

## **APPENDIX A: Pier E3 Blast Plan**

# San Francisco-Oakland Bay Bridge East Span Seismic Safety Project



## **Pier E3 Demonstration Project** **Blast Plan**

Prepared by Contract Drilling & Blasting LLC for the California Department of Transportation

# **SCOPE OF WORK**

The removal of Pier E3 of the original east span of the San Francisco Oakland Bay Bridge (SFOBB) will require a combination of conventional and controlled implosion demolition techniques. Conventional methods will be used to remove the fender system and the top section of the pier to approximately elevation +9 (NGVD29). Once this phase is complete, a work platform will be constructed on top of the exposed wall system of the pier. This platform will allow for the placement of a drilling rig(s) on top of the pier and provide a safe working area for personnel during drilling operations and explosives loading operations. The platform will also serve as cover to prevent any concrete from being ejected into the air during the blast event. Additional wire rope blast mats will be used to curtain the sides of the structure exposed above water. Vertical drilling of the required bore holes will be conducted to allow for the placement of explosives in the designed locations. Once drilling has been completed, the drill rig will be removed from the pier. On a pre-determined date, explosives will be brought to the pier and loading operations will begin. Once the loading of charges has been completed, the initiation circuit from hole to hole will be completed in accordance with the designed sequence and tested to ensure all holes will fire. To facilitate this, electronic detonators will be used to allow for accurate programming of firing times and to provide information back to the programmer that they are "ready". As an additional safety measure to ensure detonation of all explosives, all decks/holes will have two active detonators for redundancy. Loading operations will be planned to allow for the shot to be ready to blast at the following high slack tide. Once the final blast preparations have been completed and all required attenuation systems, monitoring equipment, and personnel are in place the marine blast safety zone will be secured. Traffic on the new east span will then be stopped, warning signals will be sounded, and the blast detonated. The blaster will do a visual check of post blast conditions and then give the "all clear" signal allowing traffic to resume on the new east span and Project personnel to re-enter the blast zone.

# **Design Considerations**

The following site conditions have been taken into consideration while developing the blast design for Pier E3;

- 1) The condition of the existing pier.
- 2) The proximity of the new bridge components.
- 3) The proximity of utilities.
- 4) Water depths.
- 5) The Bay bottom elevations and limits of removal.
- 6) Structures adjacent to the site.
- 7) Marine life in the immediate area.
- 8) Environmental concerns.

The blast design has addressed these factors. Hole patterns and the weight of explosives detonated per delay have been designed to minimize any detrimental effects while fragmenting the pier sufficiently.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SF,Ala	80			

REGISTERED CIVIL ENGINEER	X	DATE
YONG PIL KIM		
No. C48365		
Exp. 06-30-16		
CIVIL		
STATE OF CALIFORNIA		

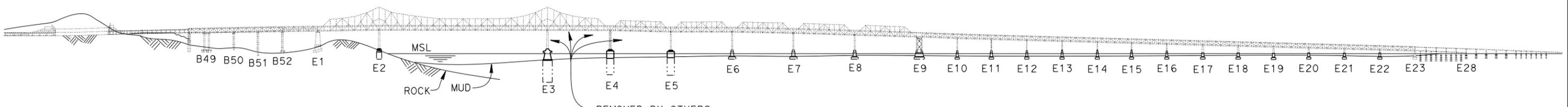
PLANS APPROVAL DATE \_\_\_\_\_

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

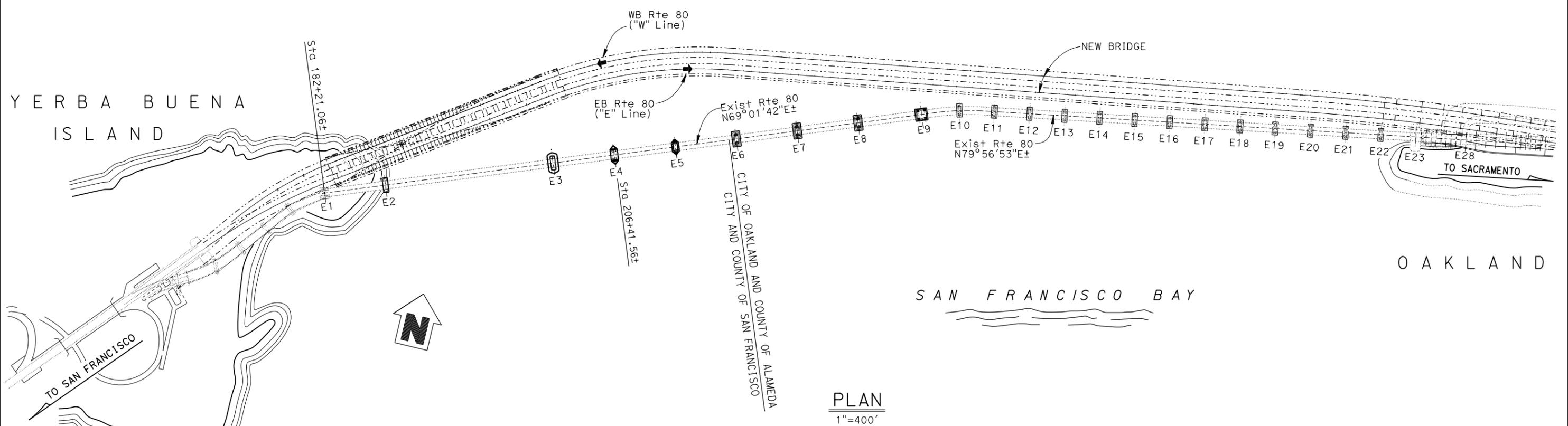
DRAFT COPY

**LEGEND:**

- Indicates existing
- Indicates removal limit (top portion only) 1 foot below mudline (Typ)
- ..... Indicates removed by others (another contract)



**ELEVATION**  
1"=400'



**PLAN**  
1"=400'

**NOTE:**  
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

**BRIAN MORI**  
DESIGN ENGINEER

DESIGN	BY Yong Pil Kim	CHECKED	LOAD & RESISTANCE FACTOR DESIGN
DETAILS	BY Carlo Cancino	CHECKED	LAYOUT
QUANTITIES	BY	CHECKED	SPECIFICATIONS
			BY Yong Pil Kim
			BY X

**STATE OF CALIFORNIA**  
DEPARTMENT OF TRANSPORTATION

**DIVISION OF ENGINEERING SERVICES**  
STRUCTURE DESIGN  
**DESIGN BRANCH 8**

BRIDGE NO.	33-0025
POST MILE	8.6/1.2

**SAN FRANCISCO-OAKLAND BAY BRIDGE**  
**EAST SPAN SEISMIC SAFETY PROJECT**

**PIER E3 REMOVAL**  
**GENERAL PLAN**

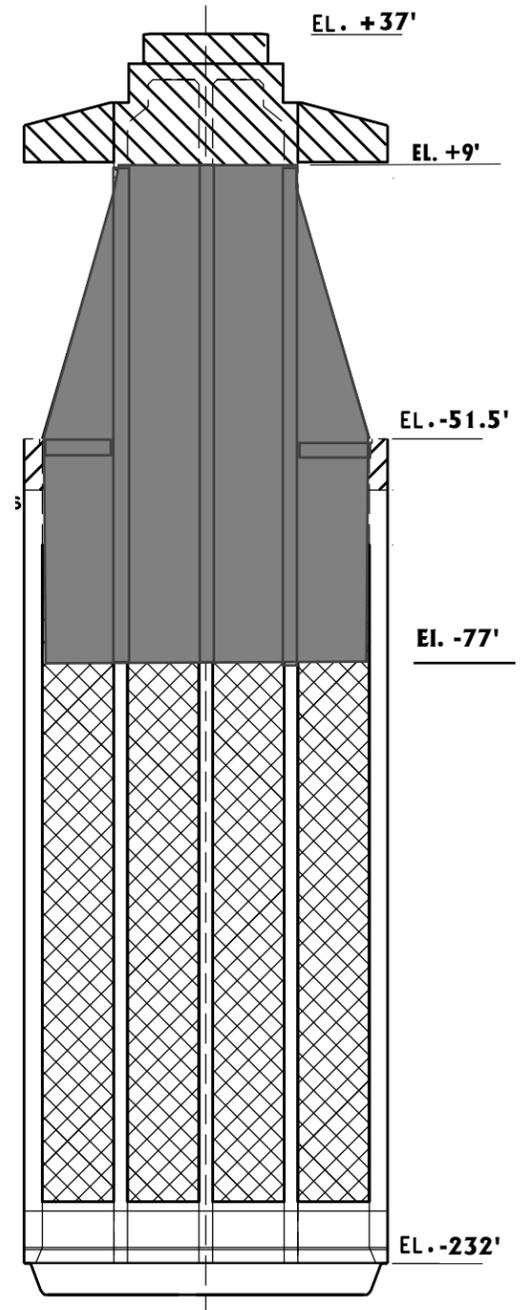
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
.	.	.	.	.	.

REGISTERED CIVIL ENGINEER DATE	
PLANS APPROVAL DATE	
<small>The State of California or its officers or agents shall not be responsible for the accuracy or completeness of scanned copies of this plan sheet.</small>	

GENERAL DEMOLITION NOTES

- All elevations referenced to NGVD29
- Blast attenuation system will be placed around the pier
- Demolition sequence
  - Mechanically remove the top section of the pier to elevation +9
  - Mechanically remove the caisson covers at the base of the buttress walls
  - Blast holes will be drilled from elevation +9 down to required depths
  - Explosives will be loaded into the bore holes and the firing circuit completed
  - Blasting mats will be placed
  - Blast will be detonated at slack high tide
- Mechanical work may be required to cut rebar and depose remaining debris into the cells



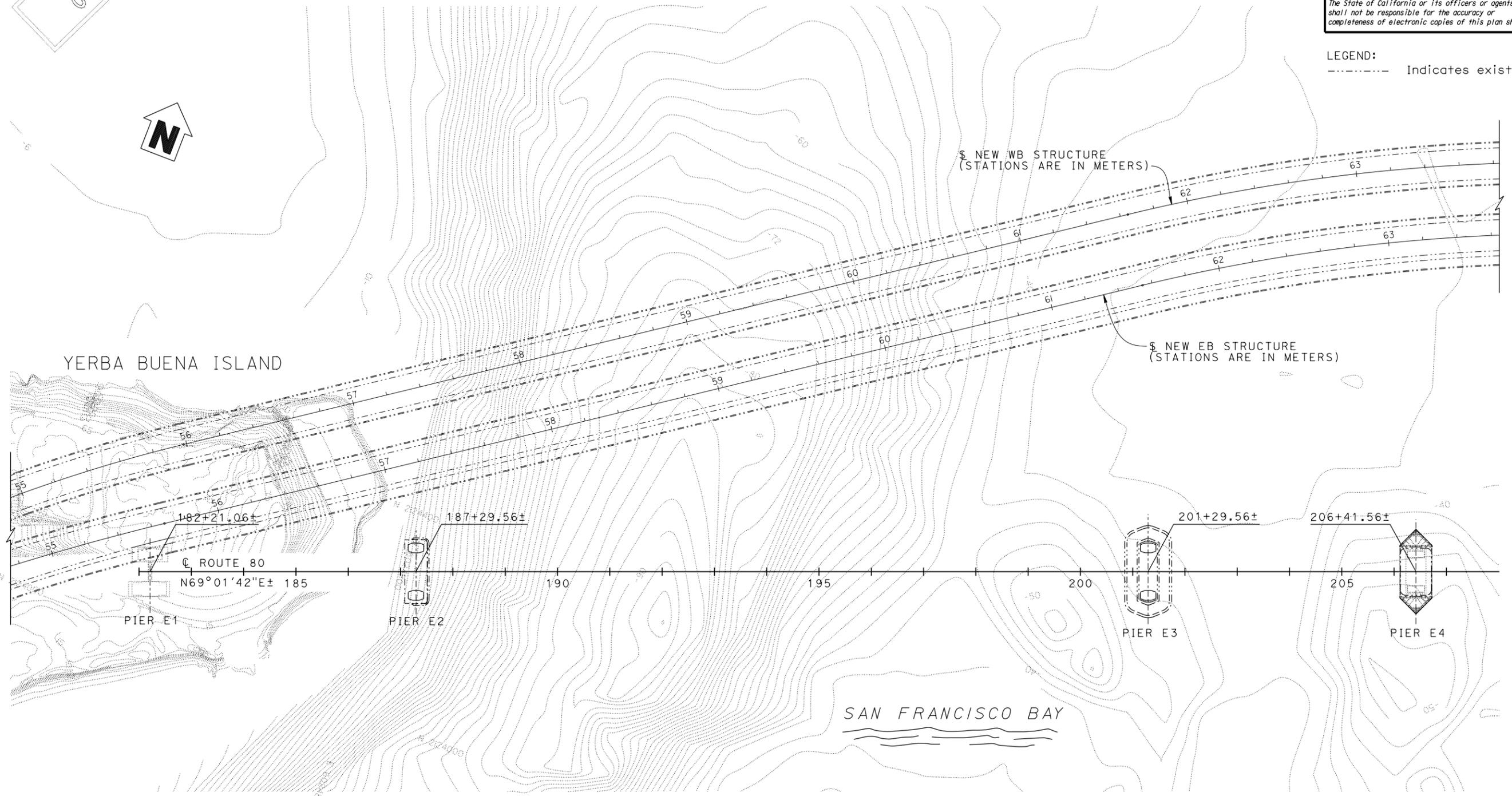
-  Limits of removal Using Wire Saw Cut or Other Mechanical Means
-  Limits of removal Using Blasting
-  Space Available for Disposal of Debris

SCALE 1"=20'

DESIGN OVERSIGHT	DESIGN	BY	CHECKED	PROJECT ENGINEER	BRIDGE NO.	SFOBB EAST SPAN DISMANTLING PROJECT
	DETAILS	BY	CHECKED		POST MILES	
	QUANTITIES	BY	CHECKED			
SIGN OFF DATE	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS			CU	DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES (PRELIMINARY STAGE ONLY)
DESIGN DETAIL SHEET (ENGLISH) (REV. 06-01-09)	0 1 2 3			EA	SHEET OF	

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SF, Alameda	80			
			X		
REGISTERED CIVIL ENGINEER			DATE		
			YONG PIL KIM		
			No. C48365		
			Exp. 06-30-16		
PLANS APPROVAL DATE			CIVIL		
<small>The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.</small>					

DRAFT COPY



LEGEND:  
 ----- Indicates existing

NOTE:  
 THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

**PLAN**  
 1" = 100'

NOTE:  
 MUDLINE CONTOURS ARE ACCORDING TO SOUNDINGS TAKEN DURING JANUARY, 1998.

**SAN FRANCISCO-OAKLAND BAY BRIDGE  
 EAST SPAN SEISMIC SAFETY PROJECT**

**PIER E3 REMOVAL  
 FOUNDATION PLAN**

DESIGN	BY Yong Pil Kim	CHECKED
DETAILS	BY Carlo Cancino	CHECKED
QUANTITIES	BY	CHECKED

**STATE OF CALIFORNIA**  
 DEPARTMENT OF TRANSPORTATION

**DIVISION OF ENGINEERING SERVICES  
 STRUCTURE DESIGN  
 DESIGN BRANCH 8**

BRIDGE NO.	33-0025
POST MILE	8.6/1.2



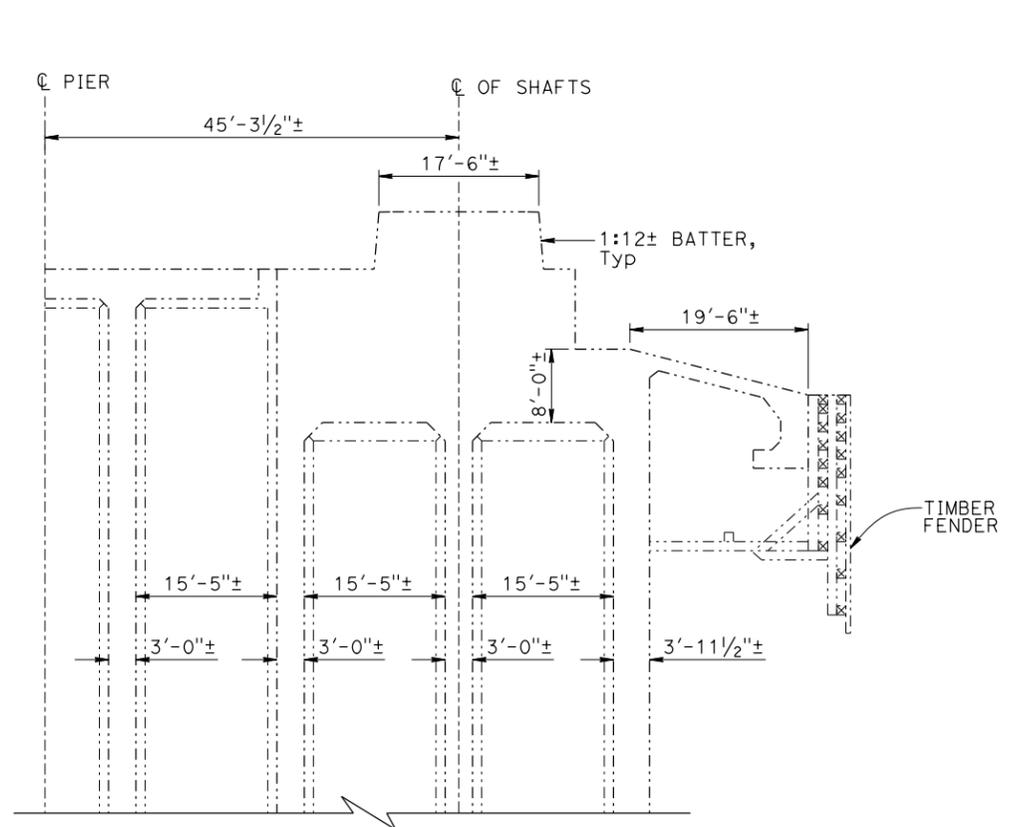
DATE PLOTTED => 20-JAN-2015 TIME PLOTTED => 14:49 USERNAME => s134003

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SF, Alameda	80			

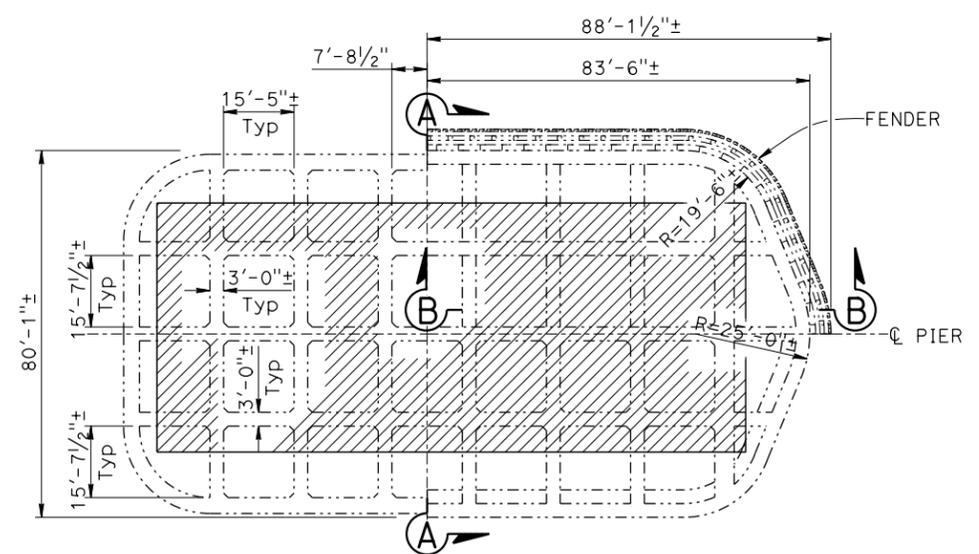
  

REGISTERED CIVIL ENGINEER	X	DATE
YONG PIL KIM		
No.	C48365	
Exp.	06-30-16	
CIVIL		
STATE OF CALIFORNIA		

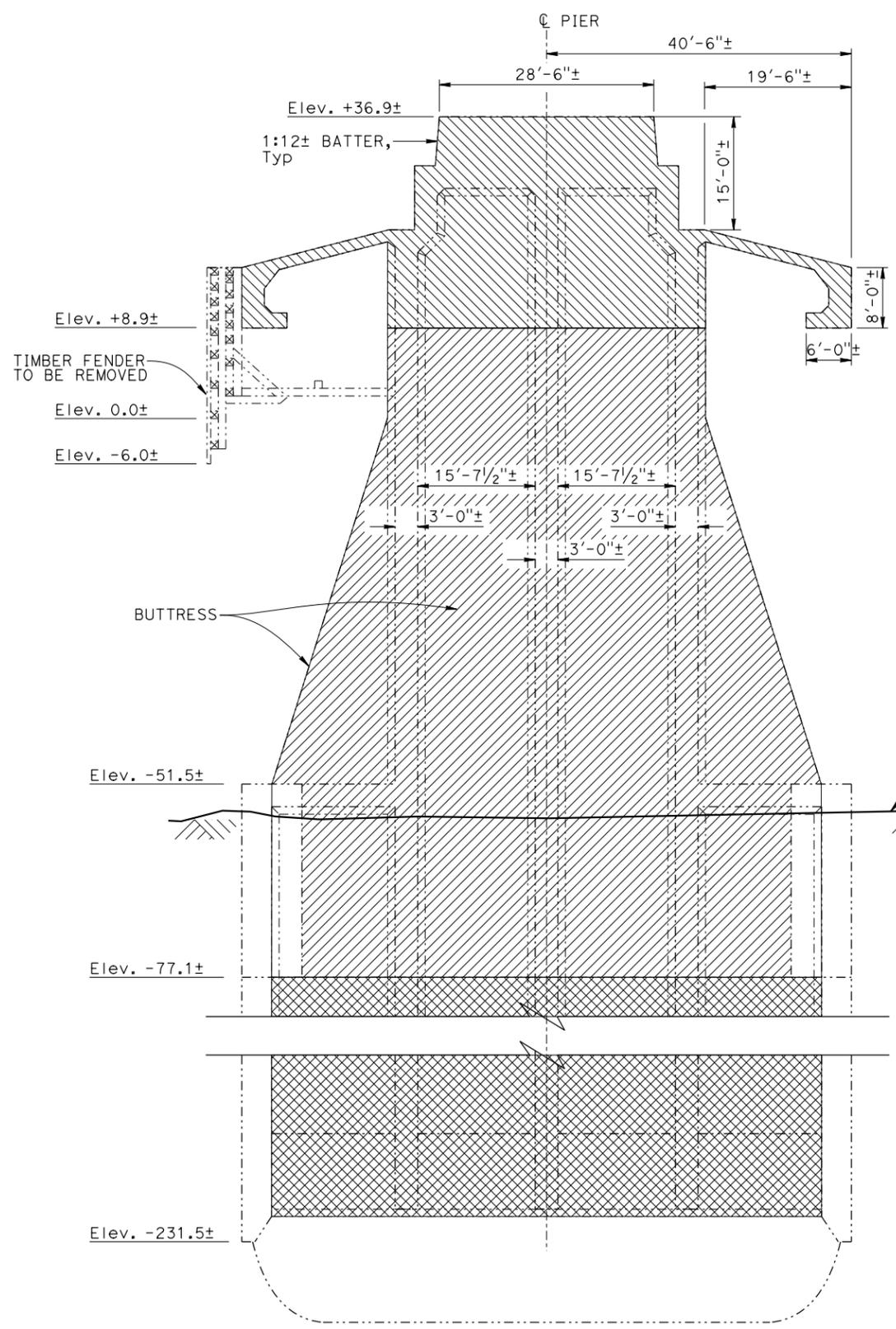
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



