

8.5 Load Rating – Graving Basins and Finger Piers





PORT OF RICHMOND

Point Potrero Marine Terminal Load Rating Report

Produced for the Port of Richmond
August 19, 2025

Document Verification

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1. Executive Summary

A load rating was developed for the Graving Basin and Finger Pier structures to support the Port in evaluating existing and proposed future uses. The load ratings presented are based on as-built conditions (e.g., no damage condition). At the graving basin structures, the allowable distributed live load, governed by slab bending, is **550 psf**. With load spreading that puts the load directly into the columns, the capacity is approximately 2000 psf. For the finger pier structures, the published load capacity of each pier is **500 psf**, according to the United States Army Corps of Engineers (USACE) Port Series No. 31, 2000. The load rating is summarized in Table 1 and Table 2.

Table 1: Load Rating at Graving Basins

<u>Structural Element / Failure Modes</u>		<u>Allowable Distributed Live Load (psf)</u>
SLAB (Transverse)	BENDING	550
	SHEAR	700
SLAB (Longitudinal)	BENDING	650
	SHEAR	750
SLAB	PUNCHING SHEAR	1100
EDGE BEAM	BENDING	31000
	SHEAR	8000
COLUMN	AXIAL	2300
BEARING / FOUNDATION	BEARING	8000 (dead + live) 10,500 (incl. seismic)
Graving Basin Controlling Load		550

Table 2: Load Rating Summary

<u>STRUCTURE</u>	<u>Allowable Distributed Live Load (psf)</u>	<u>Governed By</u>
Graving Basin	550	Deck Capacity (bending)
Finger Pier	500[†]	--

[†]Per USACE Port Series No. 31 (2000)



2. Introduction

The purpose of this report is to summarize load rating results for the Graving Basin and Finger Pier structures at the Port of Richmond's Point Potrero Marine Terminal (PPMT).



3. Graving Basins

3.1. Assumptions

The following general assumptions were made regarding the load capacity assessment of the graving basin structures:

- Section properties and overall structural configurations were based on the construction drawings and references provided by the Port.
- The member capacity analysis assumes that neither chloride ion-induced corrosion of the reinforcing steel nor concrete degradation have reduced the member capacities from their original design values.
- The unit weight of concrete was taken at 150 pounds per cubic foot (pcf), and the unit weight of asphalt paving was taken at 145 pcf.
- There is 2" thick asphalt overlay.
- Reinforcing steel properties were based on Concrete Reinforcing Steel Institute (CRSI) *Evaluation of Reinforcing Bars in Old Reinforced Concrete Structures*.
- The concrete compressive strength used in the deck capacity calculations is 5,000 psi. The results of concrete coring tests performed in 2012 state a compressive strength of 7,480 psi (5000 psi was used conservatively).
- Concrete properties were based on American Concrete Institute (ACI) 318-41.
- The following load combinations were evaluated based on United Facilities Criteria (UFC) 4-152-01:
 - 1.2 Dead + 1.6 (Uniform Live Load)

The allowable uniform live load was taken from the controlling capacity of the following:

- Deck capacity (including punching shear)
- Edge beam capacity
- Column axial capacity
- Foundation / bearing capacity
 - The bearing capacity is approximately 8,000 psf for dead plus live load and 10,500 psf for load combinations including seismic loading, as documented in the Geotechnical Characterization Report in Section 9.1. This value is well above the uniform live load capacity based on structural capacity; thus, it can be assumed that the capacity of the concrete deck will control.



3.2. Structural Configuration

There are five graving basins; basins 1,3,4 and 5 are 576 feet long, and basin 2 was upgraded circa 1969 and is 748 feet long. All basins are 100 feet wide. The graving basins are delimited by six basin fingers approximately 610-feet-long by 35-feet-wide each. The graving basin structures consist primarily of a base slab at -30-ft MLLW, cast-in-place walls and two working levels above water. The lower level is at the top of the graving basin side walls, elevation +10-ft MLLW. This is referred to as the gallery deck. The upper level is at the grade of the back lands, elevation +18.5 MLLW. The upper deck is referred to as the gallery roof deck. The gallery roof deck is supported by (2) exterior 18" square columns spaced at 6.5 feet on-center (OC) and (2) internal 18" square columns spaced at 13 feet on-center. Fingers 1 and 6 each have a wall on their west and east sides, respectively, instead of exterior columns. An edge beam 24" deep and 18" wide runs longitudinally along the exterior sides of the basin fingers. The gallery roof deck consists of an 8" thick concrete slab with an asphalt overlay topping (approximately 2" thick).

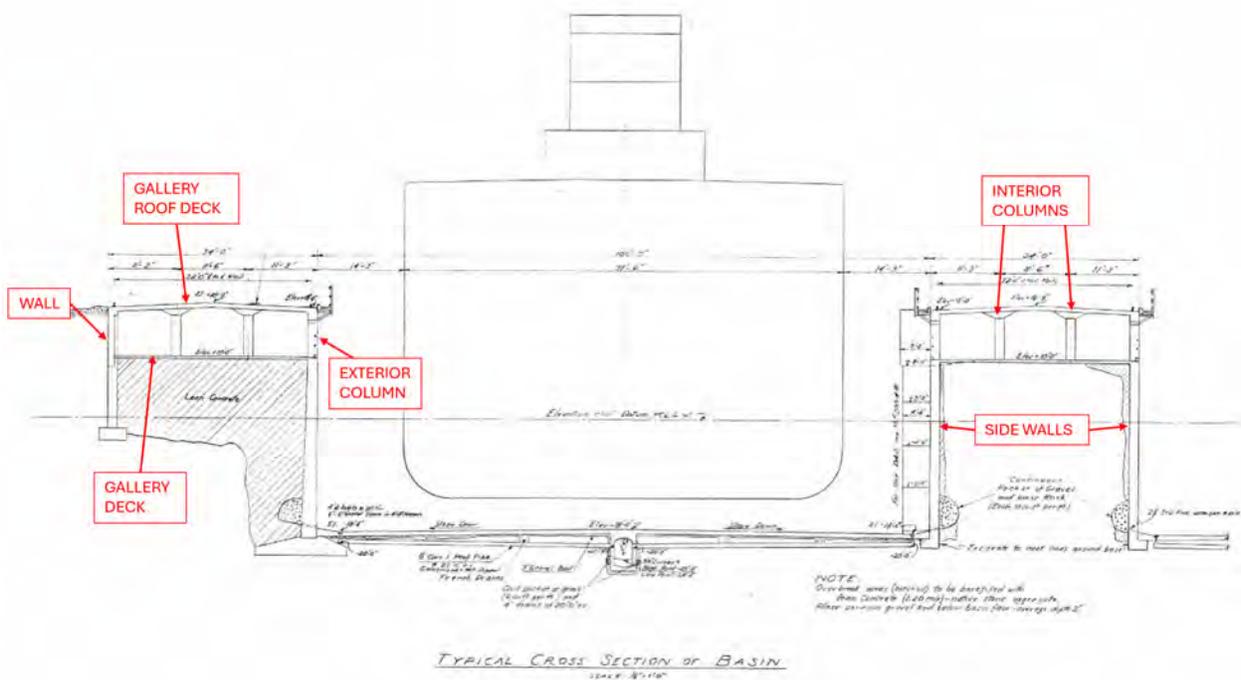


Figure 1: Typical Section of Graving Basin

It is unknown what uniform live and vehicle loading the graving basin fingers were originally designed to support. However, the U.S. Army Corps of Engineers (USACE) Port Series No. 31 *The Ports of Oakland-Alameda, Richmond, and Ports on Carquinez Strait, California* (Revised 2000), states that crane service included (4) 60-ton and (2) 45-ton electric, traveling, full-portal, gantry cranes that traveled on top of walls between the graving docks. This reference is included in Appendix D.



3.3. Load Capacity Summary

The allowable distributed live load, governed by slab bending, is **550 psf**. With load spreading that puts the load directly into the columns, the capacity is approximately 2000 psf. A summary of the allowable distributed live loads according to each considered failure mode is summarized in Table 3. Supporting calculations can be found in Appendix A.

Table 3: Load Capacity Summary – Graving Basins

<u>Structural Element / Failure Modes</u>		<u>Capacity (Dead + Live Loading)</u>		<u>Allowable Distributed Live Load (psf)</u>
SLAB (Transverse)	BENDING	11.74	kip-ft/ft	550
	SHEAR	6.39	kip/ft	700
SLAB (Longitudinal)	BENDING	15.52	kip-ft/ft	650
	SHEAR	7.32	kip/ft	750
SLAB	PUNCHING SHEAR	282	kip	1100
EDGE BEAM	BENDING	230.5	kip-ft/ft	31000
	SHEAR	39.7	kip/t	8000
COLUMN	AXIAL	564	kip	2300
BEARING / FOUNDATION	BEARING	8000	psf	--



4. Finger Piers

No load rating of the finger pier structures was performed.

- Since original construction drawings of the finger pier structures could not be located, the structural configuration of the piers (including reinforcing layout) could not be confirmed.

The published capacity of each finger pier can be found in the United States Army Corps of Engineers (USACE) Port Series No. 31, 2000. According to this document, the capacity is **500 psf**. This reference can be found in Appendix C.

4.1. Structural Configuration

There are two finger piers, approximately ±545 feet long by 48 feet wide, located on west end of the PPMT facility. Both finger piers have the same configuration, consisting of a 12" concrete deck supported by three concrete bents running the length of the pier. The external bents are supported by clusters of 4 concrete piles at 36 feet on-center (OC). Each concrete pile within the clusters is 18" x 24". The central bent is supported by 18" square concrete piles at 12 feet OC, typical. The first three shoreside piles supporting the central bent are 18" diameter steel pipe piles. The external bents are approximately 32" wide by 5' deep. The transverse beams placed at 108 feet OC (every two pile clusters) are approximately 19" wide by 5' deep. A concrete slab apron cantilevers out approximately 7' on the longitudinal sides of the pier and 2' on the transverse waterside. The shoreline edge at the landside of the piers is maintained by a steel sheet pile bulkhead fronted by rip rap. A plan view of the finger pier is depicted in Figure 2. The reinforcing layout was determined based on the minimum reinforcement specified in ACI 318-41 as no drawings were available.

