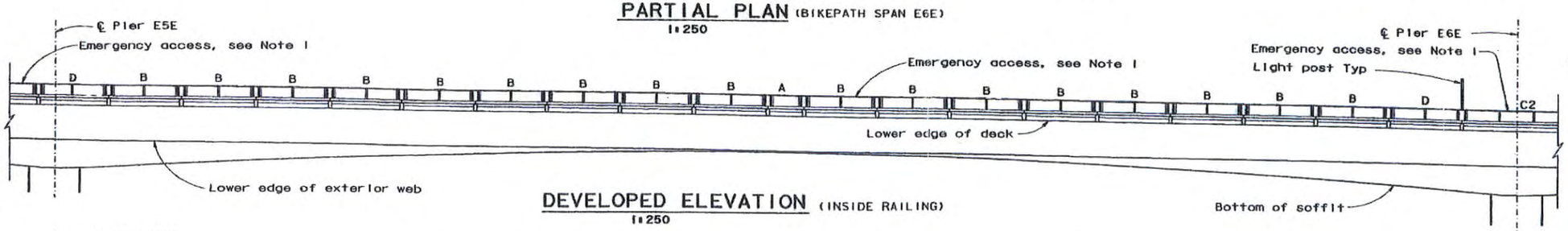

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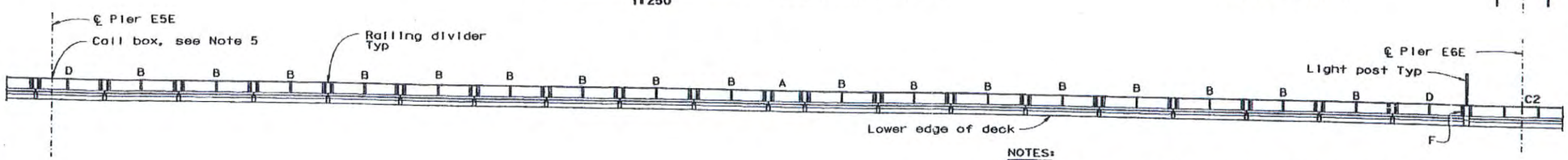

DEVELOPED ELEVATION (OUTSIDE RAILING)
1:250

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK06-1	1	7853	7892
BK06-2	1	7940	7945
BK06-3	1	7990	7990
BK06-4	1	7990	7990
BK06-5	1	7990	7990
BK06-6	1	7990	7990
BK06-7	1	7990	7990
BK06-8	1	7990	7990
BK06-9	1	7990	7990
BK06-10	1	7990	7990
BK06-11	2	3990	3990
BK06-12	1	7990	7990
BK06-13	1	7990	7990
BK06-14	1	7990	7990
BK06-15	1	7990	7990
BK06-16	1	7990	7990
BK06-17	1	7990	7990
BK06-18	1	7990	7990
BK06-19	1	7990	7990
BK06-20	1	7990	7990
BK07-1	4	11990	11990

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK06-1 — Bikepath, Span No., Panel No.
5. For call box details, see "Road Plan" sheets.

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R. S. Bagha
DESIGN OVERSIGHT
R. S. Bagha
SIGN OFF DATE 11/17/00
Rev. Dates 5-18-98

DESIGN	BY P. Chou	CHECKED C. Werts	
DETAILS	BY A. Lishansky	CHECKED C. Werts	
QUANTITIES	BY L. Greer	CHECKED J. Leventini	

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

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Sajid Abbas
PROJECT ENGINEER

CU 04
EA 012021

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.9/14.3, 0.0/1.6

DISREGARD PRINTS DATED: ____ EARLIER REVISION DATES:

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 4

REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

Caltrans

(6)

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF, Ala	80	13.9/14.3, 0.0/1.6	775	978

REGISTERED ENGINEER - CIVIL

6-4-01
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Wenpei Paul Chou No. 54019 Exp. 12/31/03 CIVIL STATE OF CALIFORNIA