**SECTION B-B**  
No Scale



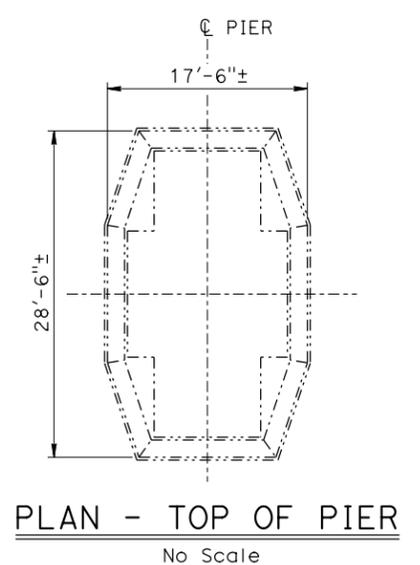
**1/2 SECTION THRU CAISSON 1/2 SECTION THRU FENDER**  
**PART SECTION**  
No Scale



**DEMOLITION LIMITS**  
**SECTION A-A**  
No Scale

- LEGENDS:**
- Indicates existing
  - [Diagonal Hatching] Indicates limits of removal using mechanical means
  - [Cross-hatching] Indicates limits of removal using blasting
  - [Grid Hatching] Indicates space available for disposal of debris

DRAFT COPY



**PLAN - TOP OF PIER**  
No Scale

NOTE:  
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

DESIGN	BY Yong Pil Kim	CHECKED
DETAILS	BY Carlo Cancino	CHECKED
QUANTITIES	BY	CHECKED

**STATE OF CALIFORNIA**  
DEPARTMENT OF TRANSPORTATION

**DIVISION OF ENGINEERING SERVICES**  
STRUCTURE DESIGN  
**DESIGN BRANCH 8**

BRIDGE NO.	33-0025
POST MILE	8.6/1.2

**SAN FRANCISCO-OAKLAND BAY BRIDGE**  
**EAST SPAN SEISMIC SAFETY PROJECT**  
**PIER E3 REMOVAL**  
**PIER E3 DETAILS**

### **Pier E3 Blast Design Parameters**

Top of structure to be left at elevation +9 (NGVD29 datum)

Removal limit: elevation -77 (interior walls only)

Hole will be drilled to elevation -55 and -77.

Hole spacing = 4.5'

Total number of holes = 159, 111 @ 86', 36 @ 64', 12 @ 50'

Hole diameter: 86' = 2 ¾ "

64' ( N & S end full height walls) = 2 ¾ "

64' & 50' (buttress walls) = 3" (will require a 2.5" ID liner pipe for loading)

Maximum pounds of explosive per delay = 35 pounds

Total explosives weight = 16875.6 pounds

Average overall powder factor = 2.4 (ranges from 3.3 to 1)

Number of individual detonations = 588

Number of delays = 587

Minimum delay separation = 9ms

Total shot time = 5.3 seconds

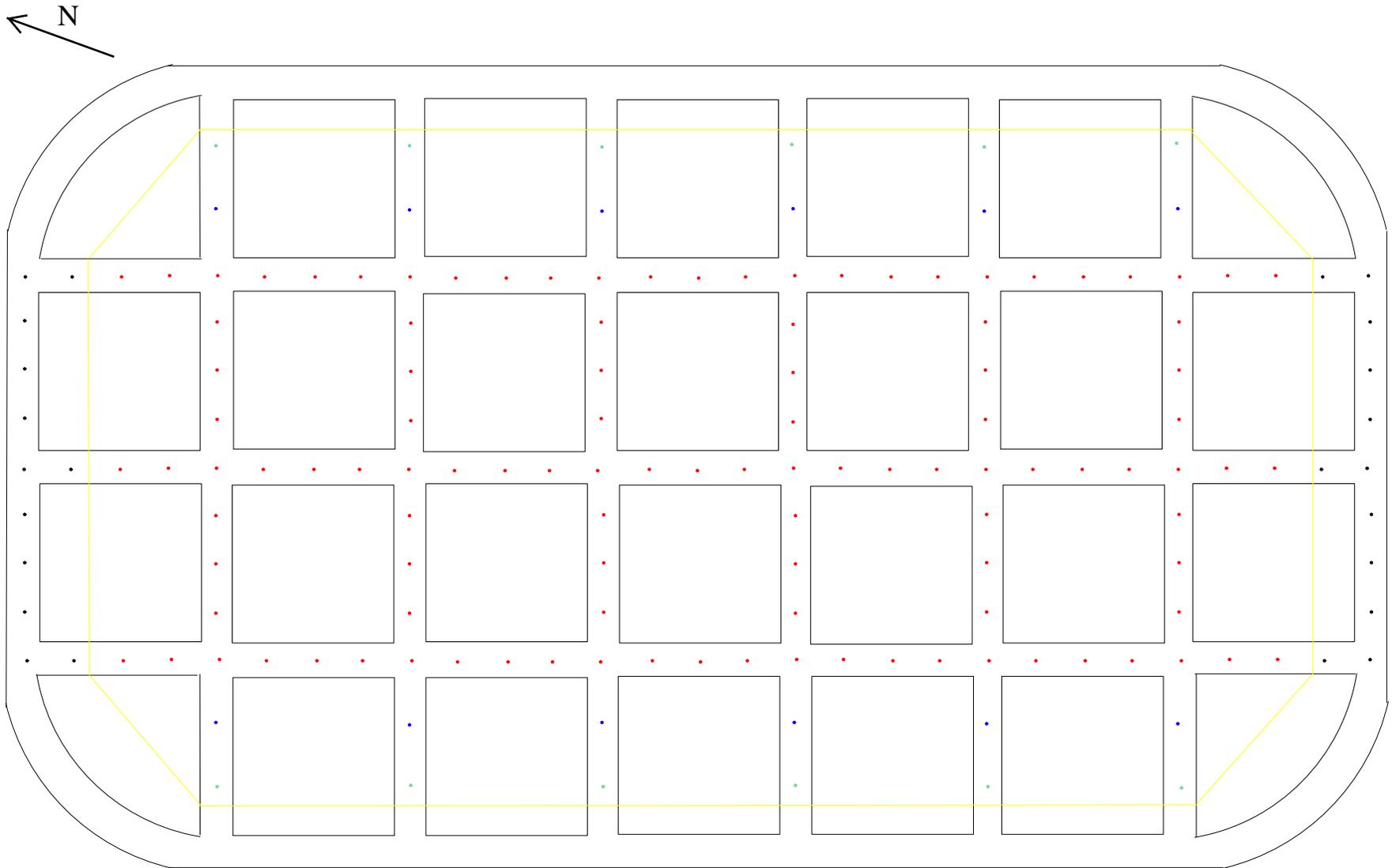
Orica's I-Kon electronic detonators will be used.

Explosive products will be 1.25"x16", 1.5"x16", 1.75"x16" and 2"x16" Unimax and Dynamax Pro dynamites in cardboard wrapped cartridges.

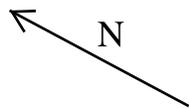
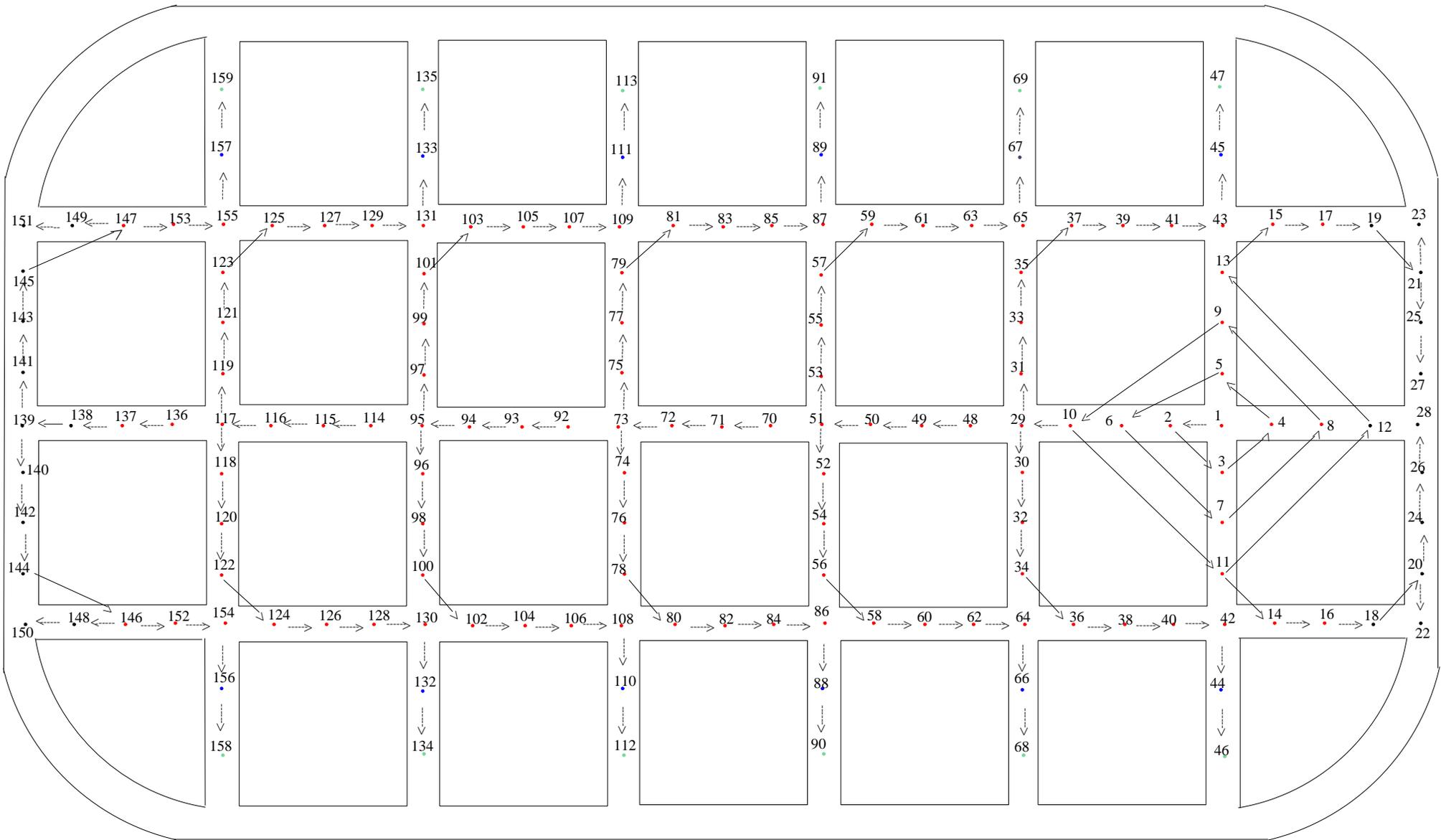
Explosives decks in each hole will be fired from bottom to top.

Blast will initiate in the interior of the pier and progress sequentially to the outside.

# Pier E3 Borehole Locations



- 2.75" diameter holes 86' deep
- 2.75" diameter holes 64' deep
- 3" diameter holes 64' deep
- 3" diameter holes 50' deep



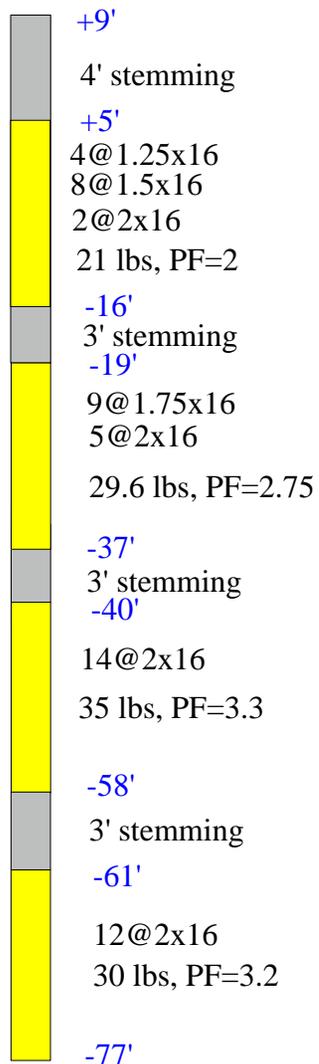
Pier E3 Firing Sequence

# Pier E3 Shot Timing

hole #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
bottom deck	0	36	72	108	144	180	216	252	288	324	360		423	459	495	531	567			
deck 2	9	45	81	117	153	189	225	261	297	333	369	396	432	468	504	540	576	603	630	657
deck 3	18	54	90	126	162	198	234	270	306	342	378	405	441	477	513	549	585	612	639	666
top deck	27	63	99	135	171	207	243	279	315	351	387	414	450	486	522	558	594	621	648	675
hole #	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
bottom deck									900	936	972	1008	1044	1080	1116	1152	1188	1224	1260	1296
deck 2	684	711	738	765	792	819	846	873	909	945	981	1017	1053	1089	1125	1161	1197	1233	1269	1305
deck 3	693	720	747	774	801	828	855	882	918	954	990	1026	1062	1098	1134	1170	1206	1242	1278	1314
top deck	702	729	756	783	810	837	864	891	927	963	999	1035	1071	1107	1143	1179	1215	1251	1287	1323
hole #	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
bottom deck	1332	1368	1404					1548	1584	1620	1656	1692	1728	1764	1800	1836	1872	1908	1944	1980
deck 2	1341	1377	1413	1440	1467	1494	1521	1557	1593	1629	1665	1701	1737	1773	1809	1845	1881	1917	1953	1989
deck 3	1350	1386	1422	1449	1476	1503	1530	1566	1602	1638	1674	1710	1746	1782	1818	1854	1890	1926	1962	1998
top deck	1359	1395	1431	1458	1485	1512	1539	1575	1611	1647	1683	1719	1755	1791	1827	1863	1899	1935	1971	2007
hole #	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
bottom deck	2016	2052	2088	2124	2160					2304	2340	2376	2412	2448	2484	2520	2556	2592	2628	2664
deck 2	2025	2061	2097	2133	2169	2196	2223	2250	2277	2313	2349	2385	2421	2457	2493	2529	2565	2601	2637	2673
deck 3	2034	2070	2106	2142	2178	2205	2232	2259	2286	2322	2358	2394	2430	2466	2502	2538	2574	2610	2646	2682
top deck	2043	2079	2115	2151	2187	2214	2241	2268	2295	2331	2367	2403	2439	2475	2511	2547	2583	2619	2655	2691
hole #	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
bottom deck	2700	2736	2772	2808	2844	2880	2916			3060	3096	3132	3168	3204	3240	3276	3312	3348	3384	3420
deck 2	2709	2745	2781	2817	2853	2889	2925	2952	2979	3006	3033	3069	3105	3141	3177	3213	3249	3285	3321	3357
deck 3	2718	2754	2790	2826	2862	2898	2934	2961	2988	3015	3042	3078	3114	3150	3186	3222	3258	3294	3330	3366
top deck	2727	2763	2799	2835	2871	2907	2943	2970	2997	3024	3051	3087	3123	3159	3195	3231	3267	3303	3339	3375
hole #	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
bottom deck	3384	3420	3456	3492	3528	3564	3600	3636	3672					3816	3852	3888	3924	3960	3996	4032
deck 2	3393	3429	3465	3501	3537	3573	3609	3645	3681	3708	3735	3762	3789	3825	3861	3897	3933	3969	4005	4041
deck 3	3402	3438	3474	3510	3546	3582	3618	3654	3690	3717	3744	3771	3798	3834	3870	3906	3942	3978	4014	4050
top deck	3411	3447	3483	3519	3555	3591	3627	3663	3699	3726	3753	3780	3807	3843	3879	3915	3951	3987	4023	4059
hole #	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
bottom deck	4068	4104	4140	4176	4212	4248	4284	4320	4356	4392	4428			4464	4491	4518	4545	4581	4617	4644
deck 2	4077	4113	4149	4185	4221	4257	4293	4329	4365	4401	4437	4464	4491	4518	4545	4581	4617	4644	4671	4698
deck 3	4086	4122	4158	4194	4230	4266	4302	4338	4374	4410	4446	4473	4500	4527	4554	4590	4626	4653	4680	4707
top deck	4095	4131	4167	4203	4239	4275	4311	4347	4383	4419	4455	4482	4509	4536	4563	4599	4635	4662	4689	4716
hole #	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	
bottom deck						4860	4896					5040	5076	5112	5148					
deck 2	4725	4752	4779	4806	4833	4869	4905	4932	4959	4986	5013	5049	5085	5121	5157	5184	5211	5238	5265	
deck 3	4734	4761	4788	4815	4842	4878	4914	4941	4968	4995	5022	5058	5094	5130	5166	5193	5220	5247	5274	
top deck	4743	4770	4797	4824	4851	4887	4923	4950	4977	5004	5031	5067	5103	5139	5175	5202	5229	5256	5283	

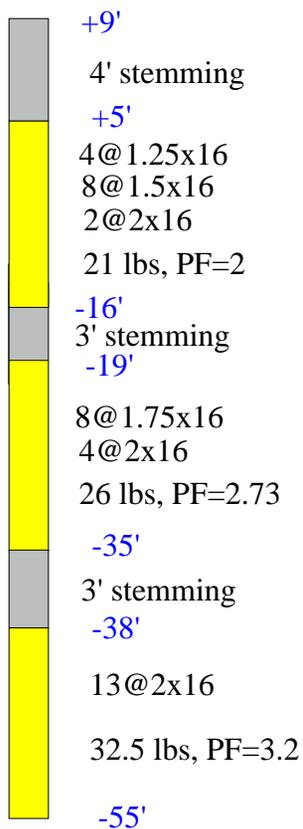
# Pier E3 Column Loads

## Full Height Walls (except N & S Ends)



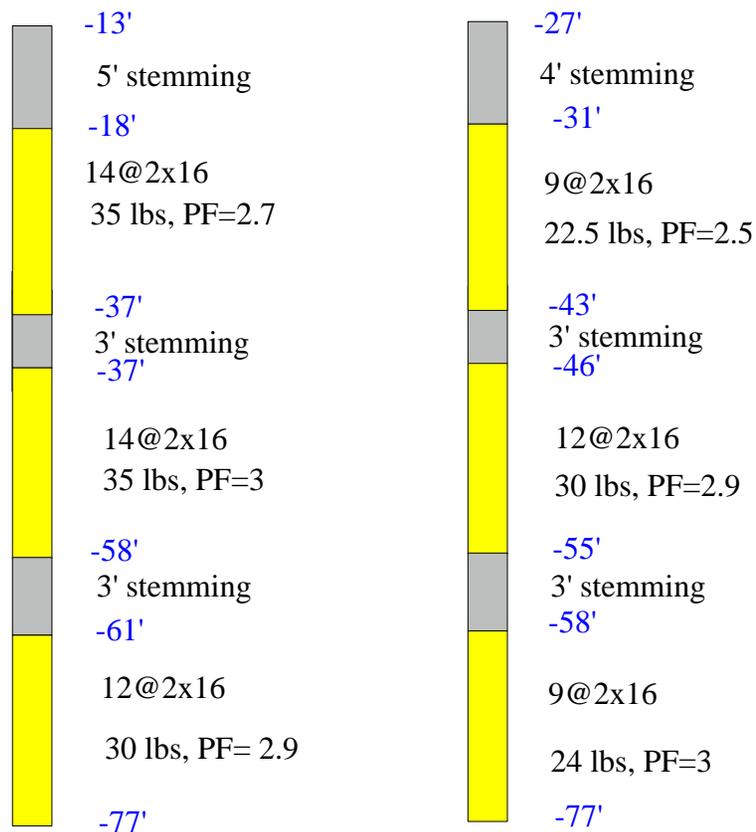
Total explosives = 115.6 lbs

## North and South End Full Height Walls



Total explosives = 79.5 lbs

## Buttress Walls



Total explosives = 100 lbs

Total explosives = 76.5

All decks will be double primed at bottom of deck with electronic detonators and fired from bottom up.