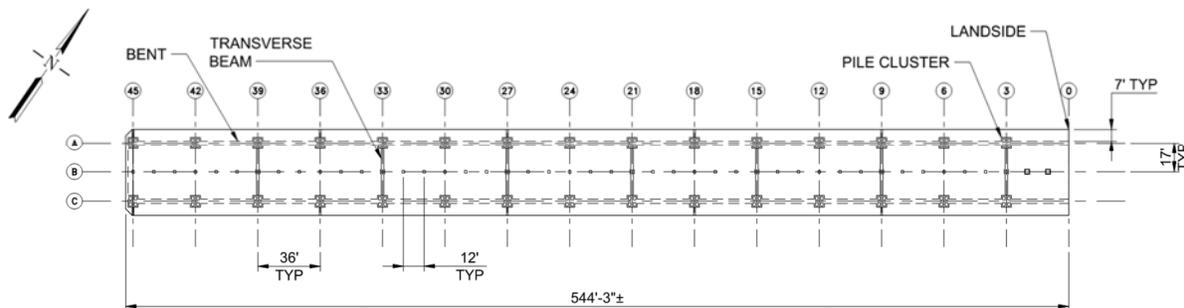


Figure 2: Typical Finger Pier Layout



5. Load Rating Summary

Table 4: Load Rating Summary

<u>STRUCTURE</u>	<u>Allowable Distributed Live Load (psf)</u>	<u>Governed By</u>
Graving Basin	550	Deck Capacity (bending)
Finger Pier	500[†]	--

[†]Per USACE Port Series No. 31 (2000)



Appendix A: Graving Basin Load Rating Calculations



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CLIENT:	Port of Richmond	JOB NO.:	241984		
PROJECT:	Point Potrero Marine Terminal	DESIGNER:	DBT (D. Taiwo)	DATE:	Jul-25
SUBJECT:	Graving Basin	CHECKER:	JB (J. Brady)	DATE:	7/20/2025
Slab Capacity - Transverse Span					

BEAM SECTION PROPERTIES

b_w =	<input type="text" value="12"/>	in	ϵ_{cu} =	<input type="text" value="0.003"/>		Rebar Type	f_y =	<input type="text" value="33"/>	ksi
depth =	<input type="text" value="8"/>	in	E_c =	<input type="text" value="4030.5"/>	ksi	US/Soft	ϵ_y =	<input type="text" value="0.00114"/>	
f_c' =	<input type="text" value="5"/>	ksi	β_1 =	<input type="text" value="0.80"/>		Metric	E_s =	<input type="text" value="29000"/>	ksi
ϵ_c' =	<input type="text" value="0.00222"/>		Total Slot Width =	<input type="text"/>	in		d_c cover =	<input type="text" value="2.00"/>	in
ϕ_f =	<input type="text" value="0.900"/>		Total Slot Depth =	<input type="text"/>	in		side cover =	<input type="text" value="2.00"/>	in

REINFORCEMENT

FLEXURAL REINFORCEMENT: (Layered reinforcing input from top to bottom)

No. of Layers =

Top/Bot	Layer	No. of Bars	Bar Size (#5, #6, etc)	A_s (in ²)	$d_{from\ top}$ (in)
Top	1	<input type="text" value="3"/>	<input type="text" value="#5"/>	0.93	<input type="text" value="1.8125"/>
Bottom	2	<input type="text" value="2"/>	<input type="text" value="#5"/>	0.62	<input type="text" value="6.1875"/>

If $A_{s,min}$ = N/A then provided reinforcement meets ACI 318-19 9.6.1.3.

$A_{s,min, top}$ = N/A in²
 $A_{s,min, bottom}$ = N/A in²
 $A_{s,max, top}$ = 4.16 in²
 $A_{s,max, bottom}$ = 4.16 in²

CALCULATED MOMENTS & SUMMARY OF RESULTS

ULTIMATE VALUES:

Calculated Capacity

$-\phi M_n$ = k-ft
 $+\phi M_n$ = k-ft

Factored Moments from Analysis

$-M_{u,max}$ = k-ft
 $+M_{u,max}$ = k-ft

SERVICE VALUES:

Calculated Crack Widths

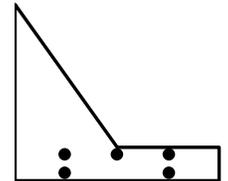
Gergley-Lutz	AASHTO 7th Ed.
Eqtn	5.7.3.4
$-\omega$ =	<input type="text" value="0.0000"/> <input type="text" value="0.0000"/> in
$+\omega$ =	<input type="text" value="0.0000"/> <input type="text" value="0.0000"/> in

Service Moments from Analysis

$-M_{s,max}$ = k-ft
 $+M_{s,max}$ = k-ft

Tolerable Crack Widths

$\omega_{allow, top}$ = in
 $\omega_{allow, bottom}$ = in





CLIENT:	Port of Richmond	JOB NO.:	241984	
PROJECT:	Point Potrero Marine Terminal	DESIGNER:	DBT	DATE: Jul-25
SUBJECT:	Graving Basin	CHECKER:	JB	DATE: 7/20/2025
Slab Capacity - Transverse Span				

$$w_{allow} = 0.006 \text{ in}$$



CLIENT:	Port of Richmond	JOB NO.:	241984		
PROJECT:	Point Potrero Marine Terminal	DESIGNER:	DBT	DATE:	Jul-25
SUBJECT:	Graving Basin	CHECKER:	JB	DATE:	7/20/2025
Slab Capacity - Transverse Span					

EVALUATION OF NEGATIVE MOMENT CAPACITY:ULTIMATE CAPACITY

$$M_u = \quad \text{k-ft (applied)}$$

CONCRETE COMPRESSION:

$$\begin{aligned} c &= 1.254 \text{ in} & "d" &= 6.1875 \text{ in} \\ a = \beta_1 c &= 1.003 \text{ in} \\ C_c &= 0.85 f_c' b_w a = 51.2 \text{ kips} \end{aligned}$$

FORCES IN REINFORCING: ('-' COMPRESSION, '+' TENSION)

Layer	A_s (in ²)	$d_{\text{from bot}}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	0.62	1.8125	0.001337	33.00	20.5	37.1
1	0.93	6.1875	0.011806	33.00	30.7	189.9

FORCE EQUILIBRIUM:

$$\begin{aligned} C &= 51.15 \text{ kips} \\ T &= 51.15 \text{ kips} \end{aligned}$$

NOMINAL MOMENT CAPACITY:

$$\phi M_n = 15.099593 \text{ k-ft}$$

CHECK CRACK WIDTH FOR SERVICEABILITY

$$\begin{aligned} d_c &= 2.313 \text{ in} & M_{s, \text{max}} &= \text{k-ft (applied)} \\ m &= 3 \text{ (No. of bars)} & \beta &= 1.482 \\ A = 2d_c(b_w - \text{slot})/m &= 18.5 \text{ in}^2 & \beta_s &= 1.418 & \text{AASHTO 7}^{\text{th}} \text{ Ed. - 5.7.3.4} \\ \text{Spacing} &= 3.063 \text{ in} \end{aligned}$$

STRESS/STRAIN COMPATIBILITY:

$$\begin{aligned} c &= 2.430 \text{ in} & A &= 1.49328 \\ \epsilon_{c, \text{max}} &= 0.00000 & B &= 0.44241 \\ C_c = 0.5(f_{c, \text{max}} * c * b_w) &= 0.00 \text{ kips} & f_{c, \text{max}} &= 0.000 \text{ ksi} \\ \epsilon_s &= 0.00000 & "d" &= 6.1875 \text{ in} \end{aligned}$$

Layer	A_s (in ²)	$d_{\text{from bot}}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	0.62	1.8125	0.000000	0.00	0.0	0.0
1	0.93	6.1875	0.000000	0.00	0.0	0.0

FORCE EQUILIBRIUM:

$$\begin{aligned} C &= 0.00 \text{ kips} \\ T &= 0.00 \text{ kips} \end{aligned}$$

SERVICE MOMENT CAPACITY:

$$M_s = 0.00 \text{ k-ft (capacity)}$$

CRACK WIDTH:

Gergley-Lutz Equation

$$\omega = 0.076 \beta f_s (d_c A)^{1/3} / 1000 = 0.0000 \text{ in}$$

AASHTO 7th Ed. - 5.7.3.4

$$\omega_e = 0.017 * (S + 2 * d_c) / 700 * \beta_s * f_{ss} = 0.0000 \text{ in}$$

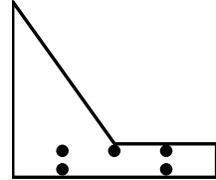
$$\omega_{\text{allow}} = 0.006 \text{ in}$$

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SUBJECT:	Graving Basin	CHECKER:	JB	DATE:	Jul-25
Slab Capacity - Transverse Span					

BEAM SECTION PROPERTIES

$b_w = 12$ in
 depth = 8 in
 $f_c' = 5$ ksi
 $f_y = 33$ ksi

$\phi_s = 0.75$
 $L_n = 138$ in
 Beam Shear Design: NORMAL BEAM SHEAR



REINFORCEMENT

SHEAR REINFORCEMENT:

VERTICAL:

No. of Stirrup Legs =
 Bar Size (#4, #5, etc) =
 Stirrup Spacing = in
 $A_v/s =$ in²/ft
 $(A_v/s)_{reqd} =$ None in²/ft
 $(A_v/s)_{min} = 0.231$ in²/ft
 $s_{max} = 3.09$ in

***HORIZONTAL:**

No. of Bars Ea. Layer =
 Bar Size (#4, #5, etc) =
 Horiz. Bar Spacing = in
 $A_{vh}/s_2 =$ in²/ft
 $(A_{vh}/s_2)_{min} =$ N/A in²/ft
 $s_{2max} =$ N/A in

TOTAL SHEAR REINFORCEMENT RATIO (ACI 318-14 23.5.3): (DEEP BEAM SHEAR DESIGN)

Angle of Inclination = (5.0 ≤ γ_1 ≤ 65.0)

$\Sigma A_{si}/bs (\sin \gamma_i) =$ **N/A**

APPLIED SHEAR AND MOMENTS & SUMMARY OF RESULTS

ULTIMATE VALUES:

$\phi V_n = 6.39$ kips $V_{u_{max}} =$ kips
 $Nu_v =$ kips (Compression is positive)

Notes: * Bottom flexural reinforcement must be fully developed at supports per code requirements (ACI 318-14 9.9.4.5).

