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

PLANS APPROVAL DATE

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

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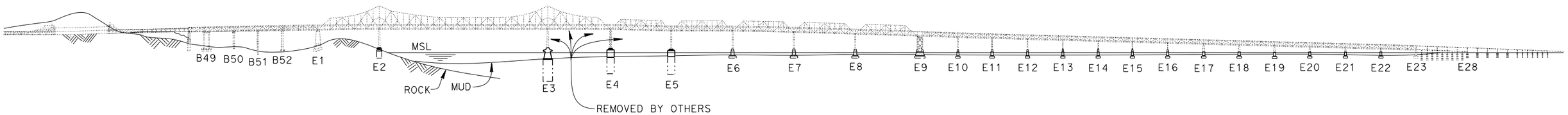
LEGEND:

Indicates existing

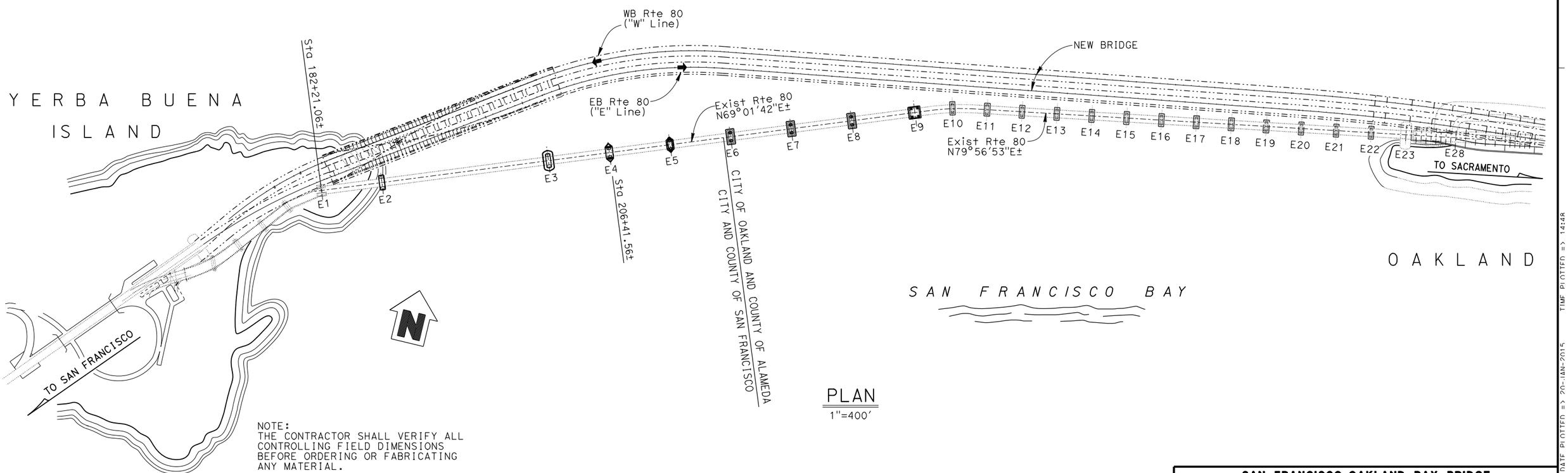
Indicates removal limit (top portion only) 1 foot below mudline (Typ)

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

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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

UNIT: 3593
PROJECT NUMBER & PHASE: 0412000609, 1
CONTRACT NO.: 04-013531

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 01-20-15

SHEET 1 OF 4

SAN FRANCISCO-OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

PIER E3 REMOVAL

GENERAL PLAN

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.09-01-10)

FILE => 33-0025-s-gp.dgn

USERNAME => s134003 DATE PLOTTED => 20-JAN-2015 TIME PLOTTED => 14:48

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

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER NO. EXP. CIVIL STATE OF CALIFORNIA