# DYNOMAX™ PRO

Technical  
Information



## Extra Gelatin Nitroglycerin Dynamite



### Product Description

DYNOMAX PRO is desensitized extra gelatin dynamite designed to satisfy the majority of explosive application requirements. DYNOMAX PRO is formulated to consistently deliver high detonation velocity and excellent water resistance while reducing cartridge to cartridge gap sensitivity and hole-to-hole propagation problems. DYNOMAX PRO is recommended for bottom loading and as the main explosive charge where high density and energy is required. DYNOMAX PRO is recommended for use as booster, bottom load or floor control solution.

### Application Recommendations

- DYNOMAX PRO is an excellent primer for Dynamix (ANFO), Dynamix WR (WR ANFO) or other detonator sensitive packaged product and can be used as a secondary primer in hard seams or at the top of the explosive column.
- Minimum diameter is 32 mm (1¼ in).
- Minimum detonator is No. 8 strength.
- DYNOMAX PRO has been formulated to reduce susceptibility to sympathetic detonation when applied in very wet conditions where boreholes are closely spaced and/or where geological conditions promote this effect. Consult your Dyno Nobel representative for product recommendations where these conditions exist.
- Storage at elevated temperatures and/or high humidity for 12-18 months can reduce the performance of DYNOMAX PRO depending on the diameter. Consult your Dyno Nobel representative for specific recommendations.

## Properties

MSDS  
#1019

<b>Density</b> (g/cc) Avg	1.45
<b>Energy<sup>a</sup></b> (cal/g)	1,055
(cal/cc)	1,510
<b>Relative Weight Strength<sup>a</sup></b>	1.20
<b>Relative Bulk Strength<sup>a,b</sup></b>	2.10
<b>Velocity<sup>c</sup></b> (m/s)	6,000
(ft/s)	19,700
<b>Detonation Pressure<sup>c</sup></b> (Kbars)	130
<b>Gas Volume<sup>a</sup></b> (moles/kg)	32
<b>Water Resistance</b>	Excellent
<b>Fume Class</b>	Not for underground use

<sup>a</sup> All Dyno Nobel Inc. energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.

<sup>b</sup> ANFO = 1.00 @ 0.82 g/cc

<sup>c</sup> Unconfined @ 50 mm (2 in) diameter.

### Hazardous Shipping Description

Explosive, Blasting, Type A 1.1D UN 0081 II  
EX200407185



# DYNOMAX™ PRO

## Technical Information



### Transportation, Storage and Handling

- For maximum shelf-life, DYNOMAX PRO dynamite must be stored in cool, dry and well-ventilated magazines. Explosive inventory should always be rotated by using the oldest materials first. For recommended good practices in transporting, storing, handling and using this product, see the booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives.
- DYNOMAX PRO must be transported, stored, handled and used in conformity with all applicable federal, state, provincial and local laws and regulations.

Diameter x Length		Nominal Cartridge Count / 25 kg (55 lb) case	Case Dimensions	
mm	in		cm	in
32 x 200	1¼ x 8	105 - 114	44 x 35 x 21	17½ x 13⅝ x 8¼
40 x 200	1½ x 8	70 - 76	44 x 35 x 21	17½ x 13⅝ x 8¼
45 x 200	1¾ x 8	49 - 55	44 x 35 x 21	17½ x 13⅝ x 8¼
50 x 200	2 x 8	40 - 44	44 x 35 x 21	17½ x 13⅝ x 8¼
50 x 400	2 x 16 <sup>a</sup>	21 - 23	44 x 35 x 21	17½ x 13⅝ x 8¼
60 x 400	2¼ x 16 <sup>a</sup>	16 - 18	44 x 35 x 21	17½ x 13⅝ x 8¼
65 x 400	2½ x 16 <sup>a</sup>	13 - 14	44 x 35 x 21	17½ x 13⅝ x 8¼
70 x 400	2¾ x 16 <sup>a</sup>	11 - 12	44 x 35 x 21	17½ x 13⅝ x 8¼
75 x 200	3 x 8 <sup>a</sup>	18 - 20	44 x 35 x 21	17½ x 13⅝ x 8¼
75 x 400	3 x 16 <sup>a</sup>	9 - 11	44 x 35 x 21	17½ x 13⅝ x 8¼

- <sup>a</sup> Available in spiral tube shell with tapered end.
- Product density is 1.40 g/cc for package diameters less than 50mm (2 in). Use cartridge count to determine actual explosive charge weight.
- Note: All weights are approximate.
- DYNOMAX PRO is available in a wide variety of sizes. Custom sizes are subject to surcharge and may require longer than usual lead times.
- Check with your Dyno Nobel representative should you have any questions.

**Product Disclaimer** Dyno Nobel Inc. and its subsidiaries disclaim any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall Dyno Nobel Inc. or any of its subsidiaries be liable for special, consequential or incidental damages or for anticipated loss of profits.

### Dyno Nobel Inc.

2650 Decker Lake Boulevard, Suite 300, Salt Lake City, Utah 84119 USA  
Phone 800-732-7534 Fax 801-328-6452 Web [www.dynonobel.com](http://www.dynonobel.com)

**DYNO**  
Dyno Nobel

Groundbreaking Performance™



## Extra Gelatin Nitroglycerin Dynamite



### Product Description

UNIMAX is an extra gelatin dynamite formulated to consistently deliver high detonation velocity and excellent water resistance. UNIMAX is designed to satisfy the vast majority of explosive applications in hard rock and may be used as the main explosive charge where high density and energy is required or as a primer for ANFO.

### Application Recommendations

- UNIMAX is an excellent primer for Dynamix (ANFO), Dynamix-WR (WR ANFO) or other detonator sensitive packaged product and can be used as a secondary primer in hard seams or at the top of the explosive column.
- Minimum diameter is 25 mm (1 in).
- Minimum detonator is No. 8 strength.
- Storage at elevated temperatures and/or high humidity for 1 to 6 months can reduce the performance of Unimax depending on the diameter. Consult your Dyno Nobel representative for specific recommendations.
- Dynamites are susceptible to sympathetic detonation when applied in very wet conditions where boreholes are closely spaced and/or where geological conditions promote this effect. Consult your Dyno Nobel representative for recommendations where these conditions exist.

## Properties

MSDS  
#1019

<b>Density</b> (g/cc) Avg	1.51
<b>Energy<sup>a</sup></b> (cal/g)	1,055
(cal/cc)	1,510
<b>Relative Weight Strength<sup>a</sup></b>	1.20
<b>Relative Bulk Strength<sup>a,b</sup></b>	2.10
<b>Velocity<sup>c</sup></b> (m/s)	5,300
(ft/s)	17,400
<b>Detonation Pressure<sup>c</sup></b> (Kbars)	106
<b>Gas Volume<sup>a</sup></b> (moles/kg)	32
<b>Water Resistance</b>	Excellent
<b>Fume Class</b>	IME1 & NRCan1 <sup>d</sup>

<sup>a</sup> All Dyno Nobel Inc. energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.

<sup>b</sup> ANFO = 1.00 @ 0.82 g/cc

<sup>c</sup> Unconfined @ 50 mm (2 in) diameter.

<sup>d</sup> Approved by Natural Resources Canada as Fume Class 1.

### Hazardous Shipping Description

Explosive, Blasting, Type A, 1.1D, UN 0081 II





### Transportation, Storage and Handling

- UNIMAX must be transported, stored, handled and used in conformity with all applicable federal, state, provincial and local laws and regulations.
- For maximum shelf-life, dynamite must be stored in cool, dry and well-ventilated magazines. Dynamite inventory should always be rotated by using the oldest materials first. For recommended good practices in transporting, storing, handling and using this product, see the booklet “Prevention of Accidents in the Use of Explosive Materials” packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives.

Diameter x Length		Qty / Case	Case Type	Nominal Case Weight	
mm	in			kg	lbs
25 x 200	1 x 8	140	DA	21	47
29 x 200	1 1/8 x 8	100	DA	20	45
32 x 200	1 1/4 x 8	88	DA	21	47
32 x 400	1 1/4 x 16	44	DA	21	47
40 x 200	1 1/2 x 8	60	DA	20	45
40 x 300	1 1/2 x 12	40	DA	21	47
45 x 200	1 3/4 x 8	40	DB	18	40
50 x 200	2 x 8	34	DB	20	45
50 x 400 <sup>a</sup>	2 x 16 <sup>a</sup>	17	DB	20	45
60 x 400 <sup>a</sup>	2 1/4 x 16 <sup>a</sup>	14	DB	19	42
65 x 400 <sup>a</sup>	2 1/2 x 16 <sup>a</sup>	10	DB	20	44
70 x 400 <sup>a</sup>	2 3/4 x 16 <sup>a</sup>	9	**	**	**
75 x 200	3 x 8	16	DE	21	47
75 x 400 <sup>a</sup>	3 x 16 <sup>a</sup>	8	DE	21	47

<sup>a</sup> Available in spiral tube shell with tapered end.

• Note: all weights are approximate.

\*\*Available upon request. Check with your Dyno Nobel representative should you have any questions.

• Product density is 1.50 g/cc for package diameters less than 50mm (2 in). Use cartridge count to determine actual explosive charge weight.

• UNIMAX is available in a wide variety of sizes. Custom sizes are subject to surcharge and may require longer than usual lead times.

### Case Dimensions

<b>DA</b>	45 x 34 x 17 cm	17 <sup>3</sup> / <sub>4</sub> x 13 <sup>3</sup> / <sub>8</sub> x 6 <sup>3</sup> / <sub>8</sub> in
<b>DB</b>	45 x 34 x 15 cm	17 <sup>7</sup> / <sub>8</sub> x 13 <sup>3</sup> / <sub>8</sub> x 5 <sup>7</sup> / <sub>8</sub> in
<b>DE</b>	45 X 34 X 17 cm	17 <sup>5</sup> / <sub>8</sub> x 13 <sup>5</sup> / <sub>16</sub> x 6 <sup>3</sup> / <sub>4</sub> in

**Product Disclaimer** Dyno Nobel Inc. and its subsidiaries disclaim any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall Dyno Nobel Inc. or any of its subsidiaries be liable for special, consequential or incidental damages or for anticipated loss of profits.

tiger values 60 extra gel

60 Extra Gel

THE HEAT OF FORMATION IS -844.948937 CAL/GM  
 THE STANDARD VOLUME IS .337856 CC/GM  
 THE STANDARD ENTROPY IS .130365 CAL/K/GM AND  
 THE STANDARD ENERGY IS -844.957120 CAL/GM.  
 OXYGEN BALANCE : 12.729 GR OF O PER 1KG  
 SHOCK VELOCITY : 5921.7 M/S 19428.0 FT/S  
 PARTICLE VELOCITY : 1689.3 M/S 5542.5 FT/S  
 SOUND SPEED : 4232.3 M/S 13885.5 FT/S  
 DETONATION PRESSURE: 139208.7 ATM  
 DETONATION TEMPERATURE : 2754.3 DEG. K  
 THE HEAT OF EXPLOSION IS... 1067.4691CAL/GM

AWS ..... 1067.0 CAL/G  
 ABS ..... 1504.0 CAL/CC  
 RWS ..... 116.0 ANFO = 100  
 RBS ..... 194.0 ANFO = .85 g/cc

INGREDIENT moles/kg

CO2 GAS 11.3142  
 H2O GAS 9.9486  
 N2 GAS 5.6642  
 CO GAS .0539  
 NO GAS .0028  
 O2 GAS .0010  
 H2 GAS .0047  
 \*CACO3 SOLID .0999  
 \*NA2O SOLID 1.3919  
 \*NA2O2 SOLID .8493  
 TOTAL GAS 26.9894

ENERGY PARTITION BETWEEN GASEOUS AND CONDENSED PHASE  
 GASEOUS PHASE : 80.94% OF THE TOTAL ENERGY  
 CONDENSED PHASE : 19.06% OF THE TOTAL ENERGY

# Material Safety Data Sheet

## Dyno Nobel Inc.

2795 East Cottonwood Parkway, Suite 500  
Salt Lake City, Utah 84121

Phone: 801-364-4800 Fax: 801-321-6703

E-Mail: [dinna.hse@am.dynonobel.com](mailto:dinna.hse@am.dynonobel.com)

FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300  
CANUTEC (CANADA) 613-996-6666

MSDS # 1019

Date 09/16/10

Supersedes

MSDS # 1019 08/25/10

## SECTION I - PRODUCT IDENTIFICATION

<b>Trade Name(s):</b>	D-GEL™ 1000	RED H®A
	DYNOSPLIT® D	RED H®B
	DYNOSPLIT® : D-1	STONECUTTER™
	DYNOMAX PRO™	UNIGEL®
	EXTRA GELATIN: 40%, 75%	UNIMAX®
	GELAPRIME® F	VIBROGEL®: 1, 3
	IP: 724, 738	Z POWDER™
	Oil Well Explosive 80%	60% Hi-Pressure Gelatin

**Product Class:** Dynamites and Blasting Gelatins

**Product Appearance & Odor:** Powdery to gelatinous solid, light tan to dark brown color. Faint, waxy odor.

**DOT Hazard Shipping Description:** Explosive, blasting, type A 1.1D UN0081 II

**NFPA Hazard Classification:** Not Available (See Section IV - Special Fire Fighting Procedures)

## SECTION II - HAZARDOUS INGREDIENTS

<b>Ingredients:</b>	<b>CAS#</b>	<b>% (Range)</b>	<b>Occupational Exposure Limits</b>	
			<b>ACGIH TLV-TWA</b>	<b>OSHA PEL-TWA</b>
Nitroglycerin (NG)	55-63-0	3-30	0.05 ppm	0.05 ppm
Ethylene Glycol Dinitrate (EGDN)	628-96-6	5-50	0.05 ppm	0.05 ppm
Nitrocellulose	9004-70-0	0-6	None	None
Ammonium Nitrate	6484-52-2	0-75	None	None
Sodium Nitrate	7631-99-4	0-50	None	None
Sulfur <sup>1</sup>	7704-34-9	0-4	None	None

<sup>1</sup> This ingredient is not found in most of the products listed above.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in de minimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

## SECTION III - PHYSICAL DATA

**Boiling Point:** Not Applicable

**Vapor Density:** Not Applicable

**Percent Volatile by Volume:** Not Applicable

**Evaporation Rate (Butyl Acetate = 1):** Not Applicable

**Vapor Pressure:** Not Applicable

**Density:** 0.8-1.48 g/cc

**Solubility in Water:** Ammonium and sodium nitrates are completely soluble. NG and EGDN are very slightly soluble.

# Material Safety Data Sheet

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

**Flash Point:** Not Applicable

**Flammable Limits:** Not Applicable

**Extinguishing Media:** (See Special Fire Fighting Procedures section.)

**Special Fire Fighting Procedures:** Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.

**Unusual Fire and Explosion Hazards:** Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

## SECTION V - HEALTH HAZARD DATA

### Effects of Overexposure

**Eyes:** May cause irritation, redness and tearing.

**Skin:** Contact may result in headache, nausea and blood vessel dilation.

**Ingestion:** May result in headache, nausea, intestinal upset and blood vessel dilation.

**Inhalation:** May result in headache, nausea and blood vessel dilation.

**Systemic or Other Effects:** None known.

### Emergency and First Aid Procedures

**Eyes:** Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.

**Skin:** Remove contaminated clothing. Wash with soap and water.

**Ingestion:** Seek medical attention.

**Inhalation:** Remove to fresh air. If irritation persists, seek medical attention.

**Special Considerations:** None.

## SECTION VI - REACTIVITY DATA

**Stability:** Stable under normal conditions. May explode when subjected to fire, supersonic shock, or high-energy projectile impact, especially when confined or in large quantities.

**Conditions to Avoid:** Keep away from heat, flame, ignition sources and strong shock.

**Materials to Avoid (Incompatibility):** Corrosives (mineral acids, bases, strong acids).

**Hazardous Decomposition Products:** Carbon Monoxide (CO), Hydrogen Sulfide (H<sub>2</sub>S), Nitrous Oxides (NO<sub>x</sub>), and Sulfur Oxides (SO<sub>x</sub>).

**Hazardous Polymerization:** Will not occur.

## SECTION VII - SPILL OR LEAK PROCEDURES

**Steps to be taken in Case Material is Released or Spilled:** Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements. Contact of this product with water may result in a reportable release.

**Waste Disposal Method:** Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

# Material Safety Data Sheet

## SECTION VIII - SPECIAL PROTECTION INFORMATION

**Ventilation:** Forced ventilation may be necessary where natural ventilation is limited. Magazines containing NG and/or EGDN based explosives must be ventilated before entry.

**Respiratory Protection:** None normally required.

**Protective Clothing:** Chemical resistant (nitrile) gloves are suggested.

**Eye Protection:** Safety glasses are recommended.

**Other Precautions Required:** Inhalation and skin contact should be minimized to avoid headaches, nausea, and blood vessel dilation. Protective clothing should be changed daily, more often if contaminated.

## SECTION IX - SPECIAL PRECAUTIONS

**Precautions to be taken in handling and storage:** Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Keep away from heat, flame, ignition sources, and strong shock.

**Precautions to be taken during use:** Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.

**Other Precautions:** It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

## SECTION X - SPECIAL INFORMATION

### Chemical Name

Nitroglycerin

### CAS Number

55-63-0

### % By Weight

3-40

The reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372 may become applicable if the physical state of this product is changed to an aqueous solution. If an aqueous solution of this product is manufactured, processed, or otherwise used, the nitrate compounds category and ammonia listing of the previously referenced regulation should be reviewed.

### **Disclaimer**

Dyno Nobel Inc. and its subsidiaries disclaim any warranties with respect to this product, the safety or suitability thereof, the information contained herein, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR OTHER WARRANTY. The information contained herein is provided for reference purposes only and is intended only for persons having relevant technical skills. Because conditions and manner of use are outside of our control, the user is responsible for determining the conditions of safe use of the product. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product or information. Under no circumstances shall either Dyno Nobel Inc. or any of its subsidiaries be liable for special, consequential or incidental damages or for anticipated loss of profits.

# *i-kon™ II* Electronic Detonator



- Reliable initiation of boosters is achieved by the full strength base charge in the *i-kon™ II* detonator. Reduced inventory frees up working capital because *i-kon™ II* detonators are fully programmable; any delay between 0 and 30,000ms is always in your magazine.
- New sub-millisecond programmability for any desired delay between 0 and 10,000 ms in 0.1ms steps (available late 2013)

## Description

The *i-kon™ II* electronic detonator is one of Orica's exciting Next Generation products.

The *i-kon™ II* detonator (standard or RX) is used in conjunction with:

- i-kon™* Logger or the new Logger II (available late 2013)
- and with the following hardware with firmware upgrades: *i-kon™* Blaster 400 or 2400S
- i-kon™* Surface Remote Blaster System (SURBS hardware)
- i-kon™* Centralised Electronic Blasting System including lock box and remote blasting box (CEBS hardware)
- Duplex harness wire

## Applications

*i-kon™ II* detonators are the most advanced Electronic detonators in the market and are particularly suitable for high value and complex blasts at large Surface and Underground operations and in the most challenging environments

## Key Benefits

- Reliable, effective and safe blasting is achieved because of the rugged, proven construction of the *i-kon™ II* detonator, with testability on the blast pattern
- Efficient operations on the blast pattern are afforded by the convenient packaging and excellent, glove-friendly connector and duplex harness wire
- Predictable blasting results with minimal environmental impact are achievable because of the high precision of *i-kon™ II* electronic detonators

## Properties

Property	<i>i-kon™ II</i>	<i>i-kon™ II RX</i>
Wire color	Yellow	Red
Tensile strength (kg) / (lbs)	22 / 48	25 / 55
Explosives charge weight (mg)	900	
Connector color	Blue	
Shell length x diameter	89 x 7.6 mm	
Shell material	Copper alloy	
Programmability (ms)	standard	1ms to 30 s
	sub-ms, available late 2013	0.1ms to 10 s
Max delay time (seconds)	30	
Precision as coefficient of variation	0.005%	

## Recommendations for Use

- *i-kon™* and *i-kon™ II* detonators should never be mixed in the same blast pattern or connected to the same equipment at the same time. Misfires may result.
- All *i-kon™ II* blasting equipment can only be used with *i-kon™ II* detonators, and *i-kon™* detonators must not be connected to any other blasting equipment.
- Damage to the leg wire insulation is the most common cause of problems with electronic blasting systems; exercise care and protect the wires when loading and stemming holes
- Handle *i-kon™ II* blasting equipment with care; it is not designed for immersion in water or for dropping onto a hard surface
- Never open *i-kon™ II* blasting equipment. It should be serviced or repaired only by Orica or approved agents

## *i-kon*<sup>TM</sup> II Electronic Detonator



### Available Lengths / Packaging

*i-kon*<sup>TM</sup> II detonators are available in the following lengths and packaging:

#### Standard *i-kon*<sup>TM</sup> II detonators (>10m spooled)

Length, m (configuration, Coil or Spool)	1.1B packaging		1.4S packaging	
	Units / Case	Weight per Case kg / lb	Units / Case	Weight per Case kg / lb
10 (C)	60	6.4 / 14.1	40	7.4 / 16.3
15 (S)	66	11.2 / 24.7	32	8.5 / 18.7
20 (S)	66	13.6 / 30.0	32	9.7 / 21.4
30 (S)	36	10.6 / 23.3	32	11.8 / 26.0
40 (S)	30	11.4 / 25.1	16	7.9 / 17.4
60 (S)	20	11.0 / 24.2	16	10.1 / 22.2

#### *i-kon*<sup>TM</sup> II RX detonators (all spooled)

Length, m (configuration, Coil or Spool)	1.1B packaging		1.4S packaging	
	Units / Case	Weight per Case kg / lb	Units / Case	Weight per Case kg / lb
10	60	10.0 / 22.0	32	8.4 / 18.5
15	60	13.0 / 28.7	32	10.0 / 22.0
20	48	13.1 / 28.9	32	11.4 / 25.1
30	30	11.8 / 26.0	16	8.2 / 18.1
40	25	12.5 / 27.5	16	9.8 / 21.6
60	18	11.0 / 24.2	12	9.9 / 21.8
80	12	11.5 / 25.3	12	12.3 / 27.1

### Safety

The *i-kon*<sup>TM</sup> II electronic initiating systems provide a high level of safety against initiation by static electricity, stray electrical currents and radio frequency transmissions. However, *i-kon*<sup>TM</sup> II detonators contain pyrotechnics and molecular explosives, which can initiate under intense impact, friction or heat. As with all high explosives, these detonators must be handled and stored with care. *i-kon*<sup>TM</sup> II detonators may only be used at temperatures up to 70°C. Seek advice from Orica for priming systems suitable for higher temperatures.