This analysis does not include a design check of the stresses associated with the tension tie that would be a part of Strut-&-Tie Modeling as reinforcement for crack control in flexural design typically controls.



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Slab Capacity - Transverse Span				

EVALUATION OF SHEAR CAPACITY:

APPLIED SHEAR = kips ASSOC. AXIAL = k-ft

NORMAL BEAM SHEAR CAPACITY: (ACI 318-19 22.5.5.1)

$$V_c = [2.0 \cdot \lambda \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 10.50 \text{ kips} \quad (\text{a) When } A_v \geq A_{v_{\min}}$$

$$V_c = [8.0 \cdot \lambda \cdot (\rho_w)^{1/3} \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 8.52 \text{ kips} \quad (\text{b) When } A_v \geq A_{v_{\min}}$$

$$V_c = [8.0 \cdot \lambda_s \cdot \lambda \cdot (\rho_w)^{1/3} \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 8.52 \text{ kips} \quad (\text{c) When } A_v < A_{v_{\min}}$$

$$V_{c_{\max}} = [5.0 \cdot \lambda \cdot (f'_c)^{1/2}] \cdot b_w \cdot d = 26.25 \text{ kips} \quad (22.5.5.1.1)$$

$$N_u / (6 \cdot A_g) \leq 0.05 \cdot f'_c = \quad \text{psi} \quad (22.5.5.1.2)$$

$$\lambda_s = (2 / (1 + d/10))^{1/2} = 1.0000 \quad (22.5.5.1.3)$$

Top Steel Ratio $\rho_w = A_s / (b_w \cdot d) = 0.0125$ Use minimum steel ratio for equations b and c

Bottom Steel Ratio $\rho_w = A_s / (b_w \cdot d) = 0.0084$

STIRRUP REINFORCEMENT SHEAR CAPACITY: (ACI 318-19 22.5.8.5.3)

$$(A_v/s)_{\text{reqd}} = (V_u - \phi V_c) / (\phi f_y d) = \text{None} \quad \text{in}^2/\text{ft}$$

$$V_s = \text{MIN}(A_v/s \cdot (f_y \cdot d), 8 \cdot (f'_c)^{1/2} \cdot b_w \cdot d) = \quad \text{kips}$$

MINIMUM REINFORCEMENT: (ACI 318-19 9.6.3)

$$(A_v/s)_{\min} = 0.75 \cdot (f'_c)^{1/2} \cdot b_w / f_y \quad (\geq 50 \cdot b_w / f_y) = 0.231 \text{ in}^2/\text{ft} \quad (\text{Table 9.6.3.4})$$

$$s_{\max} = \text{MIN}(d/2, 24 \text{ in}) = 3.09 \text{ in} \quad (\text{ACI 318-14 9.7.6.2.2})$$

ULTIMATE SHEAR CAPACITY:

$$\phi V_n = \phi (V_c + V_s) = 6.39 \text{ kips} \quad \text{Where } V_c \text{ is from equation c}$$

DEEP BEAM SHEAR CAPACITY: (ACI 318-19 9.9)

$$L_n/\text{depth} = 17.25$$

MAXIMUM SHEAR STRENGTH LIMITATION: (ACI 318-19 9.9.2.1)

$$V_{n_{\max}} \leq 10 \cdot (f'_c)^{1/2} \cdot b_w \cdot d = 52.50 \text{ kips}$$

MINIMUM REINFORCEMENT: (ACI 318-19 9.9.3.1 & 9.9.4.3)

$$(A_v/s)_{\min} = 0.0025 \cdot b_w = 0.360 \text{ in}^2/\text{ft}$$

$$s_{\max} = \text{MIN}(d/5, 12 \text{ in}) = 1.24 \text{ in}$$

$$(A_{vh}/s_2)_{\min} = 0.0025 \cdot b_w = 0.360 \text{ in}^2/\text{ft}$$

$$s_{2\max} = \text{MIN}(d/5, 12 \text{ in}) = 1.24 \text{ in}$$

CHECK WORST CASE COMBINED SHEAR REINFORCEMENT RATIO: (ACI 318-14 23.5.3)

$$\gamma_1 = 5.00 \text{ Degrees} \quad \gamma_2 = 85.00 \text{ Degrees}$$

HORIZONTAL SHEAR REINFORCEMENT RATIO:

$$A_{vh}/b_s s_2 (\sin \gamma_2) =$$

VERTICAL SHEAR REINFORCEMENT RATIO:



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SUBJECT:	Graving Basin	CHECKER:	JB	DATE:	Jul-25
	Slab Capacity - Transverse Span				

$$A_v/bs (\sin \gamma_1) =$$

$$\Sigma A_{s_i}/bs (\sin \gamma_i) = < 0.003 - \text{UNACCEPTABLE!}$$

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SUBJECT:	Graving Basin	CHECKER:	JB	DATE:	Jul-25
Slab Capacity - Longitudinal Span					

BEAM SECTION PROPERTIES

b_w =	<input type="text" value="12"/>	in	ϵ_{cu} =	<input type="text" value="0.003"/>		Rebar Type	f_y =	<input type="text" value="33"/>	ksi
depth =	<input type="text" value="8"/>	in	E_c =	<input type="text" value="4030.5"/>	ksi	US/Soft	ϵ_y =	<input type="text" value="0.00114"/>	
f_c' =	<input type="text" value="5"/>	ksi	β_1 =	<input type="text" value="0.80"/>		Metric	E_s =	<input type="text" value="29000"/>	ksi
ϵ_c' =	<input type="text" value="0.00222"/>		Total Slot Width =	<input type="text"/>	in		d_c cover =	<input type="text" value="2.00"/>	in
ϕ_f =	<input type="text" value="0.900"/>		Total Slot Depth =	<input type="text"/>	in		side cover =	<input type="text" value="2.00"/>	in

REINFORCEMENT

FLEXURAL REINFORCEMENT: (Layered reinforcing input from top to bottom)

No. of Layers =

Top/Bot	Layer	No. of Bars	Bar Size (#5, #6, etc)	A_s (in ²)	$d_{from\ top}$ (in)
Top	1	4	#5	1.24	1.8125
Bottom	2	3	#5	0.93	6.1875

If $A_{s,min}$ = N/A then provided reinforcement meets ACI 318-19 9.6.1.3.

$A_{s,min, top}$ = N/A in²
 $A_{s,min, bottom}$ = N/A in²
 $A_{s,max, top}$ = 4.16 in²
 $A_{s,max, bottom}$ = 4.16 in²

CALCULATED MOMENTS & SUMMARY OF RESULTS

ULTIMATE VALUES:

Calculated Capacity

$-\phi M_n$ = 18.93 k-ft
 $+\phi M_n$ = 15.52 k-ft

Factored Moments from Analysis

$-Mu_{max}$ = k-ft
 $+Mu_{max}$ = k-ft

SERVICE VALUES:

Calculated Crack Widths

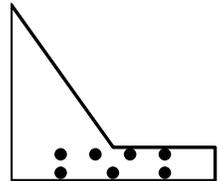
Gergley-Lutz	AASHTO 7th Ed.
Eqtn	5.7.3.4
$-\omega$ =	0.0000 in
$+\omega$ =	0.0000 in

Service Moments from Analysis

$-M_{s,max}$ = k-ft
 $+M_{s,max}$ = k-ft

Tolerable Crack Widths

$\omega_{allow, top}$ = in
 $\omega_{allow, bottom}$ = in





CLIENT:	Port of Richmond	JOB NO.:	241984	
PROJECT:	Point Potrero Marine Terminal	DESIGNER:	DBT	DATE: Jul-25
SUBJECT:	Graving Basin	CHECKER:	JB	DATE: Jul-25
Slab Capacity - Longitudinal Span				

$$\omega_{allow} = 0.006 \text{ in}$$



CLIENT:	Port of Richmond	JOB NO.:	241984
PROJECT:	Point Potrero Marine Terminal	DESIGNER:	DBT
SUBJECT:	Graving Basin	CHECKER:	JB
Slab Capacity - Longitudinal Span		DATE:	Jul-25
		DATE:	Jul-25

EVALUATION OF NEGATIVE MOMENT CAPACITY:ULTIMATE CAPACITY

$$M_u = \quad \text{k-ft (applied)}$$

CONCRETE COMPRESSION:

$$c = 1.468 \text{ in} \quad "d" = 6.1875 \text{ in}$$

$$a = \beta_1 c = 1.174 \text{ in}$$

$$C_c = 0.85 f_c' b_w a = 59.9 \text{ kips}$$

FORCES IN REINFORCING: ('-' COMPRESSION, '+' TENSION)

Layer	A_s (in ²)	$d_{\text{from bot}}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	0.93	1.8125	0.000704	20.41	19.0	34.4
1	1.24	6.1875	0.009644	33.00	40.9	253.2