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GENERAL DEMOLITION NOTES

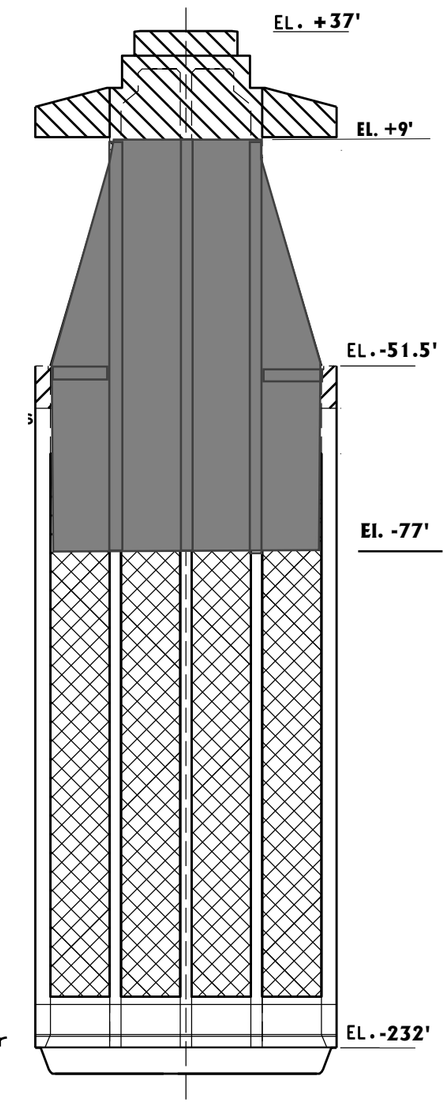
1. **All elevations referenced to NGVD29**

2. **Blast attenuation system will be placed around the pier**

3. **Demolition sequence**

   Mechaically 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

4. **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. .
. SIGN OFF DATE	DETAILS	BY .	CHECKED		POST MILES .
	QUANTITIES	BY .	CHECKED		

SFOBB EAST SPAN DISMANTLING PROJECT

DESIGN DETAIL SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) . SHEET OF .

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

REGISTERED CIVIL ENGINEER X DATE

PLANS APPROVAL DATE

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

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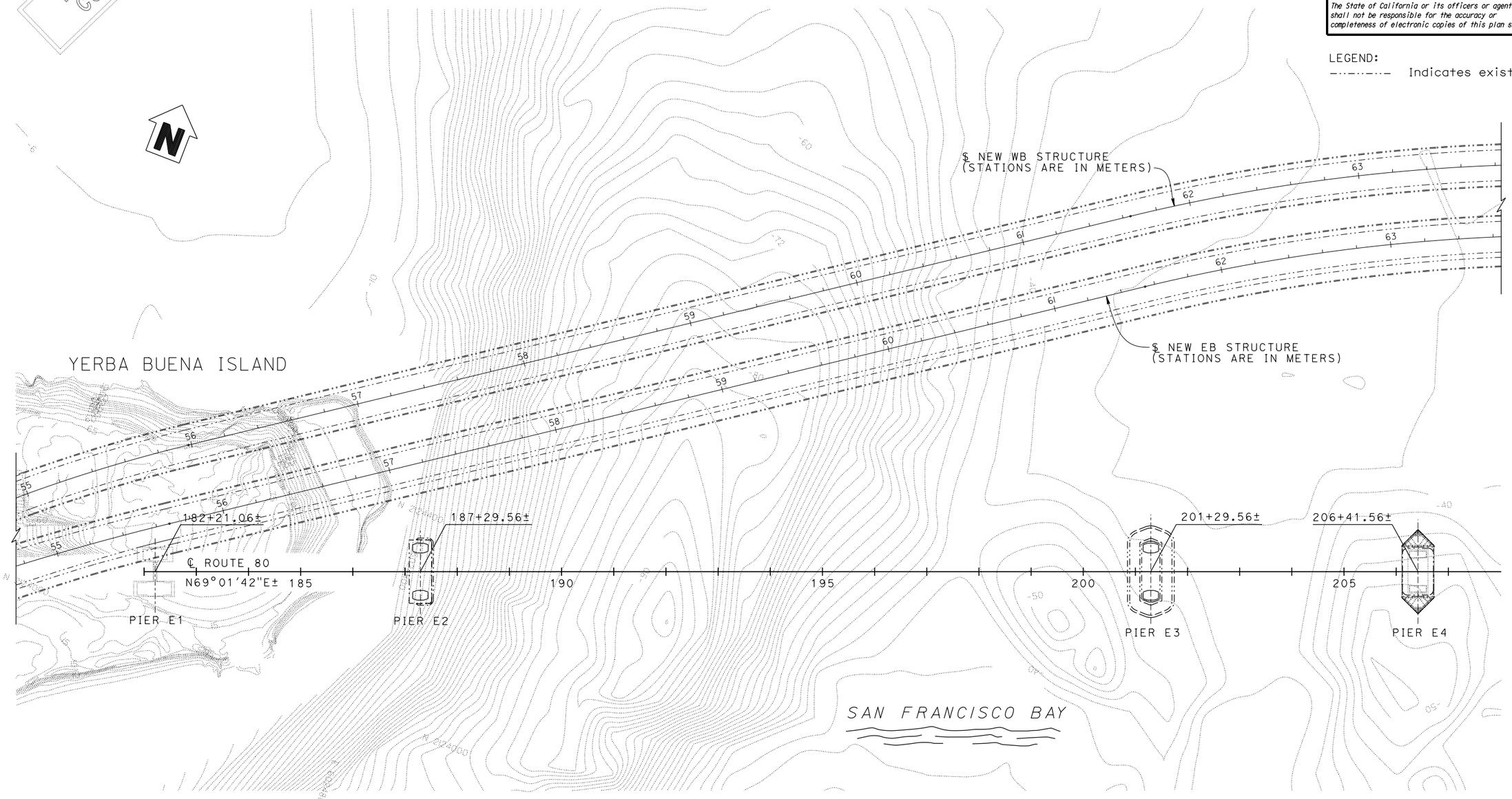