See Safety Data Sheet for more information.

### Sleep-Time Within Boreholes

The recommended maximum sleep time is 21 days. Sleep time is dependent on ground water conditions. An Orica Technical Services Representative should be consulted if special conditions exist that may reduce the allowed sleep time, or if sleep times longer than 21 days are needed.

### Product Classification

Authorised Name: *i-kon*<sup>TM</sup> II  
Correct Shipping Name: Detonators, Electric for blasting

Hazard Class	1.1B	1.4S
UN Number	0030	0456
EX Number	EX2010060238	EX2010080328

All regulations pertaining to the handling and use of such explosives apply.

### Storage and Transport

Store *i-kon*<sup>TM</sup> II detonators in a suitably licensed magazine for Class 1.1B explosives. The cases should be stacked in the manner designated on the cases.

*i-kon*<sup>TM</sup> II detonators have a storage life of up to 5 years in an approved magazine. The product is best stored at temperatures between -4°F (-20°C) to +120°F (+50°C).

*i-kon*<sup>TM</sup> II detonators may be transported at temperatures between -40°F (-40°C) to +149°F (+65°C).

## *i-kon*<sup>TM</sup> II Electronic Detonator



### Disposal

Disposal of explosive materials can be hazardous. Methods for safe disposal of explosives may vary depending on the user's situation. Please contact a local Orica representative for information on safe practices.

### Trademarks

The word Orica, the Ring device and the Orica mark are trademarks of Orica Group Companies. *i-kon*<sup>TM</sup> is a trademark of Orica Explosives Technology Pty Ltd ACN 075 659 353, 1 Nicholson Street, East Melbourne, Victoria, Australia

### Disclaimer

The information contained herein is based on experience and is believed to be accurate and up to date as at the date of its preparation. However, uses and conditions of use are not within the manufacturer's control and users should determine the suitability of such products and methods of use for their purposes. Neither the manufacturer nor the seller makes any warranty of any kind, express or implied, statutory or otherwise, except that the products described herein shall conform to the manufacturer's or seller's specifications. The manufacturer and the seller expressly disclaim all other warranties, INCLUDING, WITHOUT LIMITATION, WARRANTIES CONCERNING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Under no circumstances shall the manufacturer or the seller be liable for indirect, special, consequential, or incidental damages without limitation, damages for lost or anticipated profits.

Orica Canada Inc.  
301 Hotel de Ville  
Brownsburg, W  
QC J8G 3B5  
Tel: +1 303 268 5000  
Fax: +1 303 268 5250

Orica USA Inc.  
33101 East Quincy Ave  
atkins, CO 80137  
Tel: +1 303 268 5000  
Fax: +1 303 268 5250

### Emergency Contact Telephone Numbers

For chemical emergencies (24 hour) involving transportation, spill, leak, release, fire or accidents:

**Canada:** Orica Canada emergency response **1-877-561-3636**

**USA:** Chemtrec **1-800-424-9300**

For lost, stolen or misplaced explosives:

USA: **BATFE** 1-800-800-3855. Form ATF F5400.0 must be completed and local authorities (state / municipal police, etc) must be advised.



# Material Safety Data Sheet

## SECTION 1. IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND COMPANY IDENTIFICATION

**Product Name:** i-kon & i-kon II Electronic Detonators  
**Product Code:** 20174  
**Alternate Names:** i-kon R, i-kon II R, i-kon RX, i-kon II RX, i-kon SNS, i-kon II SNS, i-kon TX, i-kon II TX, i-kon X-414, i-kon II X-414, i-kon X-416, i-kon II X-416, i-kon X-418, i-kon II X-418 i-kon XT, i-kon II XT  
**UN No.:** UN0456 or UN0030 (Depending on packaging)  
**Recommended Use:** All i-kon detonator types are used as initiators for detonator sensitive explosives, except the i-kon SNS detonator, which is used for initiation of non-electric detonator assemblies or detonating cords.

**Suppliers:**  
Orica Canada Inc. Orica USA Inc.  
301 Hotel de Ville, 33101 E. Quincy Avenue  
Brownsburg-Chatham, QC J8G 3B5 Watkins, CO 80137  
For MSDS Requests: 1-450-533-4201 For MSDS Requests: 1-303-268-5000

## EMERGENCY CONTACT TELEPHONE NUMBERS

FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** THE ORICA CANADA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT **1-877-561-3636**. **IN THE U.S. CALL:** CHEMTREC **1-800- 424-9300**. **IN THE U.S.:** FOR LOST, STOLEN OR MISPLACED EXPLOSIVES CALL BATF **1-800-800-3855**. FORM ATF F5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE / MUNICIPAL POLICE, ETC) MUST BE ADVISED.

## SECTION 2. HAZARDS IDENTIFICATION

**Emergency Overview:** The following information is the potential hazards associated with the ingredient(s) in this product. It is our belief that, under conditions of normal occupational exposure, this product should pose no such hazards to the user. Main risk is that of explosion by shock, friction, fire or other sources of ignition. Read the entire MSDS for a more thorough evaluation of the hazards.

**Appearance:** Ingredients are housed in a metal alloy tube closed at one end with a moulded plastic plug and attached electric lead wires at the opposite end. The detonator of the i-kon SNS assembly is housed in a plastic connected block.

## SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Weight %
Metal and Plastic component articles	Not Listed	95-100
Pentaerythritol tetranitrate (PETN)	78-11-5	<3.0
Lead azide	13424-46-9	<0.5
Lead picrate	25721-38-4	<0.1
Lead dinitrophenol	625080-35-5	<0.1
Lead dioxide PbO <sub>2</sub>	1309-60-0	<0.1
Nitrocotton	9004-70-0	<0.1

## SECTION 4. FIRST-AID MEASURES

**General:** Not applicable; this is a manufactured article that will not result in exposure to the chemical components under normal conditions of use. In the event of contact causing injury, administer first aid appropriate for burns, lacerations and bruises.

**Inhalation:** In the event that workers are overexposed to fumes and vapors resulting from detonation, remove victim from exposure and provide artificial respiration if not breathing.

## SECTION 5. FIRE-FIGHTING MEASURES

**Flammable properties:** **PRODUCT WILL DETONATE.** Expected to be sensitive to mechanical impact. i-kon detonators have built-in protection against human body generated electrostatic charges but should be kept away from more powerful electrical stimuli such as grid voltages and lightning.

**Precautions for Fire Fighters:** **DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS.** This product is a high explosive with a mass detonation hazard. Mass detonation only applies to the 1.1B explosives classification.

**IMMEDIATELY EVACUATE ALL PERSONNEL FROM THE AREA TO A SAFE DISTANCE. GUARD AGAINST RE-ENTRY.**

When controlling fire **before** involvement of explosives, firefighters should wear positive pressure self-contained breathing apparatus (SCBA) and full protective gear. Keep product and empty container away from heat and sources of ignition. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for



# Material Safety Data Sheet

the system to operate. Water may be used on small fires. Thermal decomposition can lead to release of irritating gases and vapors.

## SECTION 6. ACCIDENTAL RELEASE MEASURES

**Spills, Leaks or Releases:** If not damaged, pick up by hand. Use normal precautions taken for handling explosives.  
**Deactivating Chemicals:** Not required. If detonators are damaged, contact an Orica Canada Inc. or Orica USA Inc. technical representative.

## SECTION 7. HANDLING AND STORAGE

**Handling:** i-kon detonators are explosive devices and should only be used under the supervision of trained personnel. Protect containers from physical damage. Keep away from incompatible materials, heat, sparks, flames and other ignition sources. Avoid rough handling.

**Storage:** Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for detonator storage. Do NOT store detonators in an explosives magazine. Keep away from heat, sparks and flames. Keep containers closed. i-kon detonators should be kept well away from explosives products; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles. Meet all legal requirements for shipping and magazine storage.

**Storage Temperature:** It is recommended that detonators not be stored or used at temperatures exceeding 70°C (158°F) without approved procedures to address the elevated temperatures.

## SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Preventive Measures:** Recommendations listed in this section indicate the type of equipment that will provide protection against exposure to this product under normal conditions of use. Conditions of use, adequacy of engineering or other control measures, and actual exposure situations will dictate the need for specific protective devices at your workplace.

**Engineering controls:** Full-handling precautions should be taken at all times.

### PERSONAL PROTECTIVE EQUIPMENT:

**Eye protection:** Safety glasses with side-shields.  
**Skin protection:** Gloves and protective clothing made from cotton should provide adequate protective.  
**Respiratory protection:** No special protective equipment required.  
**General hygiene considerations:** Handle in accordance with good industrial hygiene and safety practice.

### EXPOSURE GUIDELINES:

**Product:** None established for product

**Hazardous Ingredients:** Most likely exposure is from detonation products such, as Nitrogen Dioxide or Carbon Monoxide.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

**Physical State:** Article  
**Alternate Name(s):** None  
**Chemical Name:** Not applicable  
**Chemical Family:** Explosive  
**Molecular Formula:** Not applicable  
**Odor:** Odorless.  
**pH:** Not applicable  
**Vapor pressure (mmHg at 20°C/68°F)** Not applicable  
**Vapor density (Air = 1)** Not applicable  
**Boiling Point** Not applicable  
**Solubility (Water)** Not applicable  
**Solubility (Other)** Not applicable  
**Specific Gravity:** Not applicable  
**Evaporation Rate:** Not applicable  
**Melting point/range:** Plastic components melt between 100°C and 120°C. PETN melts at 284°F / 140°C

## SECTION 10. STABILITY AND REACTIVITY

**Stability:** Can explode from impact, friction, excessive heating or powerful electrical stimuli such as grid voltages and lightning.  
**Conditions to avoid:** Keep away from impact, friction or heat.  
**Incompatible materials:** Strong oxidizing agents.  
**Hazardous decomposition products:** Thermal decomposition products are toxic and may include lead, hydrocarbons, oxides of carbon and nitrogen.  
**Hazardous Polymerization:** None under normal processing



# Material Safety Data Sheet

## SECTION 11. TOXICOLOGICAL INFORMATION

The construction of these articles should prevent any chemical contamination. No adverse health effects are expected if the product is handled in accordance with this Material Safety Data Sheet and the manufacturer's recommendations.

The following information relates to the pure ingredients of this product. Symptoms or effects that may arise if the article is mishandled and overexposure occurs:

### TOXICOLOGICAL DATA:

**PRODUCT:** None established for the product.  
**INGREDIENTS:** PETN - Oral LD50 (mouse) = 25,000 mg/kg

### POTENTIAL HEALTH EFFECTS:

**Ingestion:** Highly unlikely under normal conditions of use.

**Inhalation:** Inhalation is not a likely route of exposure due to the physical form of the article and is thus not applicable. Detonation products may be irritating and/or toxic. Test firing of detonators in poorly ventilated areas can cause presence of lead fume in air. Lead fumes may be an irritant to mucous membranes and respiratory tract.

**Skin Contact:** No evidence of irritant effects from normal handling and use.

**Eye Contact:** May result in physical injury.

**Sub chronic Effects:** None known

**Chronic Effects:** Long-term exposure to low concentrations of lead may result in altered hemoglobin breakdown, anemia and central and peripheral nervous system damage.

**Carcinogenicity:** The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).

**Mutagenicity:** There is no evidence of mutagenic potential

**Reproductive Effects:** It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead exposure may cause reproductive effects based on studies in laboratory animals and on human epidemiological studies.

**Teratogenicity and Fetotoxicity:** It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead has been shown to cause congenital abnormalities and behavioral deficits in experimental animals in addition to its ability to increase the number of miscarriages, stillbirths and abortions in lead-exposed women.

**Synergistic Materials:** None known.

## SECTION 12. ECOLOGICAL INFORMATION

**Environmental Effects:** In consideration of the production and use of this product, it is unlikely that significant environmental exposure will arise.

**Ecotoxicity:** Contains no substances known to be hazardous to the environment or not degradable in wastewater treatment plants.

## SECTION 13. DISPOSAL CONSIDERATIONS

**Waste Disposal Method:** Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal laws. Call upon the services of an Orica Canada Inc. or Orica USA Inc. technical representative

## SECTION 14. TRANSPORT INFORMATION

### DOT:

<b>Proper shipping name:</b>	Detonators, Electric	Detonators, Electric
<b>Hazard Class</b>	1.4S	1.1B
<b>UN:</b>	0456	0030
<b>Packing group</b>	II	II

### TDG:

<b>Proper shipping name:</b>	Detonators, Electric	Detonators, Electric
<b>Hazard Class:</b>	1.4S	1.1B
<b>UN:</b>	0456	0030
<b>Packing group</b>	II	II



# Material Safety Data Sheet

## SECTION 15. REGULATORY INFORMATION

**CANADIAN CLASSIFICATION:** This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.

**Controlled Products Regulations (WHMIS) Classification:** This product is an explosive and is not regulated by WHMIS

**CEPA / Canadian Domestic Substances List (DSL):** The substances in this product are on the Canadian Domestic Substances List (CEPA DSL)

**IARC Classification:** None of the components for this product are listed on IARC.

### USA CLASSIFICATION:

**OSHA Classification: Physical:** Explosive. Oxidizer. **Health:** Not Regulated.

**Target Organ:** Reproductive Tract (Lead)

**SARA Regulations Sections 313 and 40CFR 372:** This product contains the following toxic chemical(s) subject to reporting requirements, Lead, Lead Compounds

**Ozone Protection and 40CFR 42:** This product does not contain, nor is it manufactured with ozone depleting substances.

**Other Regulations/Legislation which apply to this product:** New Jersey Special Health Hazard Substance List, New Jersey RTK Environmental Hazardous Substance, Massachusetts Right-to-Know, New Jersey Right-to-Know.

## SECTION 16. OTHER INFORMATION

**Prepared by:** Safety, Health and Environment (303) 268-5000

**Next Revision:** October 28, 2014

**Disclaimer:** The information contained herein is offered as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

**End of MSDS**

**Safety  
&  
Explosives Transportation**

# **PROTECTION OF THE PUBLIC**

## **General**

The Pier E3 blast design has taken into consideration the proximity of buildings in the area, the new SFOBB east span, waterways, and adjacent work areas. All explosives will be handled, transported, used and stored in accordance with all State and Federal Regulations. All on site workers will be notified of the activities and instructed to stay clear of the blast area. Signs will be posted to identify the blast area to other workers on the site. Only those authorized by the blaster will be permitted in this area. All unused product will be returned to the explosives distributor's delivery truck prior to detonating the blast. The structure will be covered with blasting mats to reduce air blast and prevent any flying debris. Prior to detonation, the blaster will ensure that a 500' radius danger area is clear of all people and the 1500' marine traffic safety zone is clear and secured by the safety boats. The waterway will be secured 15 minutes prior to the scheduled shot time and will remain secured until the blaster gives the "all clear". All persons involved with securing the blast zone will be equipped with radios. When it is confirmed that the zone is clear and the Blaster is comfortable with the conditions, he will sound the 5 minute warning, check with stationed personnel to ensure the zone is still clear, give the 1 minute warning, conduct a final radio check with stationed personnel, fire the shot, check the post shot conditions and give the "all clear" signal.

Local police and fire departments will be made aware of the blasting schedule and any change to the schedule in advance. Should circumstances arise that prevents the firing of any loaded explosives at the scheduled time, a security person will guard the shot until the blast is fired at a new time. The pier, once loaded with explosives, will not be left unattended. All local police and fire departments will be notified of the updated situation.

## **Warnings and Signals**

The blaster will warn all personnel on the job site of an impending blast through communication with the general contractor's superintendent and the use of warning signals. The warning signals to be used are as follows:

5 minute warning = three 3 second soundings of the air horn  
1 minute warning = two 3 second soundings of the air horn  
All clear = one 10 second sounding of the air horn

Before the blast is fired, a loud audible warning signal shall be given by the blaster in charge.

Pre-blast warnings will also be broadcasted to personnel via radio.

## **Pre-Blast Notifications**

All required agencies will be notified 48 hours before any blast to coordinate with the blaster in charge to determine the proper time for the blasting. A two hour notification will

be given to the general contractor's superintendent. A blast will not be fired until communication with the guards at the perimeter of the secured danger zone and marine traffic safety zone and visual inspection of both confirm that they are clear of personnel and vessels.

### **Control of Blast Debris**

Prior to the firing of the blast the structure will be covered with approved blasting mats and/or other acceptable cover material.



1500 ft marine safety zone

Blast area (50' radius around pier)

500 foot danger area

# **PROTECTION OF EXISTING STRUCTURES**

## **General**

The Pier E3 blast design has taken into consideration the proximity of the new bridge piers, commercial/residential structures, and utilities. Pounds of explosives per delay have been designed to produce minimal negative impacts on these structures.

The pier will be covered with wire-rope blast mats and other cover material prior to detonation to prevent any flying debris.

Seismographs will be set up at the closest structures to record the resulting ground vibrations and air overpressures. The blast event will be monitored and recorded.

## **Pre-Condition Surveys**

When required, the contractor shall arrange for a pre-blast survey of any nearby buildings, structures, or utilities which may potentially be at risk from blasting damage. The pre-blast surveys must contain drawings of each wall of the structure and photographs of existing damage. The survey method used shall be acceptable to the contractor's insurance company. The pre-blast survey records shall be made available to the Department for review. Occupants of local buildings shall be notified prior to the commencement of blasting.

## **Vibration Control and Monitoring**

When blasting near buildings, structures, or utilities that may be subject to damage from blast induced ground vibrations, the ground vibrations shall be controlled by the use of properly designed delay sequences and allowable charge weights per delay. Allowable charge weights per delay shall be based on vibration levels which will not cause damage. The allowable charge weights per delay shall be established through industry standard prediction equations and constantly checked through seismograph monitoring of the blast-generated ground vibration levels.

The blast will be monitored using approved seismographs located, as approved, between the blast and the closest structure subject to blast damage and other locations as identified by the Engineer. The seismographs will be capable of recording particle velocity for three mutually perpendicular components of vibration in the range generally found with controlled blasting.

Data recorded for the shot shall be furnished to the blaster in charge and the Department and shall include the following:

1. Identification of instrument used.
2. Name of equipment operator.
3. Distance and direction of recording station from blast area.

4. Type of ground at recording station and material on which the instrument is placed.
5. Maximum particle velocity in each component.
6. Resultant peak particle velocity.
7. Frequency, in hertz, of the maximum particle velocity in each component.
8. A dated and signed copy of records of seismograph readings.

The accepted conservative safe limits for blast vibration are given in Table 1 below.

**TABLE 1**  
**Safe Vibration Levels**

<b><u>Structure Type</u></b>	<b><u>Maximum PPV (inches per second)</u></b>
<b>Standard Construction (Timber, Frame, Brick, and Concrete Buildings)</b>	<b>2.0 (frequency &gt;40)</b>
<b>Reinforced Concrete Structures</b>	<b>4.0</b>
<b>Steel Structures</b>	<b>4.0</b>
<b>Buried Utilities</b>	<b>4.0</b>
<b>New SFOBB Bridge East Span</b>	<b>20.0</b>

### **Vibration Level for New Bridge**

The majority of new bridges are designed to withstand an earthquake impact of 7.3 magnitude. This is approximately equivalent to a peak particle velocity of 28 inches per second at a one hertz earthquake frequency or 56 inches per second for a 0.5 hertz earthquake frequency.

The allowable ground vibration level of 20 ips for blast design purposes is considered conservative. An earthquake would impact the entire bridge for seconds at these Richter levels where the blast is a localized, transient, high frequency event lasting only milliseconds.

For existing residential and commercial buildings the maximum vibrations levels allowed will be as indicated in Table 1.

Lewis L. Oriard has shown through his extensive research that the following levels are required to cause damage to massive concrete:

<b>Damage</b>	<b>Strain (<math>\mu\text{in/in}</math>)</b>	<b>PPV (ips)</b>
Static	140	20
grout spall	700	100
Skin spall	1300	200
Cracking	2400	375

(Lewis L. Oriard, "Explosives Engineering, Construction Vibrations and Geotechnology", Chapter 11, pages 415-416, 420-422, 444-454.)

(David E Siskind, "Vibrations from Blasting", International Society of Explosives Engineers, Cleveland OH (2000) pages 63-64.)

The estimated resultant ground vibration levels (PPV) at the closest pier of new bridge is 0.03 inches per second. (Equation used:  $24.2(d/w^{.5})^{-1.6}$ )

## **Air Blast and Noise Control**

Appropriate blast hole patterns, detonation systems, stemming material, and blast mats will be used to prevent venting of blasts and to minimize airblast and noise levels produced by the blasting operations. The peak overpressure recorded for each blast will be included on the Blast Report.