FORCE EQUILIBRIUM:

$$C = 59.90 \text{ kips}$$

$$T = 59.90 \text{ kips}$$

NOMINAL MOMENT CAPACITY:

$$\phi M_n = 18.931254 \text{ k-ft}$$

CHECK CRACK WIDTH FOR SERVICEABILITY

$$d_c = 2.313 \text{ in} \quad M_{s, \text{max}} = \text{k-ft (applied)}$$

$$m = 4 \text{ (No. of bars)} \quad \beta = 1.586$$

$$A = 2d_c(b_w - \text{slot})/m = 13.9 \text{ in}^2 \quad \beta_s = 1.418 \quad \text{AASHTO 7}^{\text{th}} \text{ Ed. - 5.7.3.4}$$

$$\text{Spacing} = 2.042 \text{ in}$$

STRESS/STRAIN COMPATIBILITY:

$$c = 3.094 \text{ in} \quad A = 1.49328$$

$$\epsilon_{c, \text{max}} = 0.00000 \quad B = 0.44241$$

$$C_c = 0.5(f_{c, \text{max}} * c * b_w) = 0.00 \text{ kips} \quad f_{c, \text{max}} = 0.000 \text{ ksi}$$

$$\epsilon_s = 0.00000 \quad "d" = 6.1875 \text{ in}$$

Layer	A_s (in ²)	$d_{\text{from bot}}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	0.93	1.8125	0.000000	0.00	0.0	0.0
1	1.24	6.1875	0.000000	0.00	0.0	0.0

FORCE EQUILIBRIUM:

$$C = 0.00 \text{ kips}$$

$$T = 0.00 \text{ kips}$$

SERVICE MOMENT CAPACITY:

$$M_s = 0.00 \text{ k-ft (capacity)}$$

CRACK WIDTH:

Gergley-Lutz Equation

AASHTO 7th Ed. - 5.7.3.4

$$\omega = 0.076\beta f_s' (d_c A)^{1/3} / 1000 = 0.0000 \text{ in} \quad \omega_e = 0.017 * (S+2*d_c) / 700 * \beta_s * f_{ss} = 0.0000 \text{ in}$$

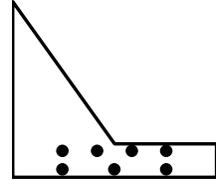
$$\omega_{\text{allow}} = 0.006 \text{ in}$$

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BEAM SECTION PROPERTIES

$b_w = 12$ in
 depth = 8 in
 $f_c' = 5$ ksi
 $f_y = 33$ ksi

$\phi_s = 0.75$
 $L_n = 138$ in
 Beam Shear Design: NORMAL BEAM SHEAR



REINFORCEMENT

SHEAR REINFORCEMENT:

VERTICAL:

No. of Stirrup Legs =
 Bar Size (#4, #5, etc) = #5
 Stirrup Spacing = 12.00 in
 $A_v/s =$ in²/ft
 $(A_v/s)_{reqd} =$ None in²/ft
 $(A_v/s)_{min} = 0.231$ in²/ft
 $s_{max} = 3.09$ in

***HORIZONTAL:**

No. of Bars Ea. Layer =
 Bar Size (#4, #5, etc) = #5
 Horiz. Bar Spacing = 6.00 in
 $A_{vh}/s_2 =$ in²/ft
 $(A_{vh}/s_2)_{min} =$ N/A in²/ft
 $s_{2max} =$ N/A in

TOTAL SHEAR REINFORCEMENT RATIO (ACI 318-14 23.5.3): (DEEP BEAM SHEAR DESIGN)

Angle of Inclination = 5.00 (5.0 ≤ γ_1 ≤ 65.0)

$\Sigma A_{si}/bs (\sin \gamma_i) =$ N/A

APPLIED SHEAR AND MOMENTS & SUMMARY OF RESULTS

ULTIMATE VALUES:

$\phi V_n = 7.32$ kips $V_{u_{max}} =$ kips
 $Nu_v =$ kips (Compression is positive)

Notes: * Bottom flexural reinforcement must be fully developed at supports per code requirements (ACI 318-14 9.9.4.5).

This analysis does not include a design check of the stresses associated with the tension tie that would be a part of Strut-&-Tie Modeling as reinforcement for crack control in flexural design typically controls.



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EVALUATION OF SHEAR CAPACITY:

APPLIED SHEAR = kips ASSOC. AXIAL = k-ft

NORMAL BEAM SHEAR CAPACITY: (ACI 318-19 22.5.5.1)

$$V_c = [2.0 \cdot \lambda \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 10.50 \text{ kips} \quad (\text{a) When } A_v \geq A_{v_{\min}}$$

$$V_c = [8.0 \cdot \lambda \cdot (\rho_w)^{1/3} \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 9.75 \text{ kips} \quad (\text{b) When } A_v \geq A_{v_{\min}}$$

$$V_c = [8.0 \cdot \lambda_s \cdot \lambda \cdot (\rho_w)^{1/3} \cdot (f'_c)^{1/2} + N_u / (6 \cdot A_g)] \cdot b_w \cdot d = 9.75 \text{ kips} \quad (\text{c) When } A_v < A_{v_{\min}}$$

$$V_{c_{\max}} = [5.0 \cdot \lambda \cdot (f'_c)^{1/2}] \cdot b_w \cdot d = 26.25 \text{ kips} \quad (22.5.5.1.1)$$

$$N_u / (6 \cdot A_g) \leq 0.05 \cdot f'_c = \quad \text{psi} \quad (22.5.5.1.2)$$

$$\lambda_s = (2 / (1 + d/10))^{1/2} = 1.0000 \quad (22.5.5.1.3)$$

Top Steel Ratio $\rho_w = A_s / (b_w \cdot d) = 0.0167$ Use minimum steel ratio for equations b and c

Bottom Steel Ratio $\rho_w = A_s / (b_w \cdot d) = 0.0125$

STIRRUP REINFORCEMENT SHEAR CAPACITY: (ACI 318-19 22.5.8.5.3)

$$(A_v/s)_{\text{reqd}} = (V_u - \phi V_c) / (\phi f_y d) = \text{None} \quad \text{in}^2/\text{ft}$$

$$V_s = \text{MIN}(A_v/s \cdot (f_y \cdot d), 8 \cdot (f'_c)^{1/2} \cdot b_w \cdot d) = \quad \text{kips}$$

MINIMUM REINFORCEMENT: (ACI 318-19 9.6.3)

$$(A_v/s)_{\min} = 0.75 \cdot (f'_c)^{1/2} \cdot b_w / f_y \quad (\geq 50 \cdot b_w / f_y) = 0.231 \text{ in}^2/\text{ft} \quad (\text{Table 9.6.3.4})$$

$$s_{\max} = \text{MIN}(d/2, 24 \text{ in}) = 3.09 \text{ in} \quad (\text{ACI 318-14 9.7.6.2.2})$$

ULTIMATE SHEAR CAPACITY:

$$\phi V_n = \phi (V_c + V_s) = 7.32 \text{ kips} \quad \text{Where } V_c \text{ is from equation c}$$

DEEP BEAM SHEAR CAPACITY: (ACI 318-19 9.9)

$$L_n/\text{depth} = 17.25$$

MAXIMUM SHEAR STRENGTH LIMITATION: (ACI 318-19 9.9.2.1)

$$V_{n_{\max}} \leq 10 \cdot (f'_c)^{1/2} \cdot b_w \cdot d = 52.50 \text{ kips}$$

MINIMUM REINFORCEMENT: (ACI 318-19 9.9.3.1 & 9.9.4.3)

$$(A_v/s)_{\min} = 0.0025 \cdot b_w = 0.360 \text{ in}^2/\text{ft}$$

$$s_{\max} = \text{MIN}(d/5, 12 \text{ in}) = 1.24 \text{ in}$$

$$(A_{vh}/s_2)_{\min} = 0.0025 \cdot b_w = 0.360 \text{ in}^2/\text{ft}$$

$$s_{2\max} = \text{MIN}(d/5, 12 \text{ in}) = 1.24 \text{ in}$$

CHECK WORST CASE COMBINED SHEAR REINFORCEMENT RATIO: (ACI 318-14 23.5.3)

$$\gamma_1 = 5.00 \text{ Degrees} \quad \gamma_2 = 85.00 \text{ Degrees}$$

HORIZONTAL SHEAR REINFORCEMENT RATIO:

$$A_{vh}/b_s s_2 (\sin \gamma_2) =$$

VERTICAL SHEAR REINFORCEMENT RATIO:



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$$A_v/bs (\sin \gamma_1) =$$

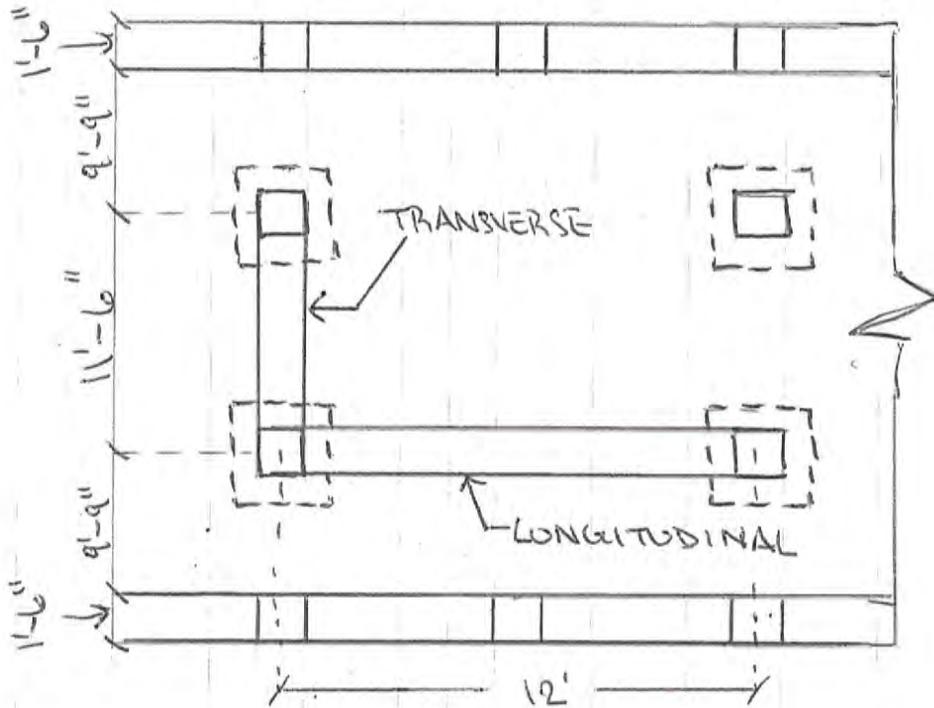
$$\Sigma A_{s_i}/bs (\sin \gamma_i) = < 0.003 - \text{UNACCEPTABLE!}$$