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

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

	BY	CHECKED
DESIGN	Yong Pil Kim	
DETAILS	Carlo Cancino	
QUANTITIES		

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

STRUCTURES DESIGN DETAIL SHEET (ENGLISH) (REV. 09-01-10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3593
PROJECT NUMBER & PHASE: 0412000609, 1
CONTRACT NO.: 04-013531

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 3 OF 4

FILE => 33-0025-u-fp01.dgn

USERNAME => s136057 DATE PLOTTED => 20-JAN-2016 TIME PLOTTED => 14:49

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

REGISTERED CIVIL ENGINEER X DATE

PLANS APPROVAL DATE

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

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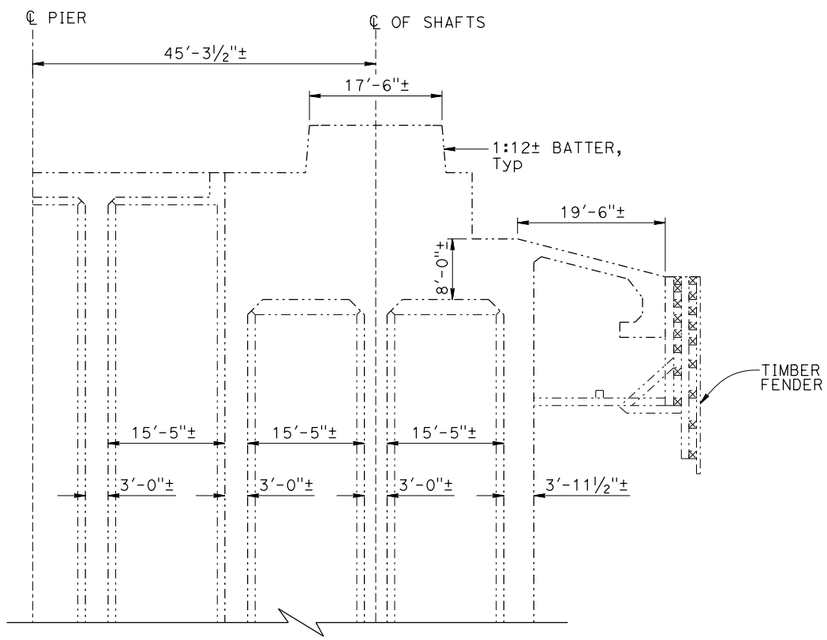
LEGENDS:

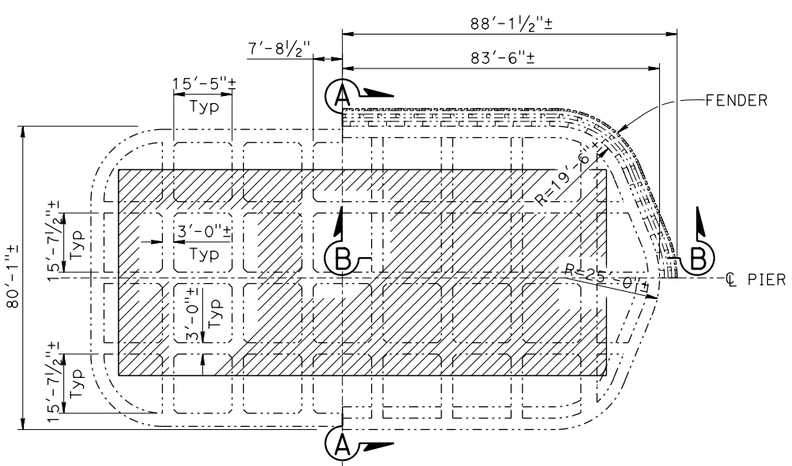
- Indicates existing
- Indicates limits of removal using mechanical means
- Indicates limits of removal using blasting
- Indicates space available for disposal of debris