# **Transportation and Storage of Explosives**

Explosives will be delivered to the site by the explosives distributor in an approved truck licensed for the transportation of explosives in California. Explosives will be brought to a location pre-approved by the USCG for explosives off-load within BATF licensed magazines. The magazines will then be transferred to a barge, also pre-approved by the USCG for the transport of explosives over water. Under a USCG 4260 permit, the magazines will be taken to Pier E3. Explosives will be taken out of the magazines on an "as needed" basis and will be attended by an authorized person at all times. Once loading is complete the magazines, containing any unused explosives, will be transported back to the off-load area and be transferred back to the delivery truck for return to the distributor's storage facilities.

There will be no unattended on-site storage of explosives.

APPLICATION AND PERMIT TO HANDLE  
HAZARDOUS MATERIALS  
*(See Instructions on Page 2.)*

TO CAPTAIN OF THE PORT U.S. COAST GUARD	FROM <i>(Name, Business address and zip code)</i>
---	---

CARGO BY PROPER SHIPPING NAME	HAZARD CLASS OR DIVISION	STOWAGE <i>(Vessel Only)</i>	WEIGHT <i>(Net Tons)</i>

TOTAL →
---------

	VESSEL OR BARGE	WATERFRONT FACILITY
NAME AND LOCATION		
NAME, ADDRESS AND ZIP CODE OF OWNER		
NAME, ADDRESS AND ZIP CODE OF AGENT OR CHARTERER		
DATE(S) AND TIME(S) OF OPERATION		

I UNDERSTAND and will comply with current safety laws, rules and regulations of the United States, the State, County, City and Port Authority while handling hazardous materials. *(See Page 2.)*

DATE	TITLE <i>(Authorized Company Representative)</i>	SIGNATURE
------	--	-----------

PERMIT

THE ABOVE REQUEST IS:

APPROVED                     
  APPROVED WITH THE FOLLOWING CONDITIONS                     
  DISAPPROVED

EXCEPTIONS/CONDITIONS

DATE	SIGNATURE <i>(Captain of the Port, U.S. Coast Guard)</i>
------	--

INSPECTION *(VESSEL LOADING ONLY)*

The stowage of the cargo listed above has been inspected and accepted as satisfactory.

DATE	SIGNATURE AND POSITION <i>(Master/Mate/Person in Charge of Vessel)</i>
------	--

## **INSTRUCTIONS**

Submit original and one copy to the Captain of the Port having jurisdiction over the load/discharge location  
(See 33 CFR Part 3)

This application and permit is required by the following regulations:

- 49 CFR 176.100 (*Military & Commercial Explosives, Division 1.1 and 1.2*)
- 49 CFR 176.415 (*Blasting Agents and Ammonium Nitrates*)
- 33 CFR 126.17 (*Military & Commercial Explosives, Division 1.1 and 1.2*)

Supplemental information required by the above regulations must be appended to this application.

"Proper Shipping Name" means the name of the cargo as given in 49 CFR 172.101. The "correct technical name" as given in the International Maritime Dangerous Goods Code published by IMO may be used as prescribed by regulation.

## **CONDITIONS**

This permit is subject to the following conditions:

- a. The limits as to maximum quantity, isolation, and remoteness established by local, municipal, territorial or state authorities having jurisdiction (*or the quantity of this permit*) shall not be exceeded by this operation. This permit does not authorize the violation of any applicable state or municipal law, ordinance, regulation or permit.
- b. The Captain of the Port shall be notified immediately of any changes in quantity, times, dates, or of any matters that might affect the safe handling or transportation of the cargo covered by this permit.
- c. All applicable laws and regulations, unless waived by the Captain of the Port, and all directions or orders of the Captain of the Port or his authorized representative, shall be complied with.

*An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB number.*

*The Coast Guard estimates that the average burden for this report is 1 hour. You may submit any comments concerning the accuracy of this burden estimate or any suggestion for reducing the burden to: Commandant (G-MOC), U.S. Coast Guard, Washington, DC 20593-0001, Project (2115-0013).*

# TRANSPORTATION OVER WATER INSPECTION CHECKLIST

## SUBAQUEOUS BLASTING ACTIVITY

Contractor: _____	Date of Inspection: _____
Project: _____	Activity Inspected: _____
Location: _____	Approved By: _____
Phase/Area: _____	Inspected By: _____
Contract No: _____	_____

DATE	TOPIC	Y	N	N/A
	<b>33 CFR 6.12 SUPERVISION AND CONTROL OF EXPLOSIVES OR OTHER DANGEROUS CARGOES.</b>			
	<b>6.12-1 GENERAL SUPERVISION &amp; CONTROL</b>			
	The Captain of the Port may supervise and control the transportation, handling, loading, discharging, stowage, or storage of hazmat on board vessels as covered by the regulations in 49 CFR Parts 170-189, 46 CFR 150-156, 46 CFR parts 170-189, 46 CFR 150-156, 46 CFR Parts 146-148 and the regulations governing tank vessels (46 CFR Parts 30-39)			
	<b>33 CFR 126.16 CONDITIONS FOR DESIGNATING A "FACILITY OF PARTICULAR HAZARD"</b>			
	(a) BASIC REQUIREMENTS. The facility shall comply with all the conditions in 33 CFR 126.15 except where specifically waived by 33 CFR 126.11.			
	(b) WARNING ALARMS. Warning alarms shall be installed at the waterside facility to warn approaching or transiting water traffic of immediate danger in the event of fire or cargo release. Warning alarms shall be of the siren type, or the emergency rotating flashing light type, and be sufficient intensity to be heard, or seen, a distance of 1 mile during normal facility working conditions. The alarm signal shall not conflict with local municipal prescription.			
	<b>46 CFR 25.30 FIRE EXTINGUISHING EQUIPMENT</b>			
	(a) The provisions of this subpart with the exception of 25.30-90, shall apply to all vessels contracted for on or after November 19,1952. Vessels contracted for or prior to that date shall meet the requirements of 25.30-90.			
	<b>25.30-10</b>			
	(b) All required portable and hand held extinguishers shall be of the BRAVO type; i.e. suitable foe fighting fires involving flammable liquids.			
	<b>25.30-15</b>			
	(a) When a fixed fire extinguishing system is installed, it shall be of an approved carbon dioxide type.			
	<b>25.30-20</b>			
	(b) MOTOR VESSELS. All motor vessels shall carry at least the minimum number of hand held portable extinguishers as set forth in Table 25.30-20 (b) (1) of 46 CFR 25.30			
	<b>33 CFR 175.201 VENTILATION</b>			
	No person shall operate a boat built after July 31,1980, that has a gasoline engine for electrical generation, mechanical power, or propulsion unless it is equipped with an operable ventilation system.			

	<b>49 CFR 176.60 “NO SMOKING” SIGNS</b>			
	When smoking is prohibited during the loading, stowing, storing, transportation, or unloading of hazmat by this part, the carrier and the master of the vessel are jointly responsible for posting “NO SMOKING” signs in conspicuous locations.			
	<b>SUBPART G- DETAILED REQUIREMENTS FOR EXPLOSIVES</b>			
	<b>49 CFR 176.100 PERMIT FOR CLASS “A”</b>			
	Before a shipment of class A explosive may be discharged from, loaded, handled, or restored on board a vessel at any place in the U.S.A., it’s territories, or it’s possessions (except for the Panama Canal Zone). The carrier must obtain a permit from the Captain of the Port or his authority’s representative.			
	<b>49 CFR 176.105 LOADING AND UNLOADING OF EXPLOSIVES</b>			
	(a) In any particular port, Class A or Class B explosives (except special fireworks), may not be loaded on a vessel until all other cargo has been loaded on board a vessel. No explosives may be loaded or unloaded at the same time that other cargo is being handled.			
	(b) All explosives must be handled carefully. Packages of explosives may not be thrown, dropped, rolled, dragged, or slid over each other or over the deck.			
	(c) Packaged Class A explosives must be loaded and discharged from a vessel by using a chute as provided for in 49CFR 176.163 or by a mechanical pallet, skipboard, tray or pie pallet, fitted with a cargo net or sideboards. A stuffed mattress at least 4 feet wide by 6 feet long and at least 4 inches thick, or a heavy hemp or jute mat of these dimensions, must be used for depositing explosives lifted by mechanical means or slide down a chute. The maximum load handled in a pallet, skipboard, tray, or pie plate may not exceed 2,640 pounds. A rope net sling with a pallet, skipboard, pie plate or similar base must be loaded so that a minimum displacement of items occurs when it is lifted; the cargo net must completely encompass the cotton and sides of the load. Not more than one third dimension of any package may extend above the sideboard of a tray. (A landing mattress and cargo net are not needed for palletized Class A explosives)			
	(d) Detonators, detonating primers, detonating fuses, fulmate or mercury, and other initiating or priming explosives defined in this subchapter constitute distinct types of explosives. They must be handled with extreme care. A chute and mattress may not be used when loading or discharging this type of explosive.			
	(e) A “can” hook may not be used for raising or lowering a barrel, drum, or other container of explosives.			
	(f) A fire hose of sufficient length to cover the area of the loading operation and connected with adequate water supply must be laid out and read for use.			
	<b>49 CFR 176.110 CONDITION OF PACKAGE</b>			
	A package of explosive which is damp, moldy, stained, or in any condition that indicates leakage may not be transported by vessel. The shipper must substantiate any claim that a stain is due to accidental contact with grease, oil, or similar substance. In case of doubt, the package may not be transported.			
	<b>49 CFR 176.115 ON DECK STORAGE OF EXPLOSIVES</b>			
	(a) The following requirements apply to the stowage of explosives on deck:			
	(1) An explosive may not be stowed on or under a bridge deck.			

	<b>49 CFR 176.115 ON DECK STORAGE OF EXPLOSIVES Continued</b>			
	(2) An explosive may not be stowed nearer than 25 feet in a horizontal plane to the crews quarters.			
	(b) Explosives being transported on deck on a vessel between receiving points within the same harbor, bay, sound, lake, or river including explosive anchorages must be covered with a fire resistant or flame-proof tarpaulin securely lashed in place.			
	<b>49 CFR 176.120 PREPERATION OF DECKS, GANGWAYS, HATCHES, AND CARGO PORTS</b>			
	(a) All decks, gangways, and hatches over or through which explosives must be freed of all loose material and must be swept broom clean before loading and unloading.			
	(b) All hatches and cargo ports opening into a compartment which any explosive are stowed must be kept closed, except during loading or unloading of the compartment. After loading, hatches must be securely closed against weather. If tarpaulins are used, They must be securely battened.			
	<b>49 CFR 176.130 SECURING AND DUNNAGING OF PACKAGEING OF EXPLOSIVES</b>			
	(a) Each package of explosives must be secured and dunnaged to prevent movement in any direction. Vertical restraints are not required if the shape of the package and the stuffing pattern precludes shifting of the load.			
	(b) Each keg of black powder must be stowed in an upright position with the bungs up and each tier must be completely dunnaged.			
	(c) Each package of explosives must be braced and dunnaged so that it is not likely to be pierced by the dunnaging or crushed by any superimposed weight.			
	<b>33 CFR 126.19 ISSUANCE OF PERMITS FOR HANDLING DESIGNATED DANGEROUS CARGO</b>			
	(a) Upon the application of the owners or operators of a designated waterfront facility or of their authorized representatives, the Captain of the Port is authorized to issue a permit for each transaction of handling, loading, discharging, or transporting designated dangerous cargo at such waterfront facility provided the following requirements are met:			
	(1) The facility shall comply in all respect with the regulations in this subchapter.			
	(2) The quantity of designated dangerous cargo, except military explosives shipped by or for the Armed Forces of the United States, on the waterfront facility and vessels moored thereto shall not exceed the limits as to maximum quantity, isolation and			
	<b>46 CFR 67.45 FAILURE TO HAVE CERTIFICATE ONBOARD</b>			
	(a) The person in command of a documented vessel must have on board that vessel the Certificate of Documentation.			
	<b>46 CFR 25.25 PERSONAL FLOTATION DEVICES</b>			
	(a) No person may operate a vessel to which this subpart applies unless it meets the requirements of this subpart.			
	(b) Each vessel not carrying passengers for hire, less than 40 feet in length must have at least one life preserver (Type I PFD), buoyant vest (Type II), or marine buoyant intended to be worn (Type III PFD) for each person on board.			

	(c) Each vessel carrying passengers for hire and each vessel 40 feet in length or longer not carrying passengers for hire must have at least one life preserver for each person aboard.			
	<b>46 CFR 25.35-1 BACKFIRE FLAME CONTROL</b>			
	(a) Every gasoline engine installed in a motorboat and motor vessel after April 25, 1940 shall be equipped with an acceptable means of backfire control.			
	(b) Installations made before November 19, 1952 need not meet the requirements of this subpart.			
	(e) The following are acceptable means of backfire flame control:			
	(1) An arrester built in accordance with Subpart 162.041 of Subchapter Q.			
	(2) An engine air and fuel induction system which provides adequate protection from propagation of backfire equal to an approved flame control.			
	(3) Any attachment to the carburetor or location of the engine air induction that disperses flames in such a manner as not to endanger the vessel.			
	(4) Vessels having an integrated engine-vessel design shall be tested and labeled in accordance with the specifications contained in Subpart 162.043 of Subchapter Q and shall be specifically approved by Commandant.			
	<b>33 CFR 155.450 PLACARD</b>			
	(a) A ship, except a ship of less than 26 feet in length must have a placard of at least 5 by 8 inches made of a durable material, fixed in a conspicuous place in each machinery space or at the bilge and ballast pump control station.			
	<b>33 CFR 151.59 PLACARDS</b>			
	(b) The master of each ship shall ensure that one or more placards meeting the requirements of this section are displayed in prominent locations.			

# **SAFETY AND ACTIVITY HAZARD ANALYSIS**

<b>PRINCIPAL STEP</b>	<b>POTENTIAL HAZARD</b>	<b>RECOMMENDED CONTROLS</b>
<b>TRANSPORTATION OF EXPLOSIVE MATERIALS</b>	Fire	Vehicles transporting explosive materials shall be equipped with one or more fire extinguishers of a type listed by a nationally recognized test laboratory.
	Fire	Persons engaged in the transportation, handling, or other use of explosive materials shall not smoke, carry matches, firearms, ammunitions, or flame producing devices.
	Poor Visibility	Display all placards, lettering, or numbering required.
	Premature Detonation	Explosives shall not be transported with any other materials, cargoes, or crew members.
	Premature Detonation	Blasting caps shall not be transported in the vehicle with other explosives.
	Premature Detonation	No other items shall be carried in the bed or body of any vehicle transporting explosive materials.
	Premature Detonation	Transportation of explosives from land to a watercraft shall be done in certified and approved magazines and shall be supervised by the CA licensed blaster.
	Theft of Product	Vehicles transporting explosive materials shall not be left unattended. All magazines are to be kept locked except during the transfer. In the event of loss or theft of product Contractor shall report all incidents with details to the BATF and police.
	Vehicle Accident	In case of an accident, Notification Instructions and Procedures on Securing an Accident Scene will be kept in the vehicle at all times.
	Vehicle Failure	Vehicle shall not be loaded beyond rated capacity and the products shall be secured to prevent shifting. Vehicles will be inspected and found satisfactory for transportation of explosive materials.
	Vehicle Failure	Operators of the vehicles shall be physically fit, careful, reliable, and able to read, write, and understand instructions in the English language.
	Vehicle Failure	Vehicles transporting explosive materials shall be in good repair.
	Vehicle Failure	Only the authorized driver and his/her helper shall be permitted to ride on any truck carrying explosive materials.
<b>HANDLING OF EXPLOSIVE MATERIALS</b>	Fire	Magazines used for the storage of detonators shall be separated from magazines storing other explosive materials by the appropriate distance or approved barrier.
	Fire	Smoking matches, firearms, open flames, or any flame producing device shall not be permitted within 50 feet of any magazine.
	Fire	Smoking will be allowed only in a designated smoking area.
	Premature Detonation	Only authorized and qualified persons shall be allowed to handle and use explosives.
	Premature Detonation	Containers shall be opened only with non-sparkling tools or instruments.
Premature Detonation	Explosive materials shall be removed from containers only as they are needed for use.	
Premature Detonation	Explosive materials and/or primers shall be separated and taken to the blasting area in their original containers.	

# **SAFETY AND ACTIVITY HAZARD ANALYSIS**

<b>PRINCIPAL STEP</b>	<b>POTENTIAL HAZARD</b>	<b>RECOMMENDED CONTROLS</b>
	Premature Detonation	Primers shall not be made up in excess of immediate need for holes to be loaded.
	Premature Detonation	Primers should be made up at the "site specific" Pier Location.
	Premature Detonation	Detonators, primers, or other initiators shall not be stored in the same magazine with explosives, or blasting agents.
	Premature Detonation	Magazines in which explosive materials are stored shall not be used for any other purposes.
	Theft of Materials	After loading a blast, all excess explosive materials and detonators shall be returned to the magazine day storage box. Inventory records shall be updated at the close of business each day.
<b>DAILY INVENTORY JUSTIFICATION</b>	Theft of Materials	Explosive materials and related materials shall be stored in approved containers.
	Theft of Materials	Magazines are to be kept locked at all times and the keys in the possession of the Licensed blaster or the explosives delivery truck driver.
<b>DRILLING AND BLASTING</b>	Drilling into Loaded Holes	Drilling and loading of holes shall not be carried on in the same immediate areas.
	Personal Injury	Personnel unnecessary for the operation are not allowed in the Blast Area.
	Personal Injury	Trained individuals under the "direct" supervision of a qualified person shall perform drilling and loading.
	Personal Injury	Safety glasses and hearing protection shall be worn while in a drilling environment.
	Personal Injury	The walking surface from the magazines to the Blast Area shall be free of trip hazards and obstructions.
	Personal Injury	Standard audible signals shall be used to warn of a blasting operation (see Warning Signs).
	Personal Injury	Explosive materials shall not be transported during crew changes.
	Personal Injury	In the event of a thunderstorm, loading of charges shall cease and the <i>Lightning Present Procedure</i> should be followed. Continuous monitoring for potential/actual thunderstorms shall be ongoing.
	Premature Detonation	Explosive materials shall only be removed from their containers for immediate intended use.
	Premature Detonation	Primers shall not be made up in or near magazines and shall be made up on an "as needed basis."
	Product Failure	All drill holes shall be of a greater diameter than the cartridges.
	Product Failure	Magazines shall be kept clean and dry at all times.
	Product Failure	Explosive materials shall be arranged so the oldest stock will be used first.

# **SAFETY AND ACTIVITY HAZARD ANALYSIS**

<b>PRINCIPAL STEP</b>	<b>POTENTIAL HAZARD</b>	<b>RECOMMENDED CONTROLS</b>	
<b>LOADING FOR BLASTING</b>	Product Failure	Explosive materials shall be stored in their original containers lying flat.	
	Personal Injury	Explosives will be delivered directly to the site by explosives distributor..	
	Personal Injury	The Blast Area shall be kept free of any equipment, operations, or persons not essential to the loading process.	
	Personal Injury	Tamping shall be done with an approved non-sparking loading pole.	
	Personal Injury	Primers shall not be tamped.	
	Personal Injury	Cartridges or boosters shall be primed only in the number required for a single round.	
	Personal Injury	No detonator shall be inserted in explosive materials without a cap well or without first making a hole in the cartridge with a non-sparking tool of proper size.	
	Personal Injury	No explosive material or loaded hole shall be left unattended.	
	Personal Injury	No holes shall be loaded except those to be fired in the designated blast. The blast shall not be detonated until all personnel are accounted for.	
	Premature Detonation	Holes will not be loaded in the prospect of thunderstorms indicated by the National Weather Service, Coast Guard, or static electricity detected by the lightning detector.	
	Vibration Control	Loaded holes or charges shall be verified and documented on the Drill Log and Blast Report before firing.	
	Vibration Control	Loaded holes shall be stemmed to the collar with non-combustible materials as designed.	
	<b>FIRING</b>	Misfire	The person attaching the lead-in connections shall fire the shot.
		Personal Injury	Prior to the firing of the shot, all persons in the Blast Area shall be warned of the blast.
Personal Injury		The blast shall not be fired until it is certain that everyone has retreated to a safe position and are accounted for.	
Personal Injury		All blasting operations shall use signals as stated in the blast plan.	
Personal Injury		Prior to each shot, security shall be posted at designated locations.	
<b>INSPECTION</b>	Premature Detonation	Accidental detonation is avoided by strict adherence to safe blast procedures.	
	Personal Injury	Immediately after the blast has been fired, the lead-in shall be disconnected from the blast machine.	
	Personal Injury	An inspection of the tattletale shall be made by the blaster to determine that all charges have been detonated.	
<b>MISFIRE</b>	Personal Injury	Other persons shall not be allowed to return to the Blast Area until an All Clear is given.	

# **SAFETY AND ACTIVITY HAZARD ANALYSIS**

<b>PRINCIPAL STEP</b>	<b>POTENTIAL HAZARD</b>	<b>RECOMMENDED CONTROLS</b>
	Detonation Failure	Misfires shall be handled under the direction of the CA Licensed blaster.
	Detonation Failure	No other work is to be done except that which is necessary to correct the hazard of the misfire.
<b>SPECIFIC HAZARDS</b>		
	Loss/Injury to Eyesight	Eye protection is available for grinding, brazing, welding and drilling operations.
	Loss/Injury to Hearing	Hearing protection shall be worn in identified noise hazard areas.
	Personal Injury	Eyewash stations and proper protective gear will be available at all times.
	Personal Injury	Employees are required to wear hard hats, safety glasses, safety boots at all times. PFD's will be worn when within 6 feet of open water.
	Respiratory Failure	Respiratory protection is issued for specific hazards.

**CONCLUSION:**

Hazards and preventative measures are not limited to this plan. Continuous efforts will be made to observe for hidden hazards and correct them with immediate and proper action.