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Calculate: Allowable uniform live load



Note:

① Assume $M_u^+ = \frac{wl^2}{9}$

- Simply supported beam, $M_u = \frac{wl^2}{8}$ (too conservative)

- Continuous beam (3) equal spans
 $M_u^+ = 0.08wl^2$

$$0.08wl^2 < \frac{wl^2}{9} < \frac{wl^2}{8}$$



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CLIENT	P/RICHMOND	JOB NO.	241984
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① Transverse Span, Bending Capacity

$$\phi M_n = 11.74 \text{ kip-ft/ft (from spreadsheet)}$$

$$\phi M_n \geq \frac{w l^2}{9} \rightarrow l = 10' \text{ (clear span)}$$

$w = 1.2DL + 1.6LL$

$$DL = \underbrace{\left(150 \text{ pcf} \times \frac{8''}{12}\right)}_{\text{concrete}} + \underbrace{\left(145 \text{ pcf} \times \frac{2''}{12}\right)}_{\text{asphalt}}$$

$$DL = 0.124 \text{ ksf}$$

$$11.74 \text{ k-ft/ft} \geq [1.2(0.124 \text{ ksf}) + 1.6(LL)] \times \frac{(10 \text{ ft})^2}{9}$$

$$1.056 \text{ ksf} \geq 0.1488 \text{ ksf} + 1.6(LL)$$

$$LL \leq 0.567 \text{ ksf} \rightarrow \text{say } \boxed{LL < 550 \text{ psf}}$$

② Transverse Span, Shear Capacity

$$\phi V_n = 6.39 \text{ kip/ft of slab (from spreadsheet)}$$

$$\phi V_n \geq (1.2DL + 1.6LL) \times \frac{l}{2}$$

$$DL = 0.124 \text{ ksf}$$

$l = 10 \text{ ft}$

$$6.39 \text{ k/ft} \geq [1.2(0.124 \text{ ksf}) + 1.6LL] \times \frac{10 \text{ ft}}{2}$$

$$1.1292 \text{ ksf} \geq 1.6LL$$

$$LL < 706 \text{ psf} \rightarrow \text{say } \boxed{LL < 700 \text{ psf}}$$



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CLIENT	P/RICHMOND	JOB NO.	241984	
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③ Longitudinal Span, Bending Capacity

$$\phi M_n = 15.52 \text{ k-ft/A (from spreadsheet)}$$

$$15.52 \text{ k-ft/A} \geq [1.2(0.124 \text{ ksf}) + 1.6(LL)] \times \frac{(10.5)^2}{9}$$

$$LL \leq \frac{0.69}{0.78} \text{ ksf} \rightarrow \text{say } \boxed{LL < 750 \text{ psf}}$$

④ Longitudinal Span, Shear Capacity

$$\phi V_n = 7.32 \text{ kip/A of slabs (from spreadsheet)}$$

$$7.32 \text{ k-ft/A} \geq [1.2(0.124 \text{ ksf}) + 1.6LL] \times \frac{10.5 \text{ ft}}{2}$$

$$LL < 0.78 \text{ ksf} \rightarrow \text{say } \boxed{LL < 750 \text{ psf}}$$

Methodology:

The following calculations follow the provisions of ACI 318–19 to check the two–way shear (punching shear) capacity of the concrete slab at the Graving Basin structures.

Material Properties:

$f'_c = 5000\text{psi}$ Concrete compressive strength, per ACI 318–41, Table 302(a)

Deck Dimensions:

$h = 8\text{in}$ Deck slab thickness

$c_c = \frac{3}{4}\text{in}$ Concrete cover

$d_v = \text{bar}_5 = 0.63 \cdot \text{in}$ Shear reinforcing, #5 at 12" spacing

$d_l = \text{bar}_4 = 0.50 \cdot \text{in}$ Longitudinal reinforcing, #4 at 12" spacing

$d = h - c_c - d_v - \frac{d_l}{2} = 6 \cdot \text{in}$ Distance from extreme compression fiber to centroid of longitudinal tension reinforcement

$\lambda = 1$ Modification factor, assume normalweight concrete, 19.2.4.3

$\lambda_s = \min \left(1, \sqrt{\frac{2}{1 + \frac{d}{10\text{in}}}} \right) = 1.00$ Size effect factor, 22.5.5.1.3

Punching Shear Calculations:

$\beta = 1$ Ratio of long side to short side of effective loaded area, assume square loaded area

Interior Column:

$s_{\text{col}} = 18\text{in}$ Square column dimensions

$s_{\text{cap}} = 5.5\text{ft}$ Square capital dimensions

$\alpha_s = 40$ Value of α_s for interior columns, 22.6.5.3

$b_o = 4 \cdot (s_{\text{cap}} + d) = 290 \cdot \text{in}$ Critical section perimeter for interior column, 22.6.4.1a



$$V_{c.int} = \min \left[\begin{array}{l} 4 \cdot \lambda \cdot \lambda_s \cdot \sqrt{f'_c \cdot \text{psi}} \cdot b_o \cdot d \\ \left(2 + \frac{4}{\beta} \right) \cdot \lambda_s \cdot \lambda \cdot \sqrt{f'_c \cdot \text{psi}} \cdot b_o \cdot d \\ \left(2 + \frac{\alpha_s \cdot d}{b_o} \right) \cdot \lambda_s \cdot \lambda \cdot \sqrt{f'_c \cdot \text{psi}} \cdot b_o \cdot d \end{array} \right] = 376 \cdot \text{kip}$$

Punching shear strength, Table 22.6.5.2

Two-Way Shear Strength:

$\phi_V = 0.75$ Strength reduction factor, Section 21.2

$\phi V_c = \phi_V \cdot V_{c.int} = 282 \cdot \text{kip}$ Nominal strength for two-way members

Allowable Distributed Live Load:

$\phi V_c \geq 1.2(\text{Dead}) + 1.6(\text{Live})$

$A_{trib} = 12\text{ft} \cdot 12\text{ft} = 144\text{ft}^2$ Tributary area

$\gamma_c = 150\text{pcf}$ Concrete unit weight

$h = 8 \cdot \text{in}$ Deck thickness

$\gamma_a = 145\text{pcf}$ Asphalt unit weight

$t_a = 2\text{in}$ Asphalt overlay thickness

$\text{Dead} = (\gamma_c \cdot h + \gamma_a \cdot t_a) \cdot A_{trib} = 18 \cdot \text{kip}$ Dead load acting over tributary area

$\text{Live} = \frac{(\phi V_c - 1.2 \cdot \text{Dead})}{1.6} = 163 \cdot \text{kip}$ Allowable concentrated live load

$LL = \frac{\text{Live}}{A_{trib}} = 1131 \cdot \text{psf}$ Allowable distributed live load

$LL < 1100 \text{ psf}$

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Edge Beam Capacity					

BEAM SECTION PROPERTIES

b_w =	<input type="text" value="18"/>	in	ϵ_{cu} =	<input type="text" value="0.003"/>	Rebar Type	f_y =	<input type="text" value="33"/>	ksi
depth =	<input type="text" value="24"/>	in	E_c =	<input type="text" value="3490.5"/>	US/Soft	ϵ_y =	0.00114	
f_c' =	<input type="text" value="3.75"/>	ksi	β_1 =	0.85	Metric	E_s =	<input type="text" value="29000"/>	ksi
ϵ_c' =	0.00208	Total Slot Width =	<input type="text"/>	in	d_c cover =	<input type="text" value="2.00"/>	in	
ϕ_f =	0.900	Total Slot Depth =	<input type="text"/>	in	side cover =	<input type="text" value="2.00"/>	in	

REINFORCEMENT

FLEXURAL REINFORCEMENT: (Layered reinforcing input from top to bottom)

No. of Layers =

Top/Bot	Layer	No. of Bars	Bar Size (#5, #6, etc)	A_s (in ²)	$d_{from\ top}$ (in)
Top	1	2	#9	2.00	2.064
Bottom	2	2	#14	4.50	21.936

If $A_{s,min}$ = N/A then provided reinforcement meets ACI 318-19 9.6.1.3.

$A_{s,min, top}$ = N/A in²
 $A_{s,min, bottom}$ = N/A in²
 $A_{s,max, top}$ = 17.63 in²
 $A_{s,max, bottom}$ = 17.63 in²

CALCULATED MOMENTS & SUMMARY OF RESULTS

ULTIMATE VALUES:

Calculated Capacity

~~ϕM_n~~ = 107.14 k-ft
 ~~ϕM_n~~ = 230.49 k-ft

Factored Moments from Analysis

~~$-M_u$~~ _{max} = k-ft
 ~~$+M_u$~~ _{max} = k-ft

SERVICE VALUES:

Calculated Crack Widths

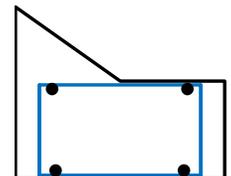
	Gergley-Lutz	AASHTO 7th Ed.
	Eqtn	5.7.3.4
$-\omega$ =	0.0000	0.0000 in
$+\omega$ =	0.0000	0.0000 in

Service Moments from Analysis

~~$-M_s$~~ _{max} = k-ft
 ~~$+M_s$~~ _{max} = k-ft

Tolerable Crack Widths

~~$\omega_{allow, top}$~~ = in
 ~~$\omega_{allow, bottom}$~~ = in



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Edge Beam Capacity					

EVALUATION OF NEGATIVE MOMENT CAPACITY:

ULTIMATE CAPACITY

$M_u =$ k-ft (applied)

CONCRETE COMPRESSION:

$c = 1.926$ in "d" = 21.936 in
 $a = \beta_1 c = 1.637$ in
 $C_c = 0.85 f_c' b_w a = 94.0$ kips

FORCES IN REINFORCING: ('-' COMPRESSION, '+' TENSION)

Layer	A_s (in ²)	$d_{from\ bot}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	4.50	2.064	0.000214	6.21	28.0	57.7
1	2.00	21.936	0.031160	33.00	66.0	1447.8

FORCE EQUILIBRIUM:

$C = 93.95$ kips
 $T = 93.95$ kips

NOMINAL MOMENT CAPACITY:

$\phi M_n = 107.14087$ k-ft

CHECK CRACK WIDTH FOR SERVICEABILITY

$d_c = 2.564$ in $M_{s, max} =$ k-ft (applied)
 $m = 2$ (No. of bars) $\beta = 1.121$
 $A = 2d_c(b_w - slot)/m = 46.2$ in² $\beta_s = 1.134$ AASHTO 7th Ed. - 5.7.3.4
Spacing = 11.622 in

STRESS/STRAIN COMPATIBILITY:

$c = 4.889$ in $A =$ #N/A
 $\epsilon_{c, max} = 0.00000$ $B =$ #N/A
 $C_c = 0.5(f_{c, max} * c * b_w) = 0.00$ kips $f_{c, max} = 0.000$ ksi
 $\epsilon_s = 0.00000$ "d" = 21.936 in

Layer	A_s (in ²)	$d_{from\ bot}$ (in)	Strain ϵ_s	Stress f_s (ksi)	Force (kips)	Moment (k-in)
2	4.50	2.064	0.000000	0.00	0.0	0.0
1	2.00	21.936	0.000000	0.00	0.0	0.0

FORCE EQUILIBRIUM:

$C = 0.00$ kips
 $T = 0.00$ kips

SERVICE MOMENT CAPACITY:

$M_s = 0.00$ k-ft (capacity)

CRACK WIDTH:

Gergley-Lutz Equation AASHTO 7th Ed. - 5.7.3.4
 $\omega = 0.076\beta f_s (d_c A)^{1/3} / 1000 = 0.0000$ in $\omega_e = 0.017 * (S + 2d_c) / 700 * \beta_s * f_{ss} = 0.0000$ in
 $\omega_{allow} = 0.006$ in



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FIND: Uniform live load (allowable) per edge beam capacity

① Beam Capacity, Bending

$$\phi M_n = 230 \text{ k-ft/A (from spreadsheet)}$$

$$\phi M_n \geq \frac{w l^2}{8} \quad ; \quad l = 6' \text{ (beam span)}$$

$$w: 1.2 \text{ DL} + 1.6 \text{ LL}$$

$$\text{DL} = \underbrace{\left(150 \text{ pcf} \times \frac{24''}{12}\right)}_{\text{concrete}} + \underbrace{\left(145 \text{ pcf} \times \frac{2''}{12}\right)}_{\text{asphalt}}$$

$$\text{DL} = 0.324 \text{ ksf}$$

$$51 \text{ ksf} \geq 1.2(0.324 \text{ ksf}) + 1.6 \text{ LL}$$

$$\text{LL} < 31.7 \text{ ksf} \rightarrow \text{say } \boxed{\text{LL} < 31,000 \text{ psf}}$$

② Beam Capacity, Shear

Note: The following calculations do not consider shear steel.

$$V_c = 2 \cdot \lambda \cdot \sqrt{f'_c} \cdot b_w \cdot d \quad (\text{ACI 318-19, 22-5.5.1})$$

$$\lambda = 1.0 \text{ (normal weight concrete)}$$

$$f'_c = 3750 \text{ psi}$$

$$b_w = 18 \text{ in} \quad d = 24 \text{ in}$$

$$V_c = 53 \text{ kip/A} \rightarrow \phi V_c = 0.75 \times 53 \text{ kip/A} = 39.7 \text{ k/A}$$

$$\phi V_c \geq \left[(1.2 \times 0.324 \text{ ksf}) + 1.6 \text{ LL} \right] \times \frac{l}{2}$$

$$12.8 \text{ ksf} \geq 1.6 \text{ LL}$$

$$\text{LL} < 8.02 \text{ ksf} \rightarrow \text{say } \boxed{\text{LL} < 8,000 \text{ psf}}$$

Beam capacity does not control allowable uniform load at graving basins.

Methodology:

The following calculations follow the provisions of ACI 318–19 to check the axial capacity of the interior columns at the graving basins.

Material Properties:

$f'_c = 3750\text{psi}$ Concrete compressive strength

$\gamma_c = 150\text{pcf}$ Concrete unit weight

$$E_c = 57 \cdot \sqrt{f'_c \cdot \text{psi}}$$

$E_c = 3491\text{ksi}$ Concrete modulus of elasticity

$f_y = 33\text{ksi}$ Steel yield strength

Section Properties:

$s_{\text{col}} = 18\text{in}$ Column dimensions, 18in x 18 in square

$A_g = s_{\text{col}}^2 = 324 \cdot \text{in}^2$ Gross area of concrete column section

$A_{\text{st}} = 4 \cdot 0.44\text{in}^2 = 1.76 \cdot \text{in}^2$ Total area of longitudinal reinforcement, (4) No.6 bars

Axial Strength:

$P_o = 0.85 \cdot f'_c \cdot (A_g - A_{st}) + f_y \cdot A_{st} = 1085 \cdot \text{kip}$	Nominal axial strength, 22.4.2.2
$P_{n,max} = 0.80 \cdot P_o = 868 \cdot \text{kip}$	Maximum nominal axial compressive strength, Table 22.4.2.1
$\phi = 0.65$	Strength reduction factor, assume compression-controlled, Table 21.2.2
$\phi P_n = \phi \cdot P_{n,max} = 564 \cdot \text{kip}$	Axial compressive strength of interior column

Allowable Distributed Live Load (Interior Column):

$\phi P_n \geq 1.2(\text{Dead}) + 1.6(\text{Live})$	
$A_{trib} = 12\text{ft} \cdot 12\text{ft} = 144\text{ft}^2$	Tributary area
$\gamma_c = 150\text{pcf}$	Concrete unit weight
$h = 8\text{in}$	Deck thickness
$\gamma_a = 145\text{pcf}$	Asphalt unit weight
$t_a = 2\text{in}$	Asphalt overlay thickness
$h_{col} = 18.5\text{ft} - 10\text{ft} = 9\text{ft}$	Interior column height
$col_{weight} = \gamma_c \cdot A_g = 0.34 \cdot \text{klf}$	Column self weight (per column length)
$\text{Dead} = (\gamma_c \cdot h + \gamma_a \cdot t_a) \cdot A_{trib} + (col_{weight} \cdot h_{col}) = 21 \cdot \text{kip}$	Dead load acting over tributary area
$\text{Live} = \frac{(\phi P_n - 1.2 \cdot \text{Dead})}{1.6} = 337 \cdot \text{kip}$	
$LL_{int} = \frac{\text{Live}}{A_{trib}} = 2341 \cdot \text{psf}$	Allowable distributed live load



Allowable Distributed Live Load (Exterior Column):

$A_{trib.ext} = 6ft \cdot 10.5ft = 63ft^2$ Tributary area

$h_{col.ext} = 16ft - 10ft = 6ft$ Exterior column height

$Dead_{ext} = (\gamma_c \cdot h + \gamma_a \cdot t_a) \cdot A_{trib.ext} + (col\ weight \cdot h_{col.ext}) = 10 \cdot kip$ Dead load acting over tributary area

$Live_{ext} = \frac{(\phi P_n - 1.2 \cdot Dead_{ext})}{1.6} = 345 \cdot kip$

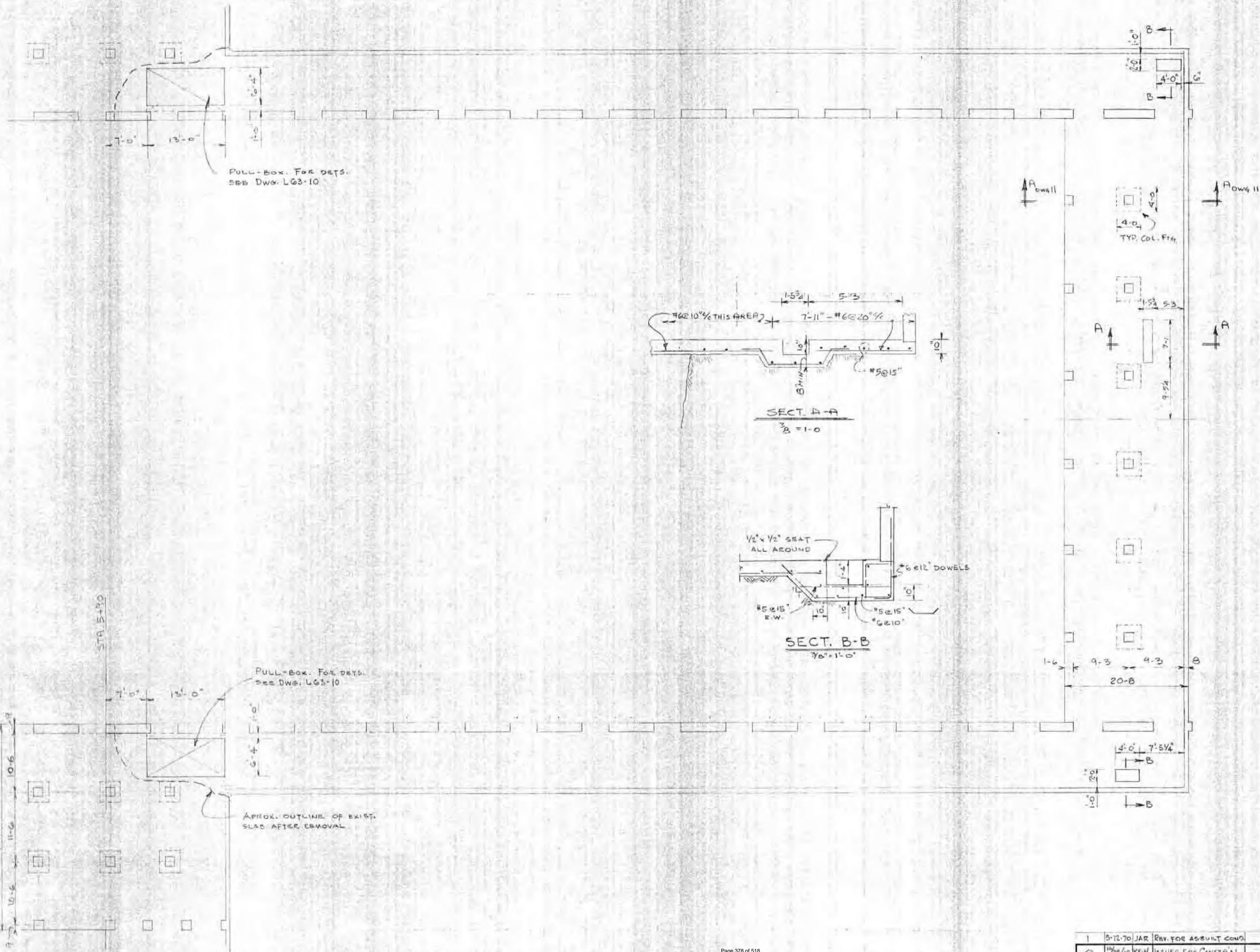
$LL_{ext} = \frac{Live_{ext}}{A_{trib.ext}} = 5481 \cdot psf$ Allowable distributed live load