DRAFT COPY



SECTION B-B

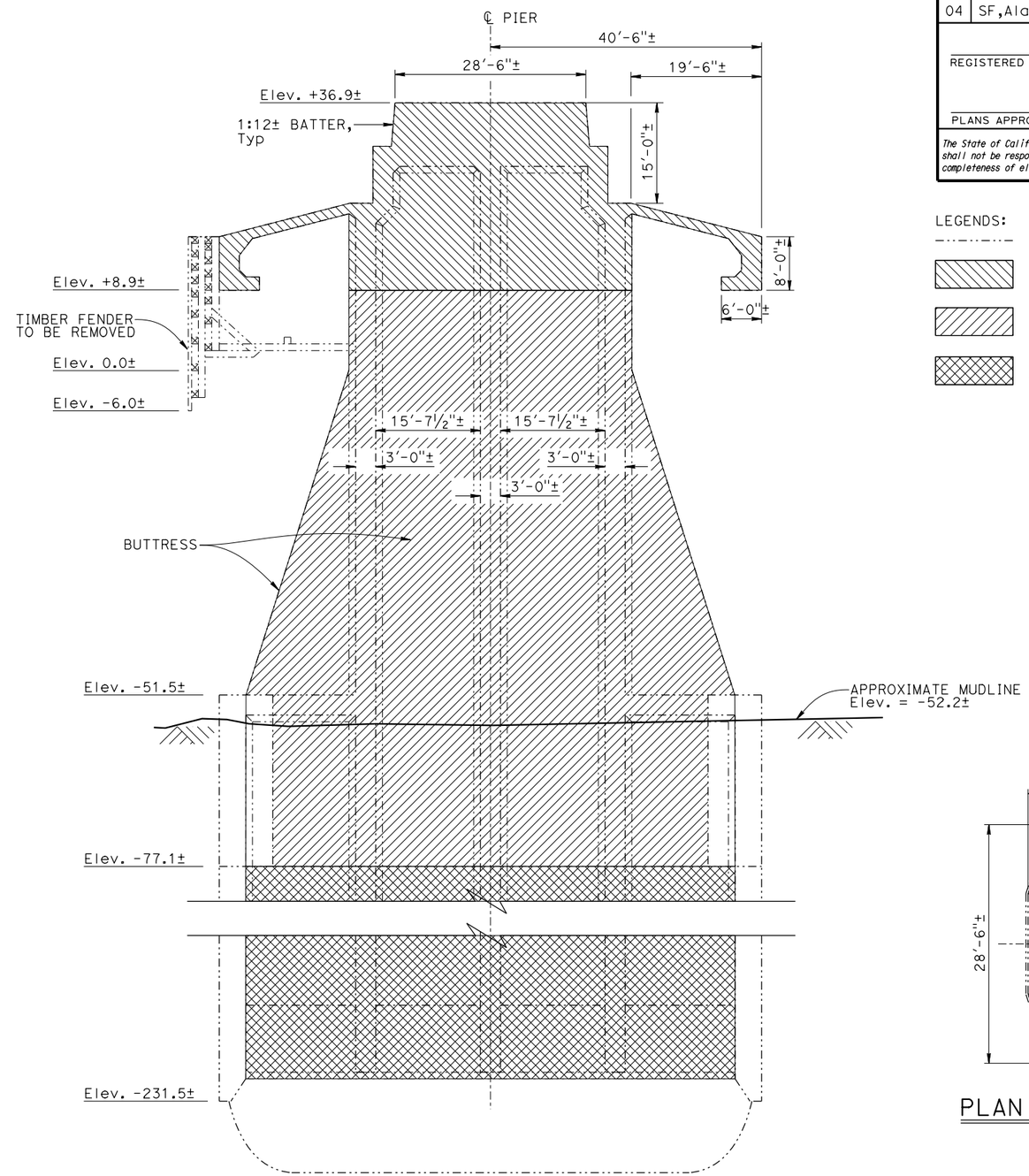
No Scale



½SECTION THRU CAISSON ½SECTION THRU FENDER

PART SECTION

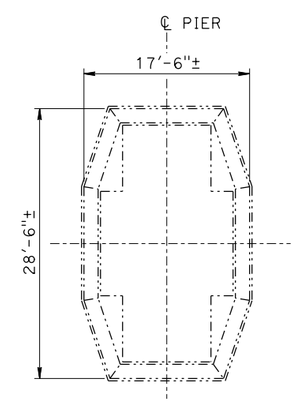
No Scale



DEMOLITION LIMTS

SECTION A-A

No Scale



PLAN - TOP OF PIER

No Scale

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

	BY	CHECKED
DESIGN	Yong Pil Kim	
DETAILS	Carlo Cancino	
QUANTITIES		

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

STRUCTURES DESIGN DETAIL SHEET (ENGLISH) (REV. 09-01-10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3593
PROJECT NUMBER & PHASE: 0412000609, 1 CONTRACT NO.: 04-013531