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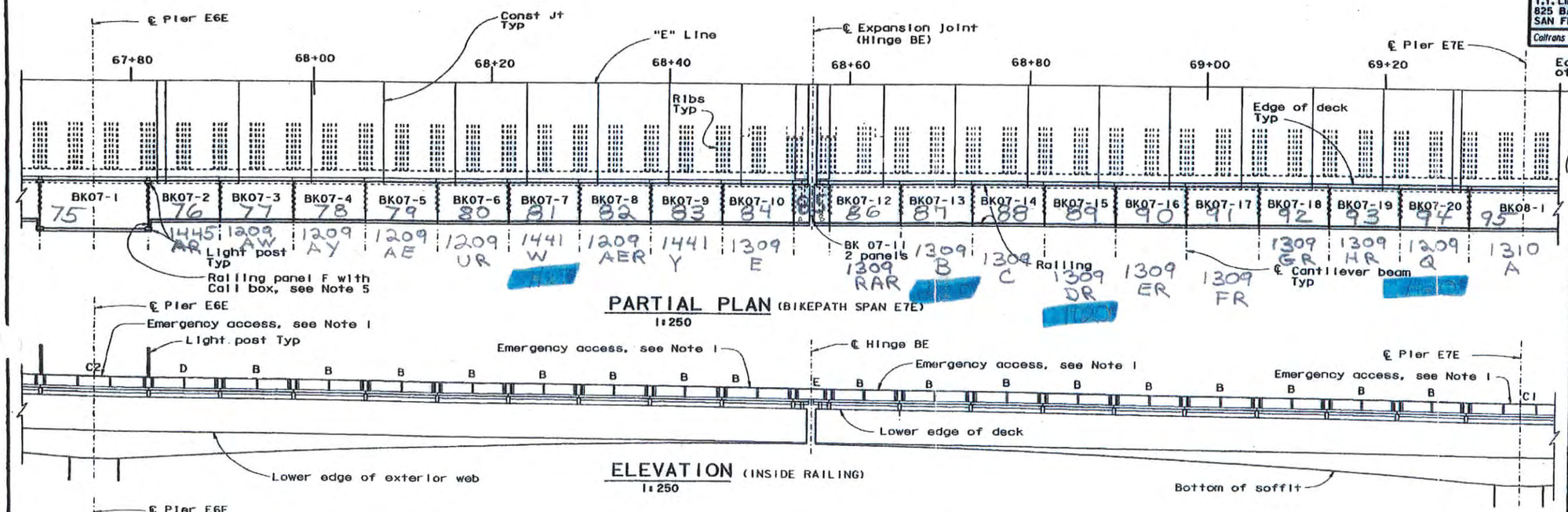

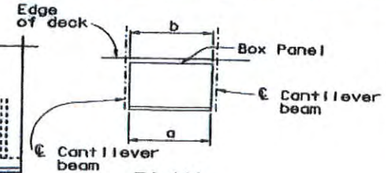

PLAN

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK07-1	4	11990	11990
BK07-2	1	7990	7990
BK07-3	1	7990	7990
BK07-4	1	7990	7990
BK07-5	1	7990	7990
BK07-6	1	7990	7990
BK07-7	1	7990	7990
BK07-8	1	7990	7990
BK07-9	1	7990	7990
BK07-10	1	7990	7990
BK07-11	5	3990	3990
BK07-12	1	7990	7990
BK07-13	1	7990	7990
BK07-14	1	7990	7990
BK07-15	1	7990	7990
BK07-16	1	7990	7990
BK07-17	1	7990	7990
BK07-18	1	7990	7990
BK07-19	1	7990	7990
BK07-20	1	7990	7990
BK08-1	3	11990	11990

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK07-1 — Bikepath, Span No., Panel No.
5. For call box details, see "Road Plan" sheets.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

R.S. Bagha, DESIGN OVERSIGHT, SIGN OFF DATE 11/17/00	DESIGN BY P. Chou	CHECKED C. Worts	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	DETAILS BY A. Lishansky	CHECKED C. Worts	
	QUANTITIES BY L. Greer	CHECKED J. Leventini	

Sajid Abbas, PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.9/14.3, 0.0/1.6

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 5

DATE PLOTTED = 09-JUN-2001 TIME PLOTTED = 13:32

100% PS&E

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Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF, Ala	80	13.9/14.3, 0.0/1.6	776	978