# **Contingency Plan**

# CONTINGENCY PLAN

The Pier E3 blast design, explosive product selection, and the choice of using electronic detonators lend to the blasting of Pier E3 being a success. Weather can not be controlled. Lightning detection equipment will be used during the entire time that explosives are on site at Pier E3. When an electrical storm is detected and presents a hazard to the safety of personnel the following procedure shall be followed:

- 1) Notify the Project manager of the potential hazard.
- 2) Terminate all loading of explosives into boreholes and return explosive to the magazines.
- 3) Clear the 500' danger zone of all vessels and personnel.
- 4) The lightning detection equipment shall be taken with the personnel to continuously monitor the conditions.
- 5) The danger zone shall be visually monitored to ensure no vessels or personnel have re-entered the danger zone while the hazard still exists.
- 6) Resume operations only after all potential hazards have passed. All other applicable safety requirements shall be implemented in addition to those required above.

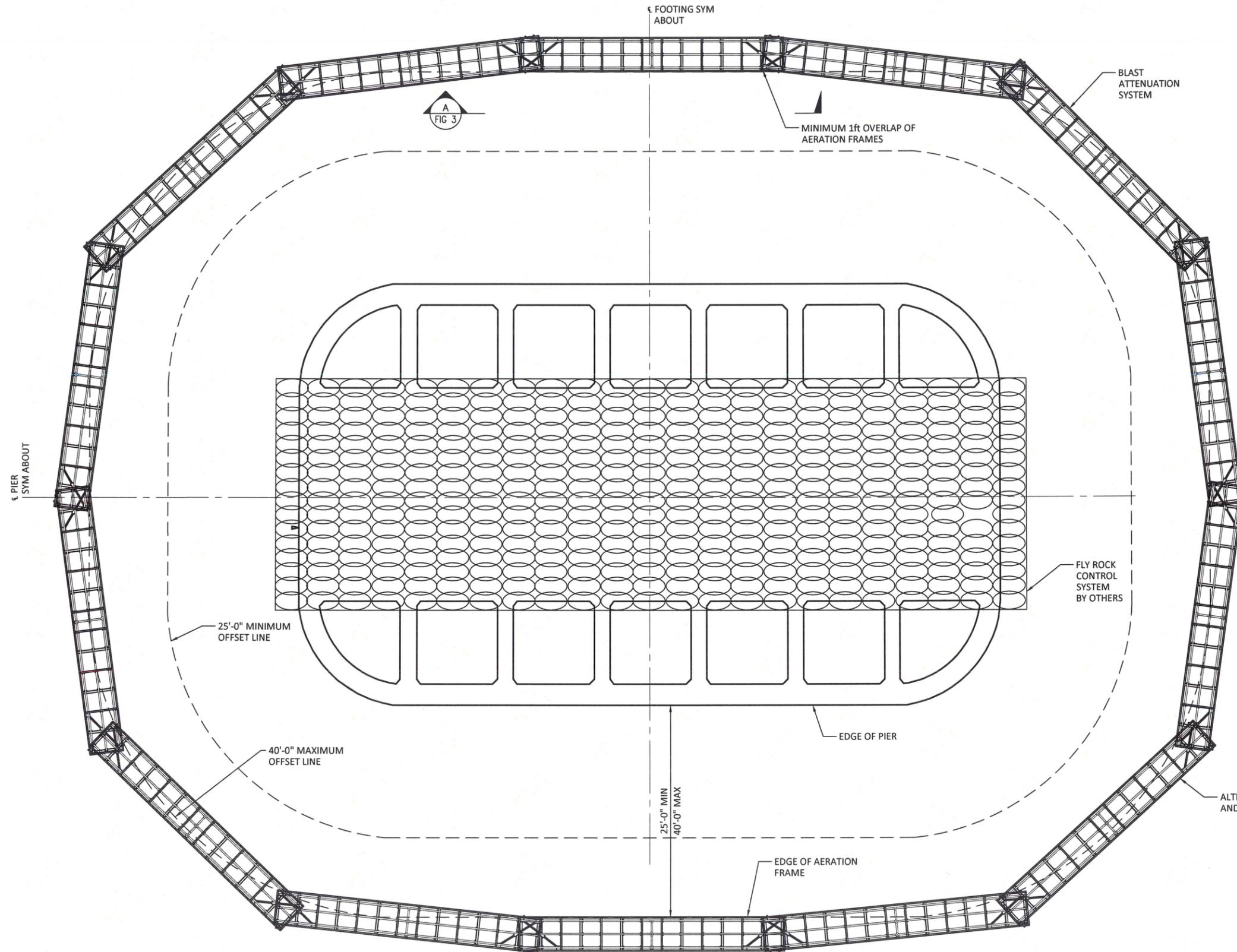
A misfire is highly unlikely due to the type of detonators being used for the blasting of Pier E3. The electronic detonation system will check the integrity of each individual electronic detonator when prompted by the blaster and identify "bad" detonators. This check allows the blaster the ability to correct a problem while charging holes and again before firing the shot. Additionally, the redundant use of detonators (i.e., two per deck/hole) ensures the detonation of explosives will occur. However, in the event of a misfire, the blaster in charge will notify the Project manager and take the following actions.

- 1) The blaster will maintain the secure 500' danger zone while he conducts an inspection to determine conditions and cause.
- 2) If the inspection indicates only that the lead line has malfunctioned, a new lead line will be installed and the shot re-fired.
- 3) If the inspection indicates that a portion of the shot misfired, hence a cut-off has occurred, the following procedure shall be implemented:
  - a) The blaster will maintain the danger zone and restrict entry for ½ hour.
  - b) The blaster and only personnel authorized by him will re-enter the blast area to rectify the problem.
  - c) If all downlines are intact where a surface connection failed, a new connection will be made, all zones re-secured, and the shot re-fired.
  - d) If the misfire cannot be safely re-energized and re-fired, the blaster will maintain security of the 500' danger zone. The blaster will contact the technical representative of the explosives manufacturing company to consult on how to best handle the situation. Once the contingency plan has been confirmed, the blaster will advise the Project manager of the appropriate procedure.
- 4) When the misfire has been corrected, the blaster will notify the Project manager of an "all clear".

## **APPENDIX B: Blast Attenuation System Details**

Copyright © BergerABAM. All Rights Reserved.

Last Saved by: Enos on: Feb 10, 2015 10:14 AM File: Q:\FederalWay\2015\A15.013600\CADD\Drawings\01\_Fig01.dwg



**STRUCTURAL NOTES**

**CODES AND STANDARDS**

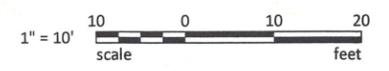
1. STRUCTURAL AND MISCELLANEOUS STEEL FABRICATION AND ERECTION THEREOF SHALL CONFORM TO THE "AISC MANUAL OF STEEL CONSTRUCTION," FOURTEENTH EDITION.
2. WELDING OF STRUCTURAL AND MISCELLANEOUS STEEL SHALL CONFORM TO THE LATEST EDITION OF "STRUCTURAL WELDING CODE - STEEL" (AWS D1.1).

**GENERAL**

1. THESE NOTES CONTAIN GENERAL INFORMATION AND ARE NOT COMPLETE FOR CONSTRUCTION PURPOSES. CONTRACTOR SHALL VERIFY INFORMATION GIVEN HERE WITH SPECIFICATIONS AND OTHER DOCUMENTS AND BRING ANY CONFLICTS TO THE ATTENTION OF THE ENGINEER BEFORE BEGINNING AFFECTED WORK. THE ENGINEER WILL RESOLVE ANY SUCH CONFLICT.
2. ALL DIMENSIONS AND DETAILS SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO FABRICATION AND CONSTRUCTION.
3. ALL SHOP DRAWINGS AND MATERIAL CERTIFICATIONS FOR STEEL, SHALL BE SUBMITTED TO AND REVIEWED BY THE ENGINEER PRIOR TO FABRICATION.
4. MAXIMUM LOAD AT EACH PICK POINT = 20,000 LBS VERTICAL AND 9000 LBS HORIZONTAL.

**STEEL**

1. ALL MISCELLANEOUS STEEL SHAPES AND PLATES, EXCEPT AS NOTED BELOW, SHALL CONFORM TO ASTM A 36, FY = 36 KSI
2. ALL BOLTS AND NUTS SHALL CONFORM TO ASTM A 307, UNLESS SPECIFICALLY NOTED OTHERWISE ON THE DRAWINGS.



**LAYOUT OF BLAST ATTENUATION SYSTEM**

SCALE: 1"=10'-0" (34x22) 1"=20'-0" (11x17)

MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
 33301 9th Avenue South, Suite 300  
 Federal Way, Washington 98003-2600  
 (206) 431-2300 Fax: (206) 431-2250

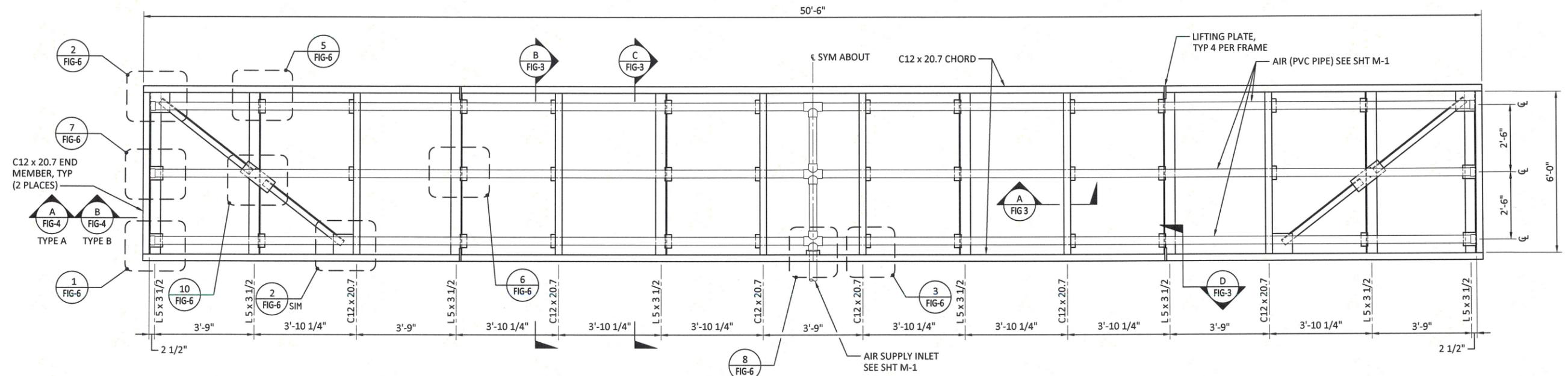
**KIEWIT/MANSON, AJV**

REGISTERED PROFESSIONAL ENGINEER  
 MICHAEL L. G. WICK  
 No. 46359  
 Exp. 12-31-16  
 CIVIL  
 STATE OF CALIFORNIA

DRAWN BY MDB  
 DESIGN BY MGW  
 CHECK BY EWO  
 PROJ MGR MGW

**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
 LAYOUT OF BUBBLE CURTAIN FRAME SIGMENTS

DRAWING NO. **FIG-1**  
 PROJECT NO. A15.0136.00  
 DATE: 2/9/15  
 SHEET NO. 1 OF 7



**PLAN - AERATION FRAME TYPE A (TYPE B SIMILAR)**  
SCALE: 1/2"=1'-0"



MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

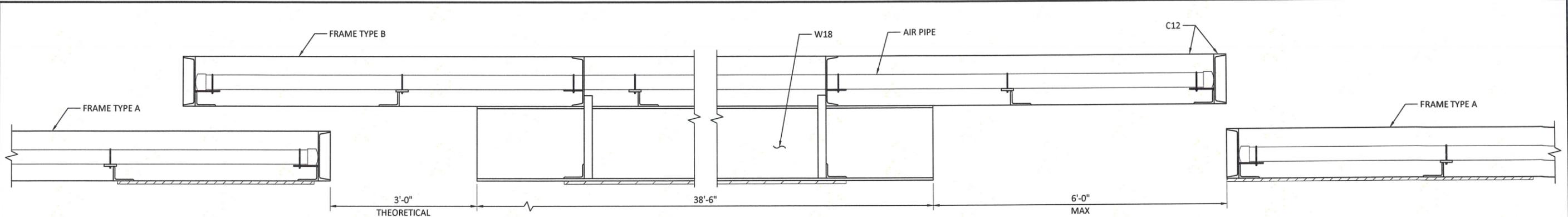
**KIEWIT/MANSON, AJV**

REGISTERED PROFESSIONAL ENGINEER  
MICHAEL G. WRAY  
NO. 46359  
EXP. 12-31-16  
CIVIL  
STATE OF CALIFORNIA

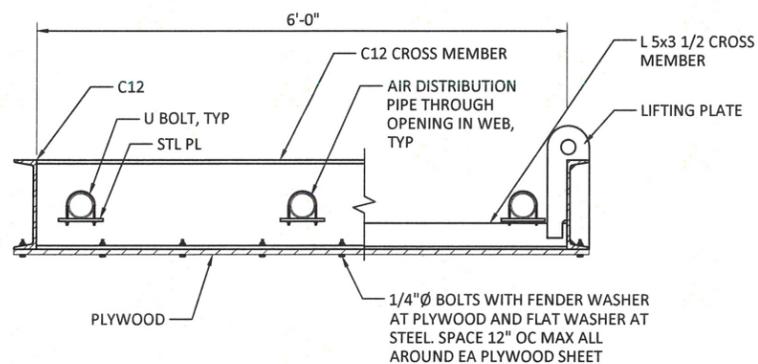
DRAWN BY MDB  
DESIGN BY MGW  
CHECK BY EWO  
PROJ MGR MGW

**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
**FRAME DETAILS**

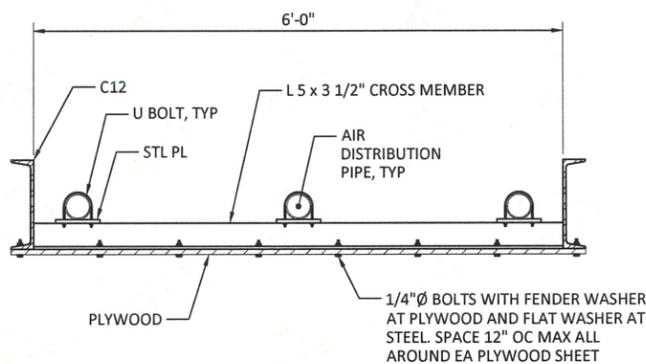
DRAWING NO. **FIG-2**  
PROJECT NO. A15.0136.00  
DATE: 2/9/15  
SHEET NO. 2 OF 7



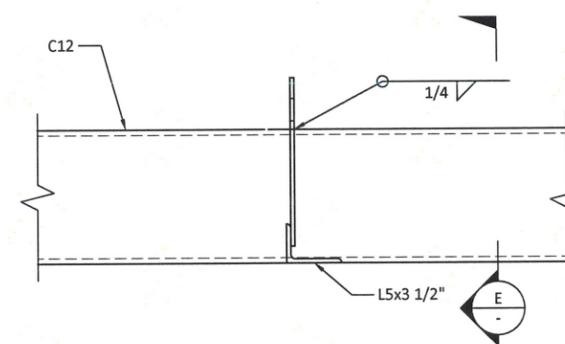
**A ELEVATION**  
FIG-1 SCALE: 1"=1'-0"



**B SECTION - FRAME TYPE A**  
FIG-2 SCALE: 1"=1'-0"

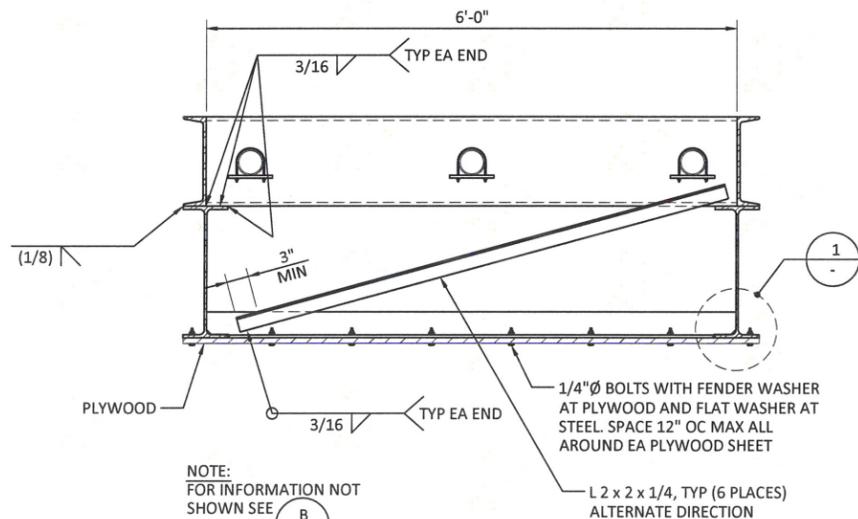


**C SECTION - FRAME TYPE A**  
FIG-2 SCALE: 1"=1'-0"



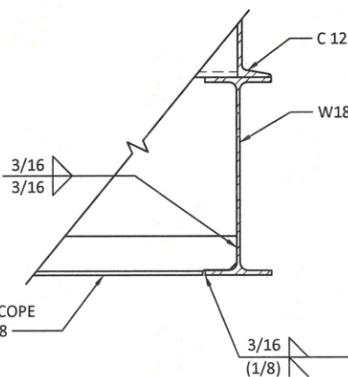
**D SECTION - LIFTING PLATE**  
FIG-2 SCALE: 1 1/2"=1'-0"