$LL = \min(LL_{int}, LL_{ext}) = 2341 \cdot psf$

$LL < 2300 \text{ psf}$

Appendix B: Historical Structural Drawings

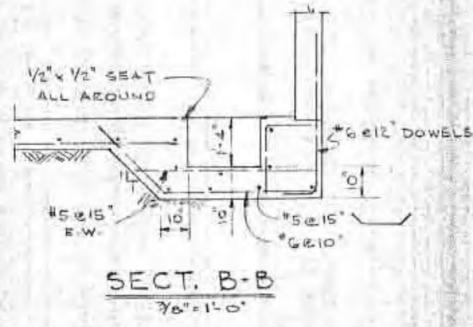
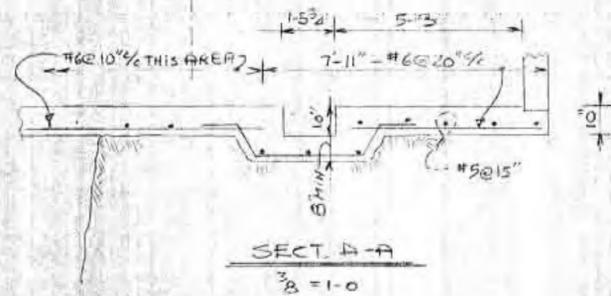




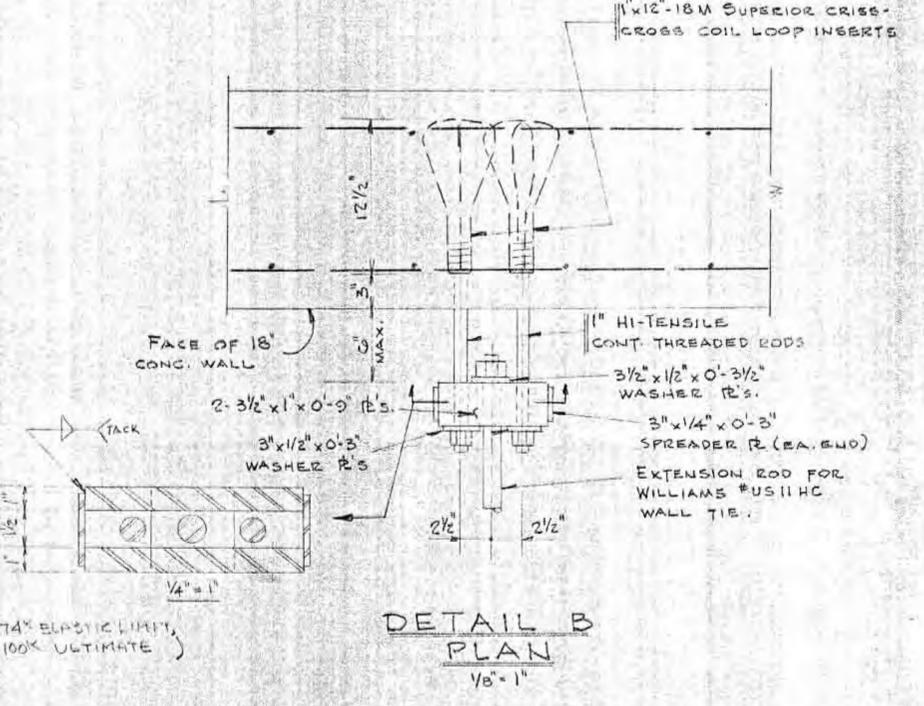
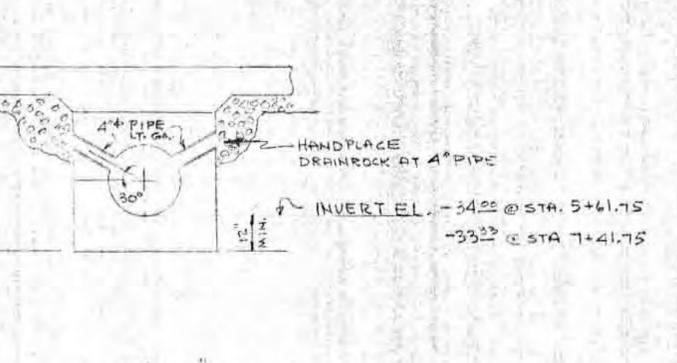
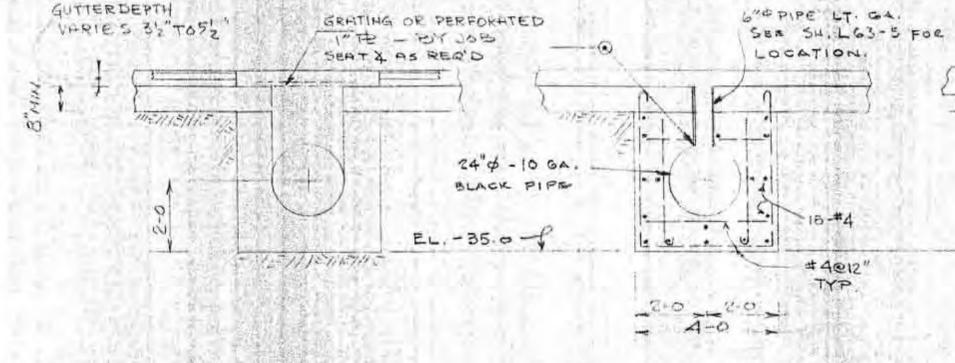
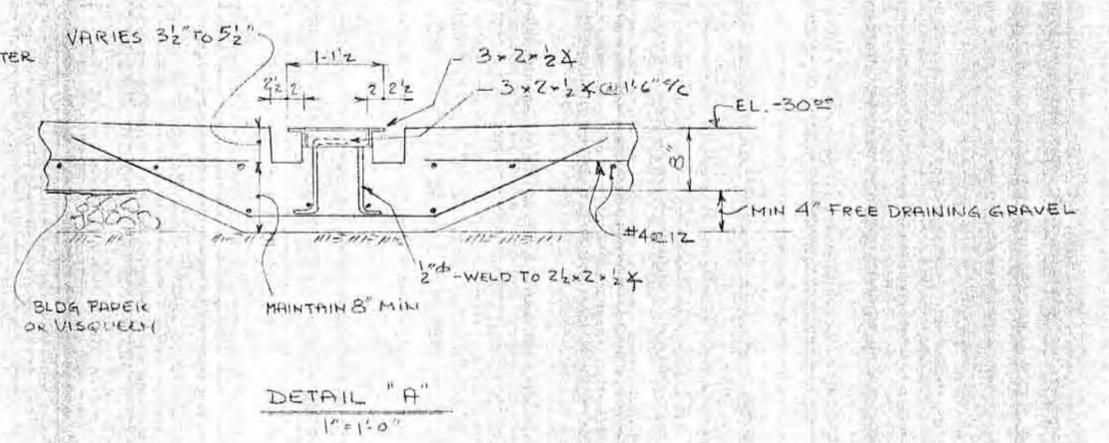
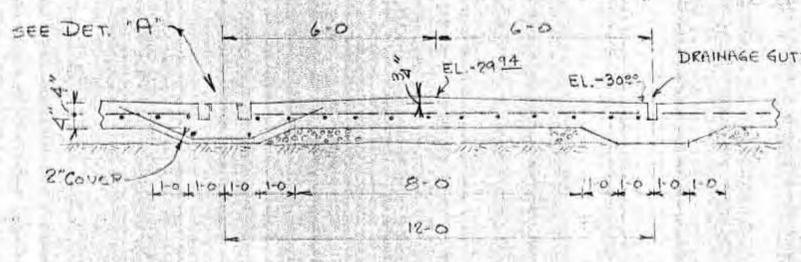
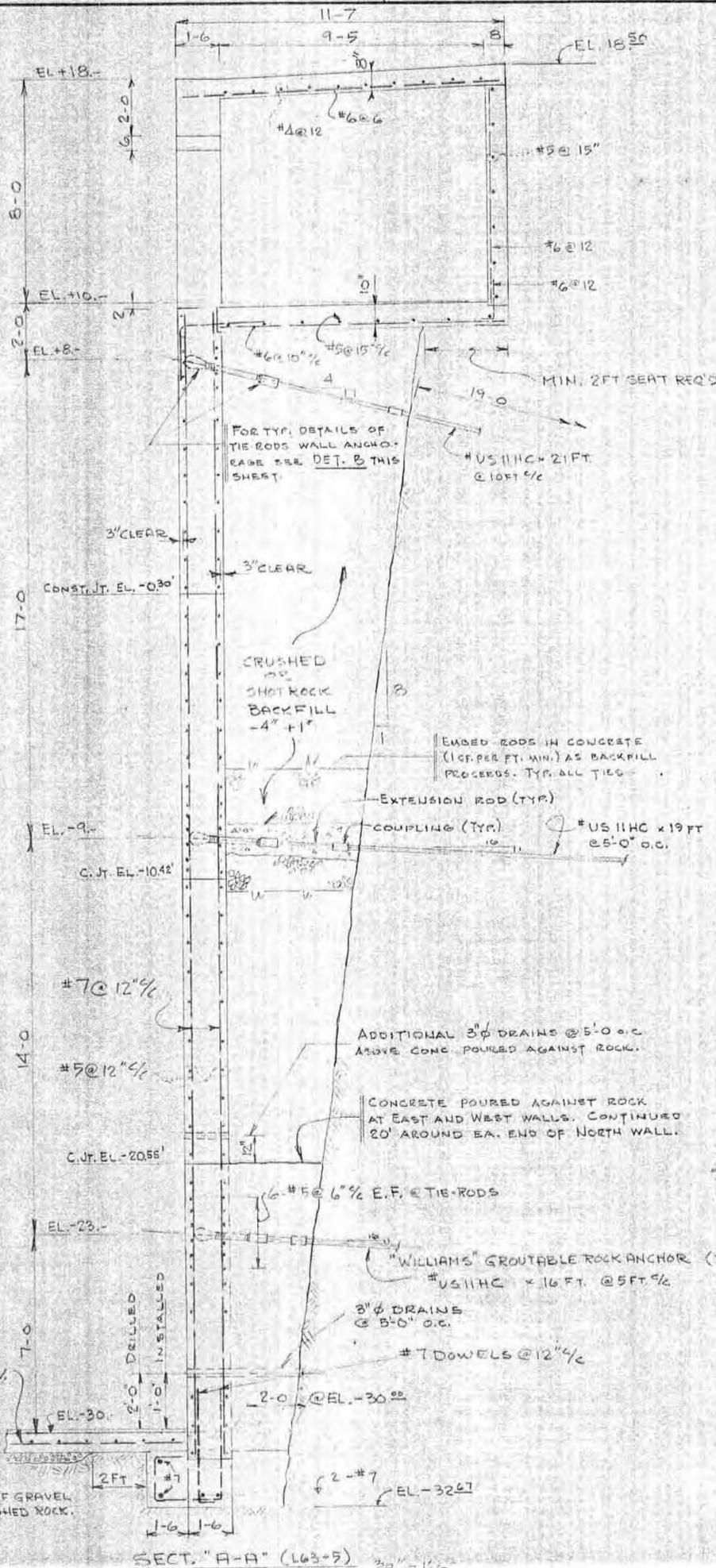
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SEE DWG. L63-10