REGISTERED ENGINEER - CIVIL

6-4-01

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Wenpei Paul Chou No. 54019 Exp. 12/31/03 CIVIL STATE OF CALIFORNIA

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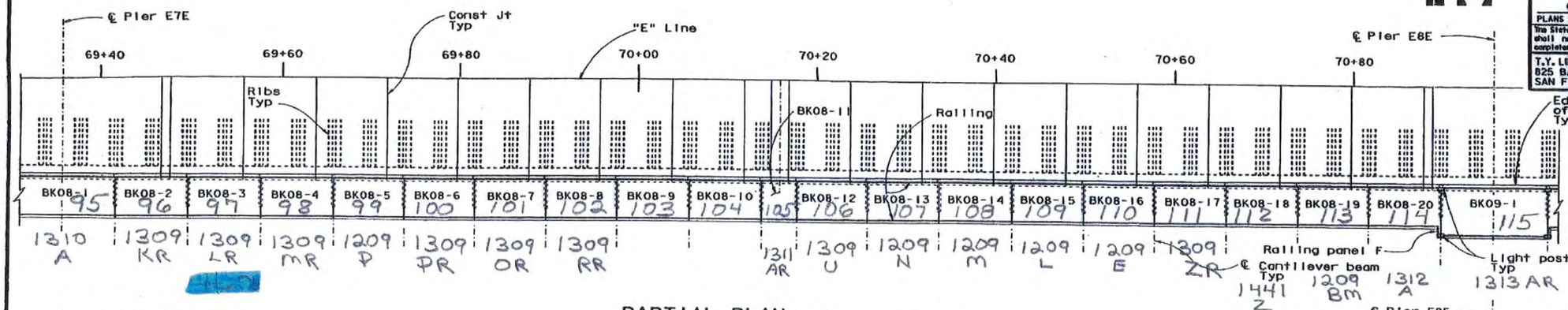
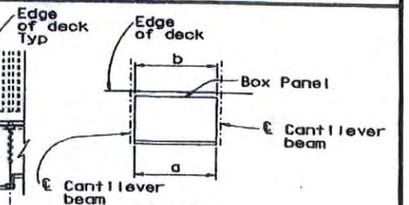
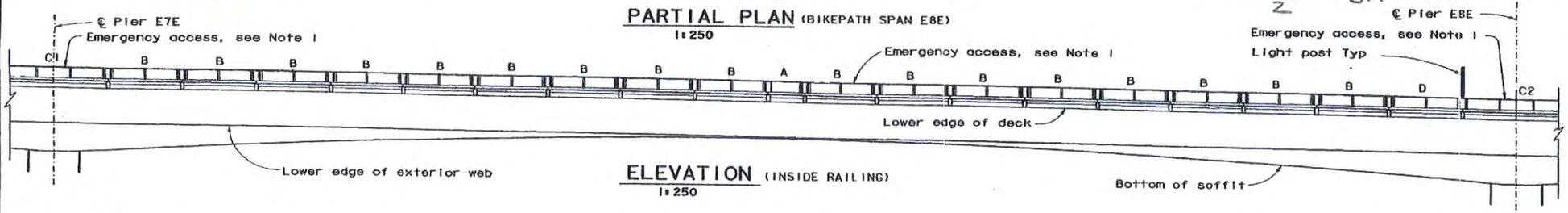