NOTE:  
FOR FRAME TYPE B,  
SEE **D**

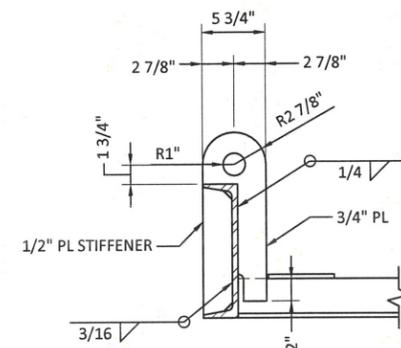


**D SECTION - FRAME TYPE B**  
SCALE: 1"=1'-0"

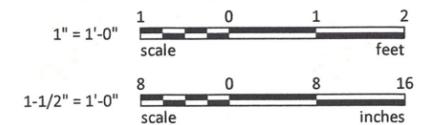
NOTE:  
FOR INFORMATION NOT  
SHOWN SEE **B**



**1 DETAIL**  
SCALE: 1 1/2"=1'-0"



**E SECTION**  
SCALE: 1 1/2"=1'-0"



MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

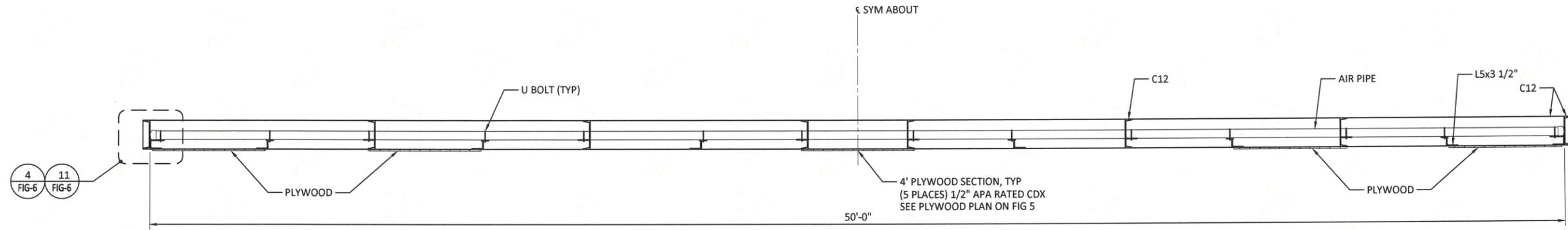
**KIEWIT/MANSON, AJV**

REGISTERED PROFESSIONAL ENGINEER  
MICHAEL G. WEAVER  
NO. 463359  
EXP. 12-31-16  
CIVIL  
STATE OF CALIFORNIA

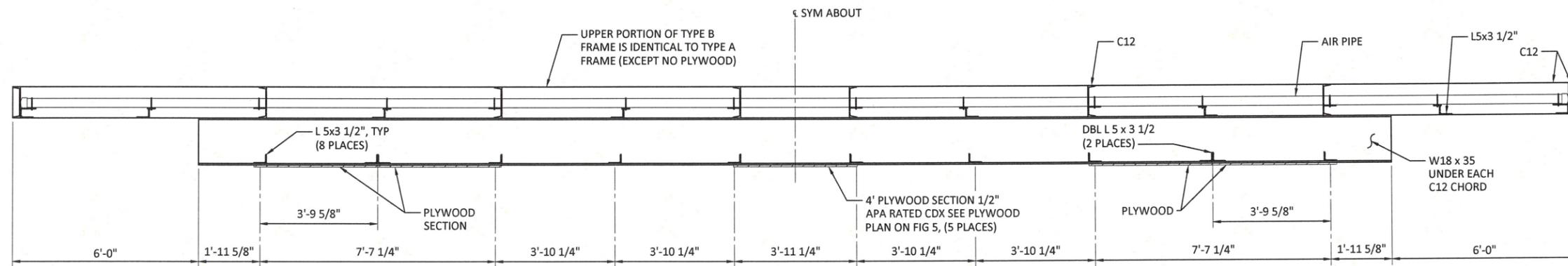
DRAWN BY MDB  
DESIGN BY MGW  
CHECK BY EWO  
PROJ MGR MGW

**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
**FRAME DETAILS**

DRAWING NO. **FIG-3**  
PROJECT NO. A15.0136.00  
DATE: 2/9/15  
SHEET NO. 3 OF 7



**A**  
SECTION - TYPE A  
FIG-2 SCALE: 1/2"=1'-0"



**B**  
SECTION - TYPE B  
FIG-2 SCALE: 1/2"=1'-0"



MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

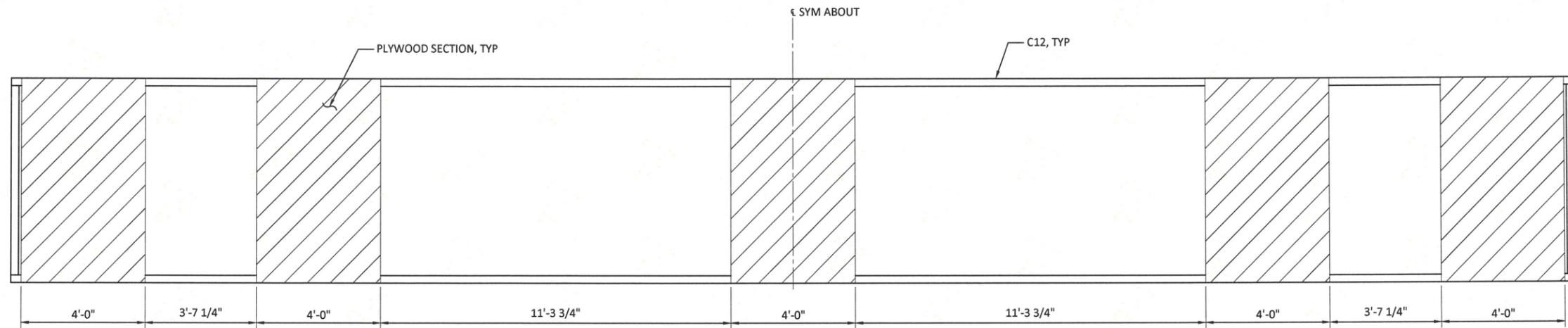
**KIEWIT/MANSON, AJV**

REGISTERED PROFESSIONAL ENGINEER  
MICHAEL G. WILSON  
NO. 45350  
EXP. 12-31-16  
CIVIL  
STATE OF CALIFORNIA

DRAWN BY MDB  
DESIGN BY MGW  
CHECK BY EWO  
PROJ MGR MGW

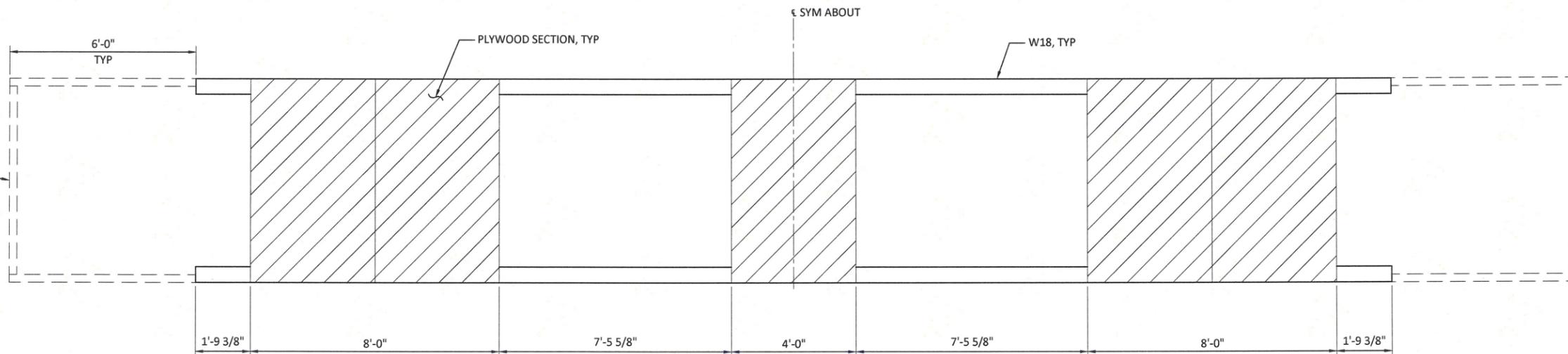
**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
**FRAME DETAILS**

DRAWING NO. **FIG-4**  
PROJECT NO. A15.0136.00  
DATE: 2/9/15  
SHEET NO. 4 OF 7



**PLYWOOD PLAN - FRAME TYPE A (NO STAND OFF)**  
SCALE: 1/2"=1'-0"

NOTE:  
AERATION FRAME MEMBER  
NOT SHOWN FOR CLARITY



**PLYWOOD PLAN - FRAME TYPE B (W/W18 STAND OFFS)**  
SCALE: 1/2"=1'-0"

NOTE:  
INTERNAL AERATION FRAME  
MEMBERS NOT SHOWN FOR  
CLARITY



MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

**KIEWIT/MANSON, AJV**

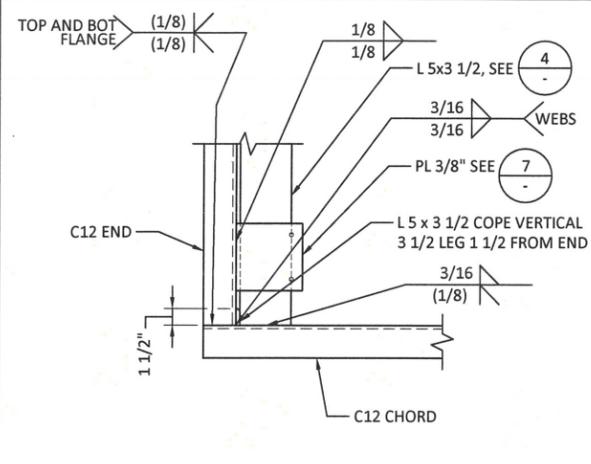
2-9-15

REGISTERED PROFESSIONAL ENGINEER  
MICHAEL G. WIPACER  
NO. 46339  
EXP. 12-31-16  
CIVIL  
STATE OF CALIFORNIA

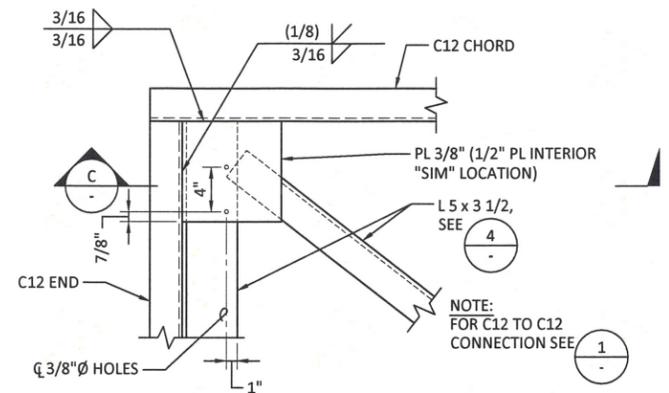
DRAWN BY MDB  
DESIGN BY MGW  
CHECK BY EWO  
PROJ MGR MGW

**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
**FRAME DETAILS**

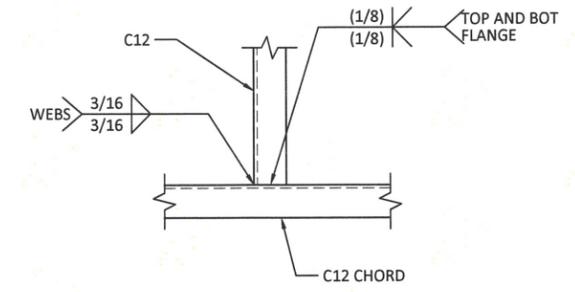
DRAWING NO. **FIG-5**  
PROJECT NO. A15.0136.00  
DATE: 2/9/15  
SHEET NO. 5 OF 7



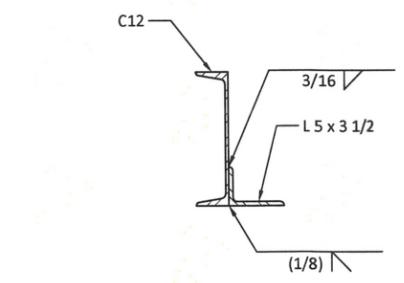
1  
FIG-2 DETAIL - CORNER C12 TO C12  
SCALE: 1 1/2"=1'-0"



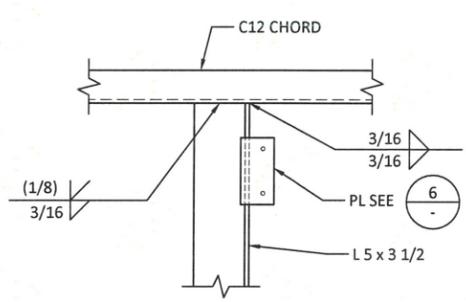
2  
FIG-2 DETAIL - CORNER L 5 x 3 1/2 TO C12  
SCALE: 1 1/2"=1'-0"



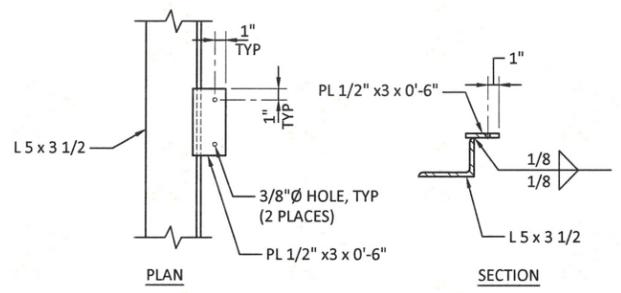
3  
FIG-2 DETAIL - MID SPAN C12 TO C12  
SCALE: 1 1/2"=1'-0"



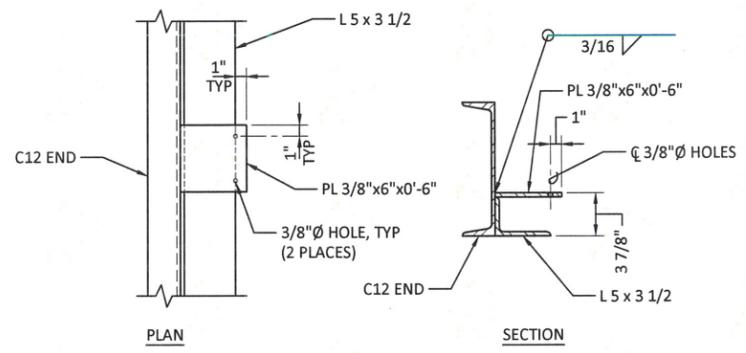
4  
FIG-2 DETAIL - END L 5 x 3 1/2 TO C12  
SCALE: 1 1/2"=1'-0"



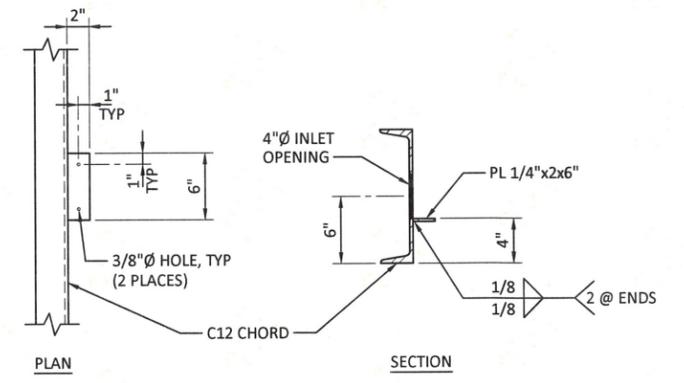
5  
FIG-2 DETAIL - MID L 5 x 3 1/2 TO C12  
SCALE: 1 1/2"=1'-0"



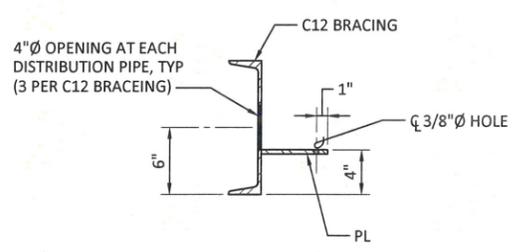
6  
FIG-2 DETAIL - C4 BRACING @ C4  
SCALE: 1 1/2"=1'-0"



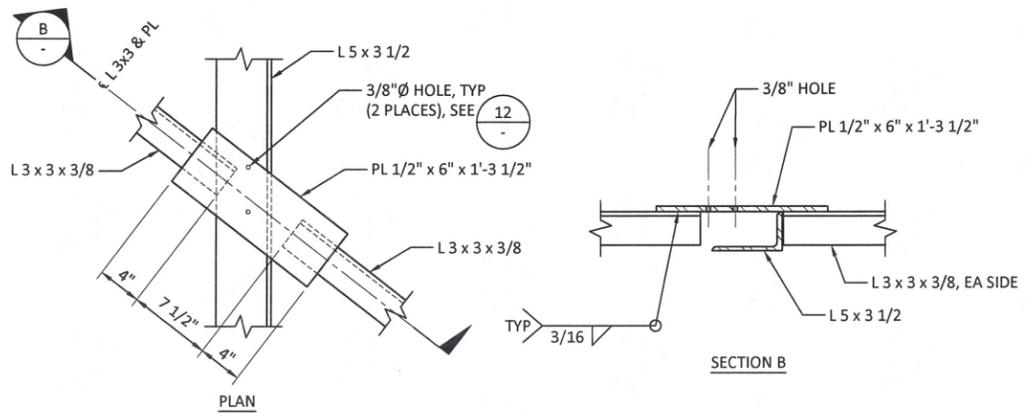
7  
FIG-2 DETAIL - PLATE TO END C12  
SCALE: 1 1/2"=1'-0"



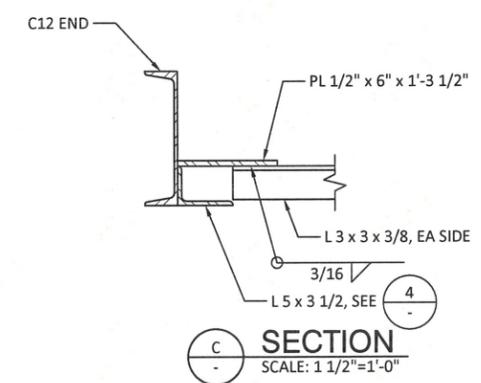
8  
FIG-2 DETAIL - PLATE TO C12  
SCALE: 1 1/2"=1'-0"



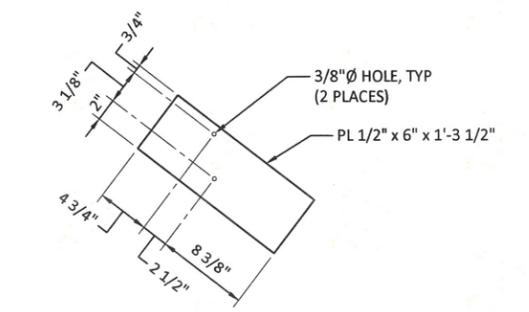
A  
FIG-2 SECTION - C12  
SCALE: 1 1/2"=1'-0"



10  
FIG-2 DETAIL - DIAGONAL MID SPAN CONNECTION  
SCALE: 1 1/2"=1'-0"



C  
SECTION  
SCALE: 1 1/2"=1'-0"



12  
SCALE: 1 1/2"=1'-0"



MARK	REVISION DESCRIPTION	BY	APP.	DATE

**BergerABAM**  
33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

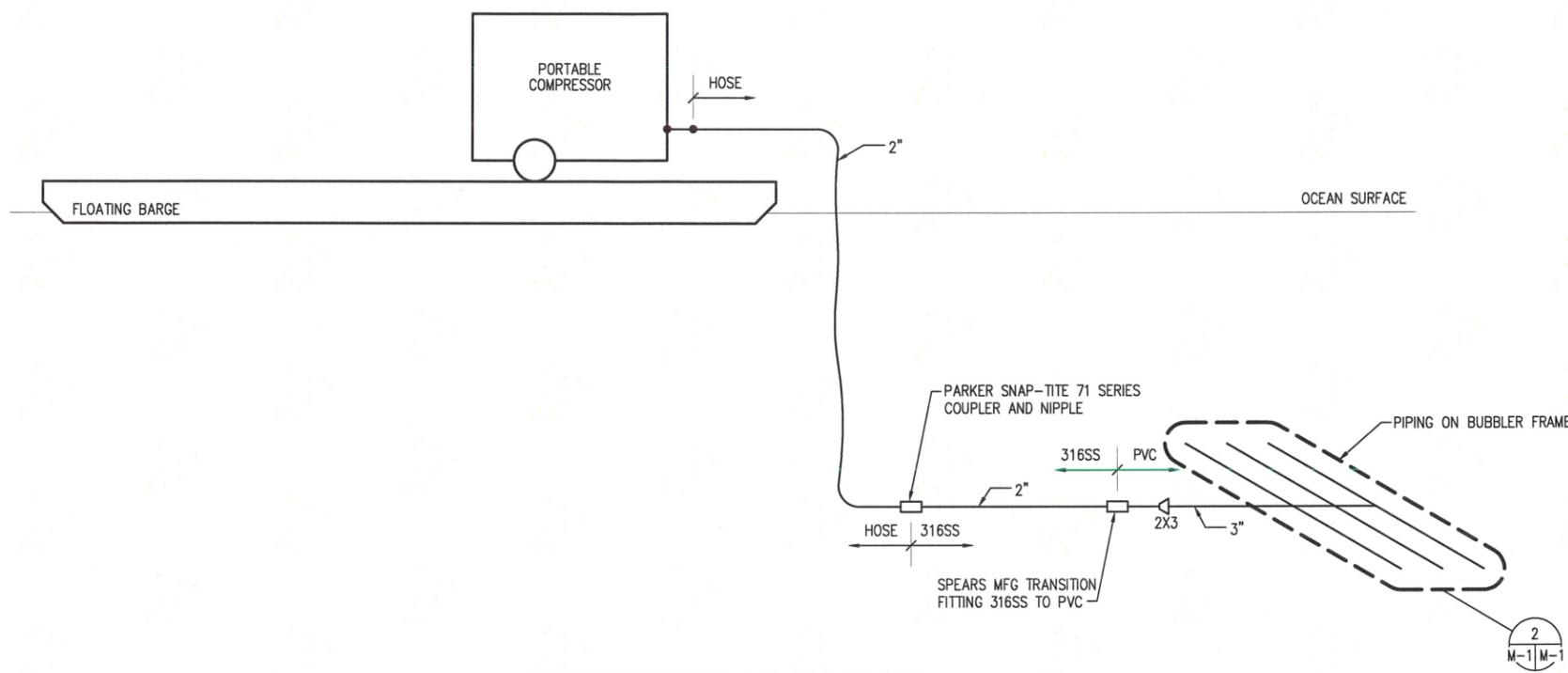
**KIEWIT/MANSON, AJV**

REGISTERED PROFESSIONAL ENGINEER  
MICHAEL G. WIRLEY  
NO. 46359  
EX. 12-31-16  
CIVIL  
STATE OF CALIFORNIA

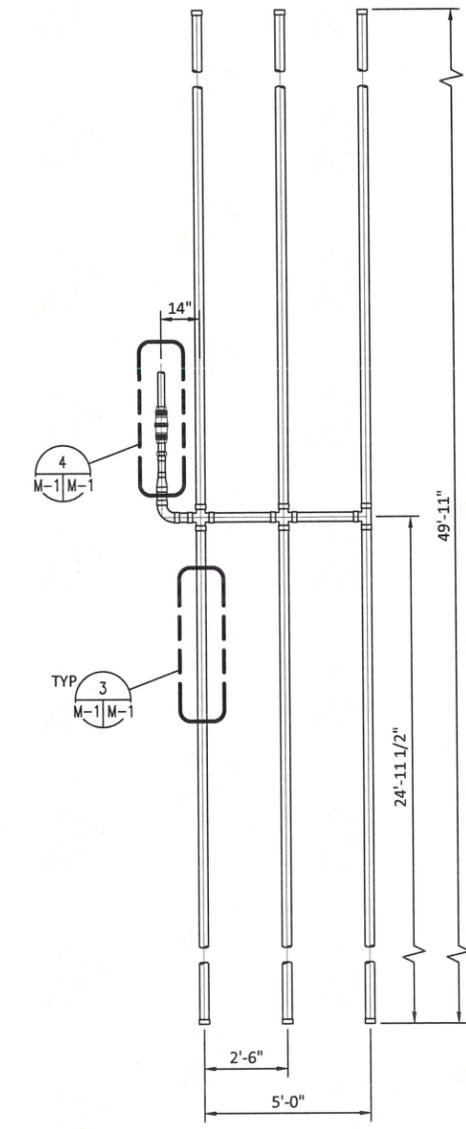
DRAWN BY MDB  
DESIGN BY MGW  
CHECK BY EWO  
PROJ MGR MGW

**KIEWIT/MANSON**  
**SFOBB EAST SPAN DISMANTLING PROJECT**  
**BUBBLE CURTAIN DESIGN**  
  
FRAME DETAILS

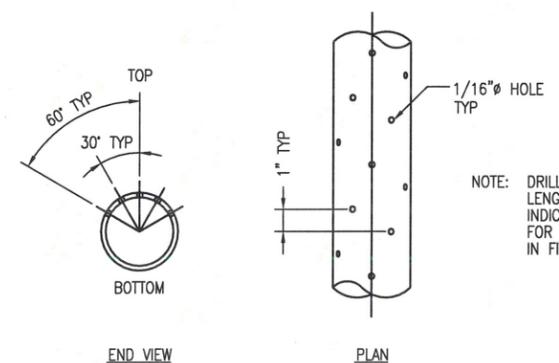
DRAWING NO. **FIG-6**  
PROJECT NO. A15.0136.00  
DATE: 2/9/15  
SHEET NO. 6 OF 7



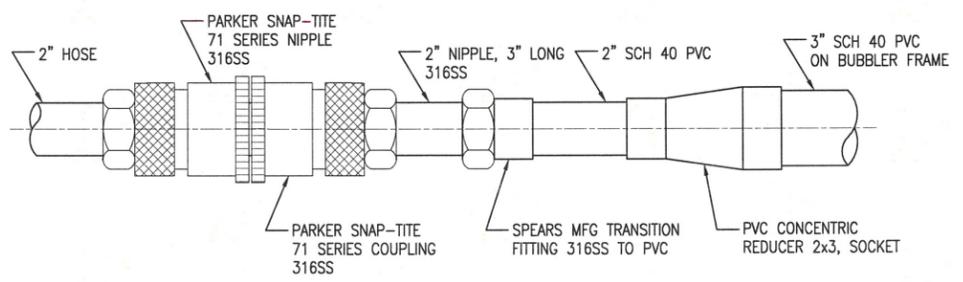
COMPRESSED AIR DIAGRAM



AIR BUBBLER PIPING ENLARGED PLAN



BUBBLER HOLE LOCATION DETAIL



AIR BUBBLER PIPING CONNECTION DETAIL

Last Saved by: Cpeck on: Feb 9, 2015 3:50 PM File: G:\2014\1414073\00\DWG\MW-M-1.dwg

MARK	REVISION DESCRIPTION	BY	APP.	DATE

33301 9th Avenue South, Suite 300  
Federal Way, Washington 98003-2600  
(206) 431-2300 Fax: (206) 431-2250

KIEWIT/MANSON, A JV

DRAWN BY TJB  
DESIGN BY TJB  
CHECK BY CEL  
PROJ MGR CEL

KIEWIT/MANSON  
SFOBB EAST SPAN DISMANTLING PROJECT  
BUBBLE CURTAIN DESIGN  
AIR BUBBLER PIPING DIAGRAM AND DETAILS

DRAWING NO. M-1  
PROJECT NO. A15.0136.00  
DATE: 2/9/2015  
SHEET NO. 7 of 7

## **APPENDIX C: Alternatives Analysis**



**Garcia and Associates**  
**1512 Franklin Street,**  
**Oakland, CA 94612**  
**Phone: (510) 891-0024 Fax: (510) 891-0027**

---

**To:** Mr. Stefan Galvez (SFOBB Environmental Compliance Manager)  
**From:** Alex Pries  
**Date:** January 30, 2015  
**RE: SFOBB East Span Seismic Safety Project (SFOBB Project) Marine Mammal Impacts from Pier E3 Cofferdam Installation**

Removal of the marine foundations of the original east span of the San Francisco-Oakland Bay Bridge (SFOBB) is required as part of regulatory requirements for the SFOBB East Span Seismic Safety Project (SFOBB Project). Due to the schedule, cost, and environmental benefits when compared to mechanical demolition, the California Department of Transportation (Department) has proposed controlled implosion as the preferred alternative methodology of removal. Potential impacts to biological resources by the proposed demolition were previously presented in a biological evaluation. Up to a total of 22 marine foundations of the original east span may be removed to meet regulatory requirements. Three of these piers, E3 – E5, are deep-water caissons that require more complex methods for their removal.