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 01-20-15

SHEET 4 OF 4

FILE => 33-0025-v-pe3_details.dgn

USERNAME => e174201 DATE PLOTTED => 20-JAN-2014 TIME PLOTTED => 14:49

Pier E3 Blast Design Parameters

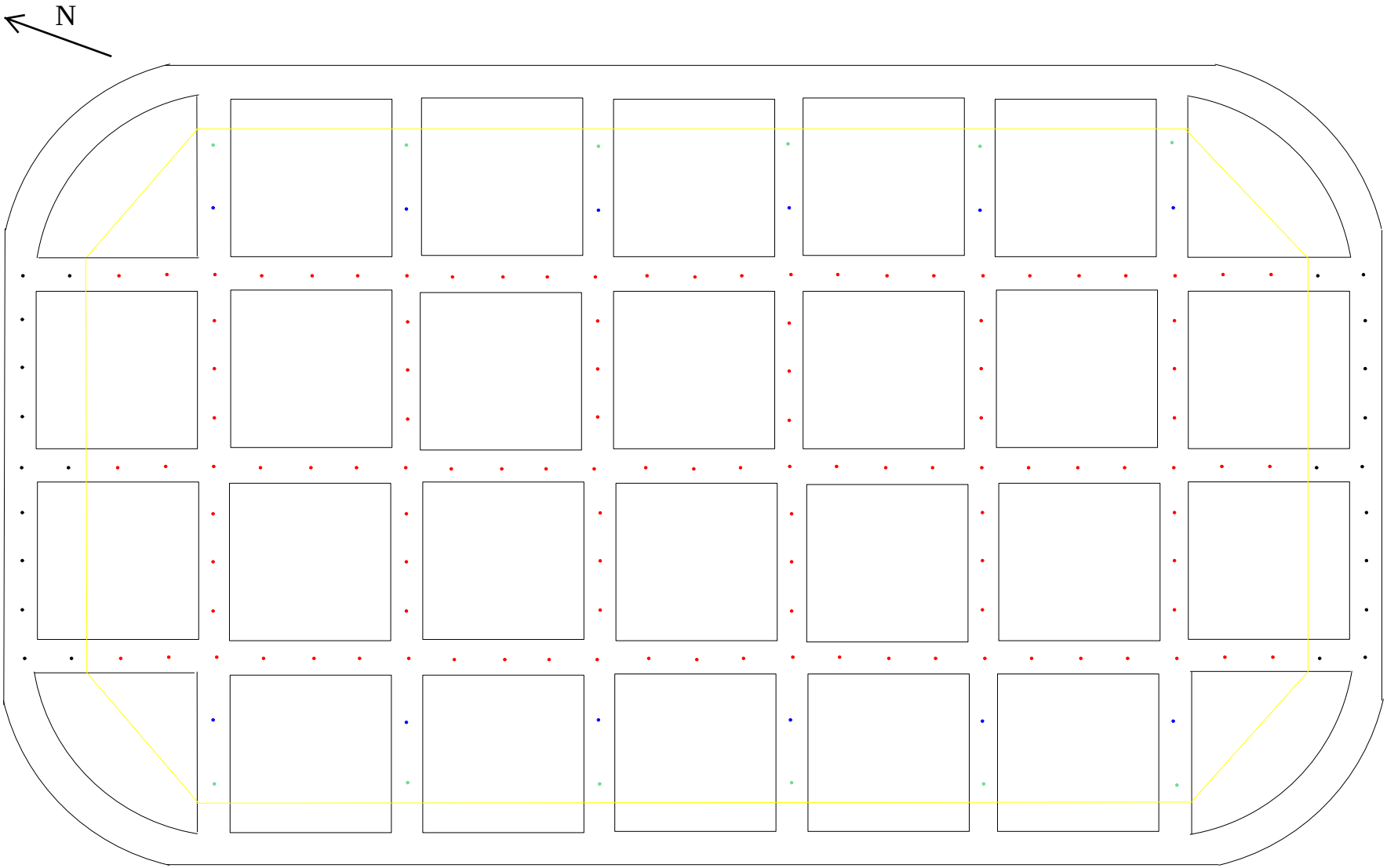
Top of structure to be left at elevation +9 (NGVD29 datum)
Removal limit: elevation -77 (interior walls only)
Hole will be drilled to elevation -55 and -77.
Hole spacing = 4.5'
Total number of holes = 159, 111 @ 86', 36 @ 64', 12 @ 50'
Hole diameter: 86' = 2 ¾ "
64' (N & S end full height walls) = 2 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.