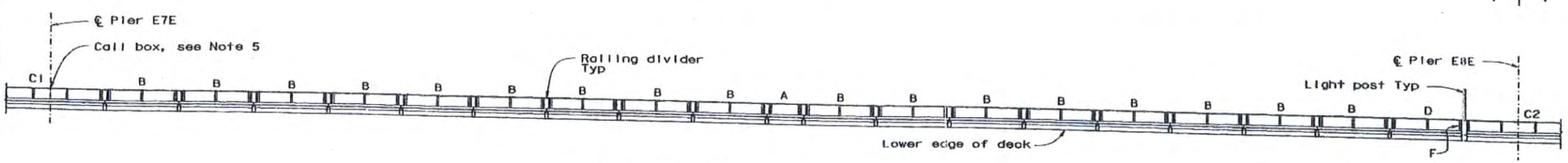
PARTIAL PLAN (BIKEPATH SPAN E8E)
1:250



PLAN



ELEVATION (INSIDE RAILING)
1:250



ELEVATION (OUTSIDE RAILING)
1:250

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK08-1	3	11990	11990
BK08-2	1	7990	7990
BK08-3	1	7990	7990
BK08-4	1	7990	7990
BK08-5	1	7990	7990
BK08-6	1	7990	7990
BK08-7	1	7990	7990
BK08-8	1	7990	7990
BK08-9	1	7990	7990
BK08-10	1	7990	7990
BK08-11	2	3990	3990
BK08-12	1	7990	7990
BK08-13	1	7990	7990
BK08-14	1	7990	7990
BK08-15	1	7990	7990
BK08-16	1	7990	7990
BK08-17	1	7990	7990
BK08-18	1	7990	7990
BK08-19	1	7990	7990
BK08-20	1	7990	7990
BK09-1	4	11990	11990

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK08-1 — Bikepath, Span No., Panel No.
5. For call box details, see "Road Plan" sheets.

100% PS&E

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

R.S. Bagha, DESIGN OVERSIGHT, SIGN OFF DATE 11/17/00	DESIGN BY P. Chou	CHECKED C. Werts	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	DETAILS BY A. Lishansky	CHECKED C. Werts	
	QUANTITIES BY L. Greer	CHECKED J. Leventini	

Sajid Abbas, PROJECT ENGINEER

BRIDGE NO. 34-0006L/R
KILOMETER POST 13.9/14.3, 0.0/1.6
CU 04

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 6

ORIGINAL SCALE IN MILLIMETERS

DISPLAYED PRINTS DEVIATION

REVISION DATES (PRELIMINARY STAGE ONLY)

Caltrans

(8)

Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF, Ala	80	13.9/14.3, 0.0/1.6	777	978

REGISTERED ENGINEER - CIVIL

6-4-01

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Wenpei Paul Chou No. 54019 Exp. 12/31/03 CIVIL STATE OF CALIFORNIA

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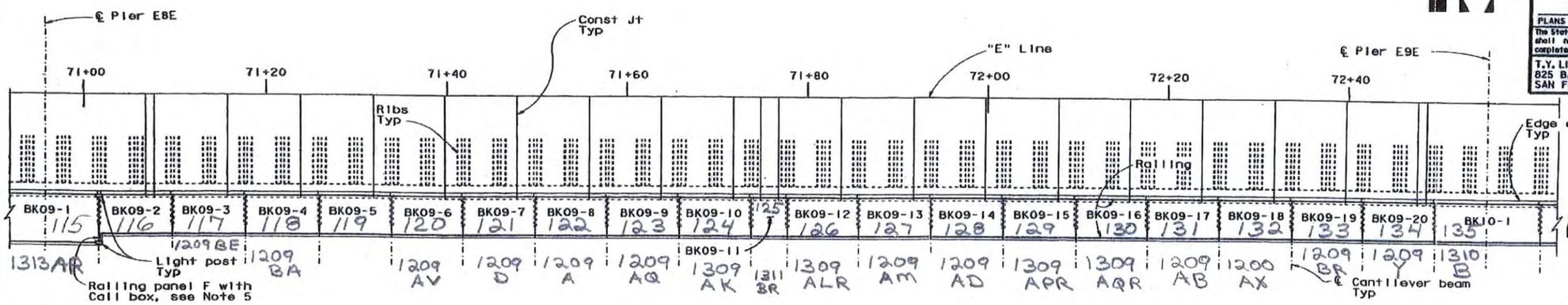
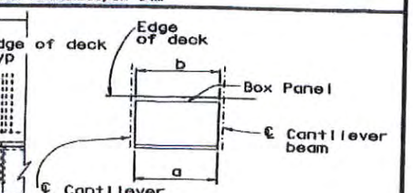
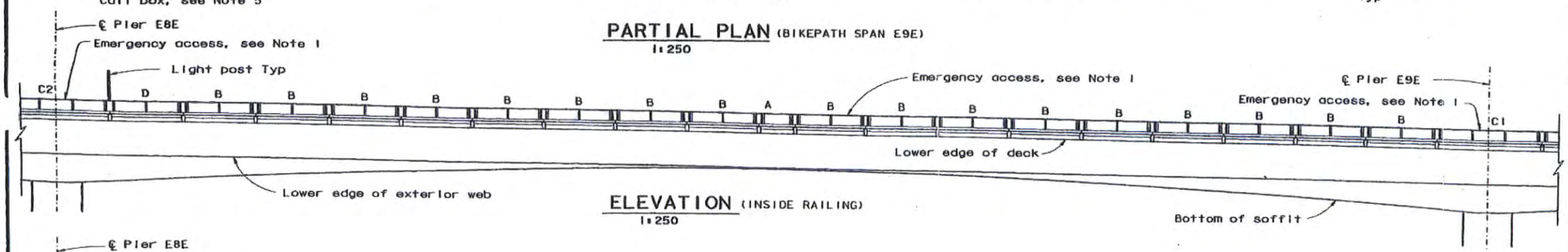