The purpose of this memorandum is to present the evaluation of methodology and potential impacts to marine mammals from removal of Pier E3, the deepest marine foundation of the SFOBB, by means of installing a cofferdam around the structure prior to mechanical dismantling via ram hoe or saw cutting. This method is evaluated as an alternative to the preferred method of removing Pier E3 through controlled implosion.

*Description of the Alternative to the Proposed Action:*

For the purpose of analysis, the Department has prepared a conceptual plan for dismantling the concrete caisson supporting Pier E3, which is located approximately 1,535 feet (468 meters) east of Yerba Buena Island (YBI) in San Francisco Bay. Prior to demolition of this marine foundation, the Department would complete the removal of the above-water bridge superstructure, including the original cantilever span, truss, truss span, and supporting tower on Pier E3. Removal of the marine foundation via mechanical dismantling methods would require installation of a cofferdam, dewatering activities, and use of conventional equipment (i.e., ram

hoe or wire saw) to break the pier into smaller pieces for disposal.

Impacts to marine mammals from the proposed action would largely come from the marine propagation of impulse sound associated with the impact driving of piling to support and build the cofferdam. Exposure to impulse sound can result in short-term hearing loss (i.e., temporary threshold shift [TTS]), permanent hearing loss (i.e., permanent threshold shift [PTS]), and a variety of physical injuries up to mortality. Once installed, the area inside the cofferdam would be dewatered and the sound associated with mechanical dismantling is expected to be negligible in the marine environment. Thus, any impacts to marine mammals or their habitat from dismantling activities would be minimal. Impacts to marine mammals and their habitat from the sound associated with pile driving during cofferdam installation will be the key focus of this analysis. The use of vibratory methods to install piles is preferred and believed to have lesser impacts to marine mammals than impact pile driving methods. Vibratory installation of piles works well in soft sediments, but can be difficult if rocks, debris, or harder sediment layers impede installation of the pile. Additionally, for the Pier E3 cofferdam, obtaining a secure final elevation for the larger piles will be particularly critical to ensure the cofferdam's structural stability for holding back Bay waters and to create a safe working environment. As a result, Department engineers concluded for this analysis that the large diameter piles (e.g., 54" bulkhead pile and king pile) would require impact driving, and not vibratory methods, to obtain final, secure pile depth.

Installation of the Pier E3 cofferdam is anticipated to require the following pile array:

- Thirty six (36) 54" diameter 150 foot long bulkhead pipe piles [to prevent vessel impacts from breaching the cofferdam];
- One-hundred seventy (170) 145 foot long king or H-piles [HZM 1180M-D];
- Eighteen (18) 24" diameter 85 foot long support pipe piles;
- One-hundred seventy (170) 145 foot long sheet piles [AZ 26-700]

For the purpose of this analysis, installation of the above materials to a final elevation of approximately 57 feet below mudline (-114 feet 1929 NGVD) are as follows:

- All 36 bulkhead piles (54" diameter) would be impact driven with an attenuation system (i.e., bubble curtain) installed around the pile. An estimated 1,425 total strikes per pile would be required to reach final elevation. The anticipated impact hammer would be a Delmag D-100 with hammer energies between 214-360 kilojoules (kJ) per strike.
- All 170 king (H) piles would be impact driven with an attenuation system installed around the pile. An estimated 4,800 total strikes per pile would be required to reach final elevation. The anticipated hammer would be a Delmag D-100 with hammer energies between 214-360 kilojoules (kJ) per strike.
- All 18 support pipe piles (24" diameter) would be installed using a vibratory hammer, and then pile proofed to confirm elevation and stability. Pile proofing would involve a maximum of 20 strikes per pile using unattenuated impact driving. However, the use of an attenuation system is not practical given the amount of time required to set up

the system for a small number of strikes. The anticipated hammer for pile proofing of the support piles would be a Delmag 80 with hammer energies between 171-288 kJ per strike.

- All sheet piles (170 total) would be installed using a vibratory hammer, and one half (85 total) also would be proofed to confirm elevation and stability. As with the support piles, sheet pile proofing would involve a maximum of 20 strikes per sheet pile using unattenuated impact driving. The anticipated hammer for sheet pile proofing and unattenuated impact driving of sheet piles would be a Delmag D-46 with hammer energies between 71-166 kJ per strike.

*Existing Guidance on SFOBB Pile-Driving Activities:*

On December 18, 2013, the National Marine Fisheries Service (NMFS) issued an Incidental Harassment Authorization (IHA) to the Department for impacts to marine mammals from pile-driving activities associated with the SFOBB Project. The IHA distinguishes harassment into Levels A and B. Level A Harassment includes PTS, physical injury, or mortality. Level B Harassment is subdivided into Level B Behavioral Harassment, which may elicit a behavioral response from a marine mammal and Level B TTS Harassment. This document provided NMFS' guidance on the allowed amount of incidental exposure to Level B Behavioral Harassment for marine mammals from the SFOBB Project (Table 1). In addition, the IHA identifies temporary exclusion zones and Level B Behavioral harassment zones associated with Project pile-driving activities. Temporary exclusion zones are areas where individuals might be subject to Level B TTS Harassment and Level A Harassment during pile-driving activities. No pile driving is permitted to begin if a marine mammal is present in the temporary exclusion zone before activities begin. Pile-driving activities may occur when individual marine mammals are present in the Level B Behavioral Harassment zone. These zones are presented in Table 2, and include:

- Exclusion zones [Level B Harassment (TTS) or Level A Harassment (PTS or greater harm)] where sound pressure levels exceed 180 dB RMS (cetaceans) and 190 dB RMS (pinnipeds);
- A Level B Behavioral Harassment zone for impact pile driving noise level of equal to or greater than 160 dB RMS, and for vibratory pile driving noise level equal to or greater than 120 dB RMS.

Prior hydroacoustic monitoring of the area around the SFOBB has indicated that ambient noise levels often are greater than 120 dB, the level cited above for the onset of behavioral changes in marine mammals from vibratory pile driving. This portion of the Bay is a busy area with marine vessels transiting through the area on their way to the Port of Oakland. Because of this, it can be difficult to measure the distance to 120 dB RMS in the field. As a result, NMFS has established a distance of 2,000 meters from pile driving as the exposure area for Level B Behavioral Harassment from vibratory pile driving. This distance is assumed as the point where noise levels reach their baseline, or ambient, Bay conditions.

**Table 1.** Species and number of marine mammals allowed exposure (or ‘take’) to Level B Behavioral Harassment under the 2014 IHA for pile-driving activities.

Species	Take Allowed
Pacific harbor seal	50
California sea lion	10
Harbor porpoise	10
Gray whale	5

**Table 2.** Temporary Exclusion Zones [Level B (TTS) and Level A (PTS or greater harm) Harassment] and Level B Behavioral Harassment Zones for SFOBB pile-driving activities from 2014 IHA.

Pile Driving Activity	Pile Size	Level B Behavioral Harassment Zone		Temporary Exclusion Zone [Level B (TTS) and Level A (PTS or greater harm) Harassment]	
		Distance to 120 dB RMS (m) <sup>1</sup>	Distance to 160 dB RMS (m) <sup>2</sup>	Distance to 180 dB RMS (m) <sup>2</sup> (cetaceans)	Distance to 190 dB RMS (m) <sup>2</sup> (pinnipeds)
Vibratory Driving	24"	2,000	NA	NA	NA
	36"	2,000	NA	NA	NA
	Sheet pile	2,000	NA	NA	NA
Attenuated Impact Driving	24"	NA	1,000	235	95
	36"	NA	1,000	235	95
Unattenuated Pile Proofing	24"	NA	1,000	235	95
	36"	NA	1,000	235	95
Unattenuated Impact Driving	H-Pile	NA	1,000	235	95

<sup>1</sup> Threshold only applies to vibratory pile driving.

<sup>2</sup> Threshold only applies to impact pile driving.

Under the 2014 IHA, marine mammal observers are required to monitor areas around SFOBB prior to the initiation of pile driving activities. If individual marine mammals are within the identified temporary exclusion zones (180 dB or 190 dB RMS), pile driving activities will be delayed until the individual leaves the area. If an individual enters the 180 or 190 dB RMS exclusion zone after the commencement of pile driving, the Department is required to notify NMFS within 24 hours.

**Hydroacoustic Analysis of Pier E3 Cofferdam (under current regulations)**

A calculation of the distance to temporary exclusion (Level B [TTS] or Level A Harassment) zones and Level B Behavioral Harassment zones for installation of the Pier E3 cofferdam is presented below based on hydroacoustic analyses completed by Illingworth & Rodkin. Data

from the *Compendium of Pile Driving Sound Data* were used to establish the baseline source levels. The average RMS levels recorded for several projects were used to predict potential sound levels for the Pier E3 cofferdam installation. For installation of the 24” support pipe piles, data from the Amorco Wharf repair in San Francisco Bay, Tongue Point dock repair on the Columbia River in Oregon, Rodeo Dock repair in San Francisco Bay, Schuyler Heim Bridge replacement project in the Port of Long Beach, the Northern Rail project in Alaska, and the retrofit of the Richmond-San Rafael Bridge in San Francisco Bay were considered. For the 54” bulkhead pipe piles, data from the driving of 48” piles for the SFOBB Project were used exclusively. Distances were calculated for one impacted pile per day un-attenuated and attenuated with the assumption of 25 strikes per foot (1,425 total strikes per pile) for each pile type during impact driving. The maximum of 20 strikes per pile was assumed for unattenuated pile proofing of sheet piles and 24” support piles. Table 3 summarizes the distance to Temporary Exclusion and Level B Behavioral Harassment zones per pile activity for the Pier E3 cofferdam, under adherence to current SFOBB Project pile-driving regulations.

**Table 3.** Modeled Temporary Exclusion and Level B Behavioral Harassment Zones for the Pier E3 cofferdam.

Pile Driving Activity	Pile Size	Level B Behavioral Harassment Zone		Temporary Exclusion Zone (Level B [TTS] and Level A [PTS or greater harm] Harassment)	
		Distance to 120 dB RMS (m) <sup>1</sup>	Distance to 160 dB RMS (m) <sup>2</sup>	Distance to 180 dB RMS (m) <sup>2</sup> (cetaceans)	Distance to 190 dB RMS (m) <sup>2</sup> (pinnipeds)
Vibratory Driving	24”	2,000	--	--	--
	Sheet Pile	2,000	--	--	--
Attenuated Impact Driving	54”	--	338	23	6
	King Pile	--	225	15	4
Unattenuated Pile Proofing	24”	--	582	39	10
	Sheet Pile	--	508	34	9

<sup>1</sup> Threshold only applies to vibratory pile driving.

<sup>2</sup> Threshold only applies to impact pile driving.

## SUMMARY

In summary, the total area subject to Level B Behavioral Harassment of marine mammals is much larger for the cofferdam installation scenario, largely due to the increased time required to install the piles than for the controlled implosion scenario. The cumulative area exposed to Level B (TTS) or Level A (PTS or greater harm) Harassment of marine mammals is higher for the one-day controlled implosion (109 acres) when compared at the 190 dB RMS threshold for pinnipeds (9.3 acres) during cofferdam installation. However, for cetaceans (the 180 dB RMS threshold), cumulative exposure during pile driving would be approximately one and a half times the area of the controlled implosion scenario (147 acres versus 109 acres). The actual risk of Level A Harassment exposure to individual marine mammals from either demolition method is unlikely

given the implementation of exclusion zones and monitoring. Exposure to Level B (TTS) Harassment of three harbor seals may occur from the controlled implosion. In contrast, the increased time (months to years) required to install the cofferdam, along with historical monitoring data, suggest there is a potential for equal, or greater, TTS exposure under this method. This could occur even with effective monitoring, because current regulations allow for continued pile driving if an individual enters the exclusion zone after work has commenced

The proposed installation of a Pier E3 cofferdam under adherence to current SFOBB Project IHA pile-driving regulations for marine mammals is achievable. The modeled distances for impact and vibratory driving of the piles required for the cofferdam are well within the accepted distances as defined in the Project's current IHA. However, the time and duration required to install all piles for the cofferdam also would increase the potential for individual exposure. With a total of 394 piles proposed for the Pier E3 cofferdam and more restrictive regulations on daily sound exposure from pile driving under the 2012 NMFS Biological Opinion (BO) for marine fish, pile driving for the cofferdam likely would occur for months to years. This increased duration for pile driving may increase the potential risk for individual exposure to harassment.

While marine mammal monitoring during pile driving for the E3 cofferdam may result in no exposures greater than behavioral harassment, the installation of piles for the cofferdam likely will result in a similar outcome as the controlled implosion (e.g., some TTS exposure). This is because the increased duration of pile driving actions (months/years) when compared to the controlled implosion (seconds) may increase the probability of exposing an individual to TTS. Since 2001, a total of 19 harbor seals and 3 California sea lions have been observed, during 210 days of monitoring for the SFOBB Project, entering the Level B (TTS) Harassment Zone after pile driving activities began. These numbers suggest there is about a 10% chance of encountering a harbor seal daily inside the Level B (TTS) Harassment Zone while pile driving. For California sea lions, this chance is about 1.5%. Using these values and an assumption of pile-driving for the cofferdam requiring 394 days (i.e., one pile per day), potential TTS exposure could occur to 39 harbor seals and six California sea lions.

In contrast, the current blast plan would remove Pier E3 down to mudline and the detonation sequence would last for approximately **5 to 6** seconds. On-site work in advance of the implosion would likely take months, but is anticipated to result in negligible disturbance to the marine environment when compared to the hydroacoustic impacts associated with pile driving. In late 2013, NMFS developed new regulatory thresholds for marine mammals subject to underwater blasting. The new thresholds use Sound Exposure Level (SEL) and peak pressure (in dB) thresholds to establish areas of potential behavioral harassment, Level A harassment, or Level B harassment for marine mammals. The new thresholds establish different threshold criteria for underwater explosions compared to pile driving. This makes comparisons to the same sound exposure threshold difficult. However, the difference in the area of exposure for a threshold at which an effect may occur remains a valid comparison. As a result, comparison of the total acres affected over time for the exclusion zone thresholds for cofferdam construction is compared to the total acres affected over time for exclusion zone thresholds for the controlled implosion.

Hydroacoustic analysis of the Pier E3 implosion using the revised (2013) thresholds indicates the largest distance to the Level B Behavioral Harassment zone would be 13,564 meters (44,500

feet) for harbor porpoise (the most acoustically sensitive species). The distance to Level B (TTS) Harassment Zone for harbor porpoise was modeled at 8,077 meters (26,500 feet). However, the likelihood of this species occurring within the Bay during the implosion is very low and the species has not been detected within the project area during 210 days of marine mammal monitoring to date. However, real-time acoustic monitoring for harbor porpoises will be proposed in advance and during the implosion to ensure this species is not in the immediate area. For the species expected to be present around Pier E3 (i.e., harbor seal, California sea lion, and Northern elephant sea), the modeled distance to the Level B Behavioral Harassment zone was 2,957 meters (9,700 feet). The distance to the Level B (TTS) Harassment zone was 1,737 meters (5,700 feet), which does include known foraging areas for harbor seals at YBI, Clipper Cove, and southeast of YBI. The distance to the Level A (PTS or greater harm) Harassment zone, which reflects the implosion's marine mammal exclusion zone, for these species is 354 meters (1,160 feet). This distance could be effectively monitored under the existing marine mammal monitoring plan for the SFOBB Project. Inclusion of the Level B Behavioral Harassment Zone into the implosion's exclusion zone is not feasible due to the high probability that harbor seals will occupy known foraging areas near YBI and Clipper Cove. Prevention of Level B (TTS) exposure to individual seals within these areas could delay the implosion during a small window of opportunity.

The Pier E3 blast was modeled to potentially result in Level B (TTS) Harassment exposure to three Pacific harbor seals. This assessment is based on historic marine mammal densities in the exposure area and the implosion's duration of 5 to 6 seconds. In addition, six harbor seals, one Northern elephant seal, and one harbor porpoise would potentially be within the implosion's behavioral response zone. Through the implementation of exclusion zones and monitoring, no individuals would be subject to Level A (PTS or greater harm) Harassment.

The duration of potential exposure to marine mammals affected from cofferdam installation can be expressed as the product of the daily amount of acres affected multiplied by the number of days of effect. This value also can be interpreted as the cumulative amount of acres exposed during installation of a Pier E3 cofferdam. Table 4 presents cumulative acre information for marine mammal exposure under the assumption of one pile driven per day plus an estimated exposure to marine mammals from the controlled implosion. In reality, the 2012 BO's more restrictive pile-driving regulations for marine fish would likely limit the amount of pile driving allowed on a daily basis. However, for the sake of this comparative analysis we have ignored this limitation.

**Table 4.** Comparison of Marine Mammal Hydroacoustic Impacts from Pier E3 Cofferdam Installation versus Controlled Implosion

				Level B Behavioral Harassment Zone				Temporary Exclusion Zone (Level B [TTS] and Level A [PTS or greater harm] Harassment)			
Construction Approach	METHOD	Pile Type	Days Required <sup>1</sup>	Acres Affected to 120 dB RMS (Per Pile)	Acres Affected to 120 dB RMS (Total)	Acres Affected to 160 dB RMS (Per Pile)	Acres Affected to 160 dB RMS (Total)	Acres Affected to 180 dB RMS (Per Pile)	Acres Affected to 180 dB RMS (Total)	Acres Affected to 190 dB RMS (Per Pile)	Acres Affected to 190 dB RMS (Total)
Cofferdam Installation	Vibratory <sup>2</sup> Driving	24"	18	3,113	56,034	N/A	N/A	N/A	N/A	N/A	N/A
		Sheet Pile	170	3,113	529,210	N/A	N/A	N/A	N/A	N/A	N/A
	Attenuated Impact Driving	Bulkhead 54"	36	N/A	N/A	88	3,168	0.4	14.4	0.03	1.1
		King Pile	170	N/A	N/A	39	6,630	0.2	34	0.01	1.7
	Unattenuated Pile Proofing	24"	18	N/A	N/A	262	4,716	1.2	22	0.08	1.4
		Sheet Pile	85	N/A	N/A	200	17,000	0.9	76.5	0.06	5.1
	<b>Totals<sup>3</sup></b>	-	<b>497</b>	<b>6,226</b>	<b>585,244</b>	<b>589</b>	<b>31,514</b>	<b>2.7</b>	<b>147</b>	<b>0.18</b>	<b>9.3</b>
				Level B Behavioral Harassment Zone (Total Acres Affected) <sup>4</sup>		Level B (TTS) Harassment Zone (Total Acres Affected) <sup>5</sup>		Temporary Exclusion Zone (Level A [PTS or greater harm] Harassment) (Total Acres Affected) <sup>6</sup>			
Controlled Implosion	Attenuated Implosion	NONE	<b>1</b>	<b>4,401</b>		<b>1,854</b>		<b>109</b>			

<sup>1</sup> Assumption that one pile per day can be driven or vibrated.

<sup>2</sup> Vibratory drilling does not generate enough noise to reach Level B or Level A Harassment

<sup>3</sup> Totals tally Total Acres

<sup>4</sup> Area is calculated to 172 dB SEL Criteria

<sup>5</sup> Area is calculated to 177 dB SEL Criteria

<sup>6</sup> Area is to calculated to 192 dB SEL Criteria