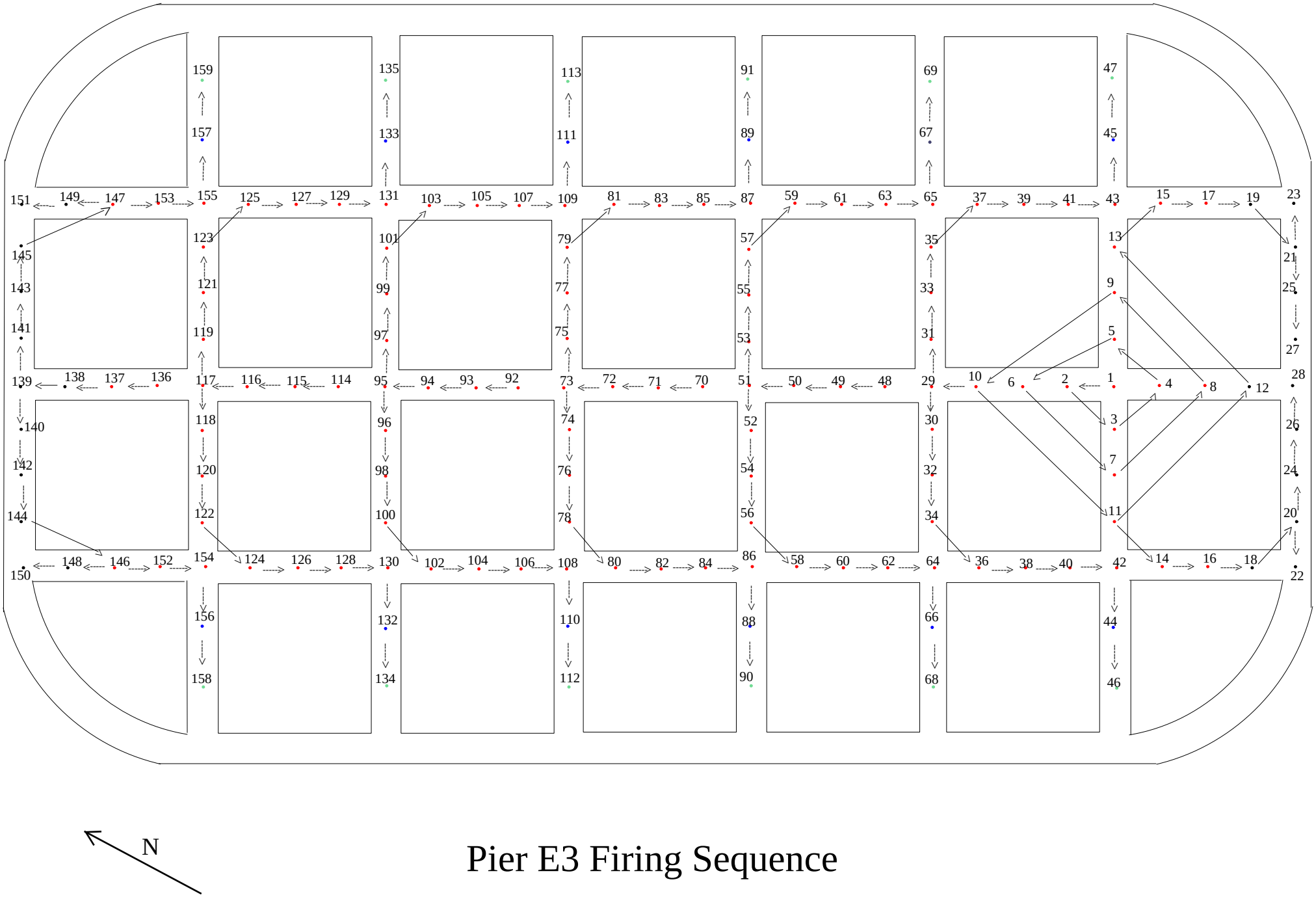
Explosive products will be 1.25"x16", 1.5"x16", 1.75"x16" and 2"x16" Unimax and Dynomax Pro dynamites in cardboard wrapped cartridges.

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



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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
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					4572	4608			
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)

+9'
4' stemming
+5'
4@1.25x16
8@1.5x16
2@2x16
21 lbs, PF=2
-16'
3' stemming
-19'
9@1.75x16
5@2x16
29.6 lbs, PF=2.75
-37'
3' stemming
-40'
14@2x16
35 lbs, PF=3.3
-58'
3' stemming
-61'
12@2x16
30 lbs, PF=3.2
-77'

Total explosives = 115.6 lbs

North and South End Full Height Walls

+9'
4' stemming
+5'
4@1.25x16
8@1.5x16
2@2x16
21 lbs, PF=2
-16'
3' stemming
-19'
8@1.75x16
4@2x16
26 lbs, PF=2.73
-35'
3' stemming
-38'
13@2x16
32.5 lbs, PF=3.2
-55'

Total explosives = 79.5 lbs

Buttress Walls

-13'
5' stemming
-18'
14@2x16
35 lbs, PF=2.7
-37'
3' stemming
-37'
14@2x16
35 lbs, PF=3
-58'
3' stemming
-61'
12@2x16
30 lbs, PF= 2.9
-77'

Total explosives = 100 lbs

-27'
4' stemming
-31'
9@2x16
22.5 lbs, PF=2.5
-43'
3' stemming
-46'
12@2x16
30 lbs, PF=2.9
-55'
3' stemming
-58'
9@2x16
24 lbs, PF=3
-77'

Total explosives = 76.5

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