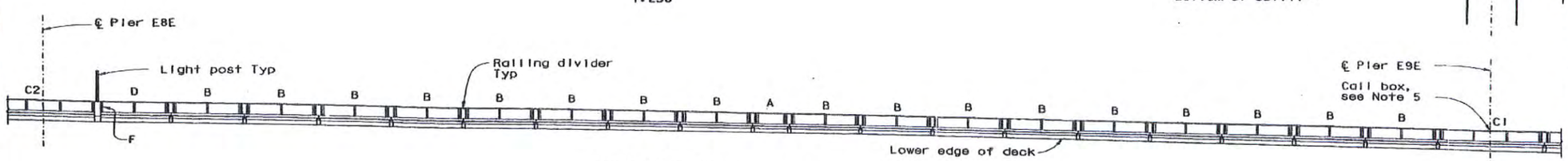
PARTIAL PLAN (BIKEPATH SPAN E9E)
1:250



PLAN



ELEVATION (INSIDE RAILING)
1:250



ELEVATION (OUTSIDE RAILING)
1:250

BIKEPATH STEEL BOX DIMENSION TABLE

Box Panel Mark	Box Panel Type	a	b
BK09-1	4	11990	11990
BK09-2	1	7990	7990
BK09-3	1	7990	7990
BK09-4	1	7990	7990
BK09-5	1	7990	7990
BK09-6	1	7990	7990
BK09-7	1	7990	7990
BK09-8	1	7990	7990
BK09-9	1	7990	7990
BK09-10	1	7990	7990
BK09-11	2	3990	3990
BK09-12	1	7990	7990
BK09-13	1	7990	7990
BK09-14	1	7990	7990
BK09-15	1	7990	7990
BK09-16	1	7990	7990
BK09-17	1	7990	7990
BK09-18	1	7990	7990
BK09-19	1	7990	7990
BK09-20	1	7990	7990
BK10-1	3	11990	11990

NOTES:

1. For railing, railing divider and emergency access details, see "Railing Details" sheets.
2. Bikepath railing panel types indicated by letters A, B, C1, C2 and D. For details, see "Railing Details" sheets.
3. For box panel type and cantilever beam, see "Bikepath Details" sheets.
4. Box panel nomenclature: BK09-1 (Bikepath — Span No. — Panel No.)
5. For call box details, see "Road Plan" sheets.

100 % PS&E

TIME PLOTTED: 13:32
DATE PLOTTED: 09-JUN-2001

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R.S. Bagha, DESIGN OVERSIGHT, R.S. Bagha, SIGN OFF DATE 11/17/00	DESIGN BY P. Chou	CHECKED C. Werts	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	DETAILS BY A. Lishansky	CHECKED C. Werts	Sajid Abbas, PROJECT ENGINEER
	QUANTITIES BY L. Greer	CHECKED J. Leventini	BRIDGE NO. 34-0006L/R; KILOMETER POST 13.9/14.3, 0.0/1.6

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SKYWAY STRUCTURES

BIKEPATH AND RAILING LAYOUT NO. 7

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