PULL-BOX FOR DRY
SEE DWG. L63-10

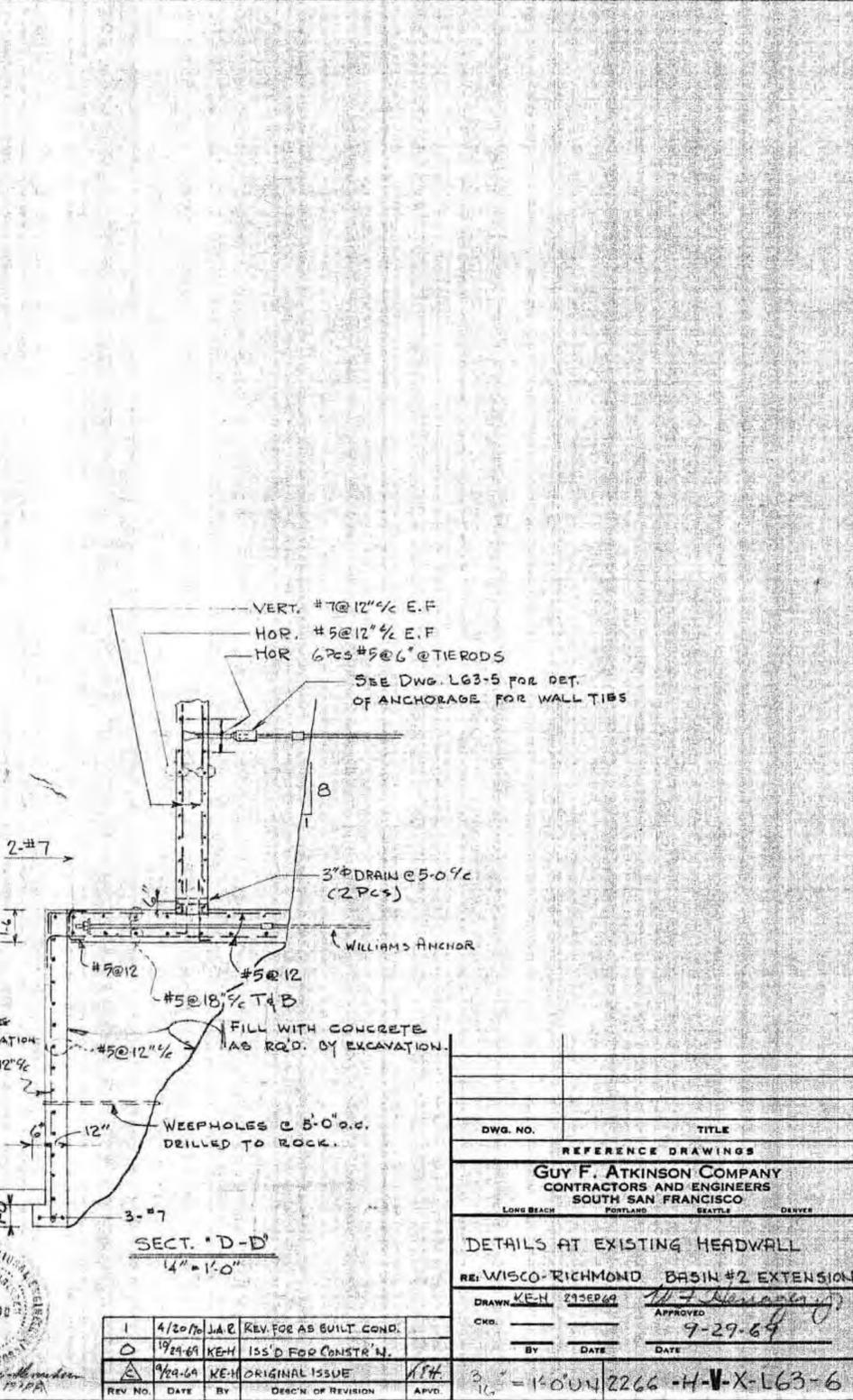
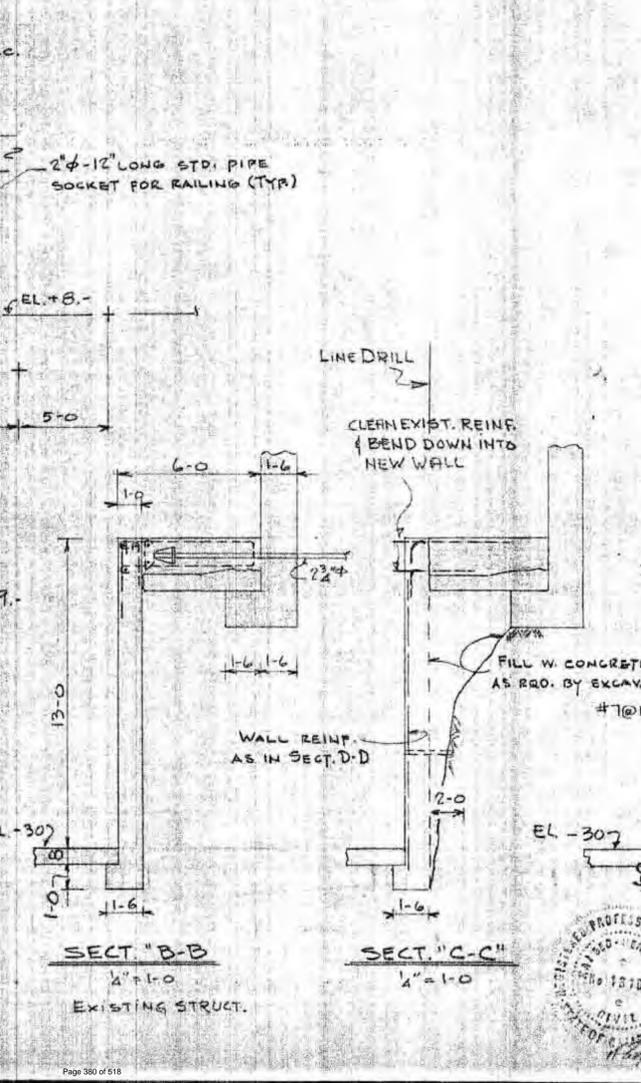
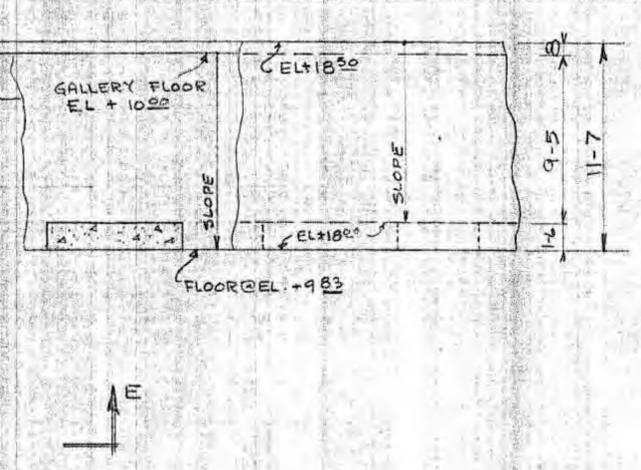
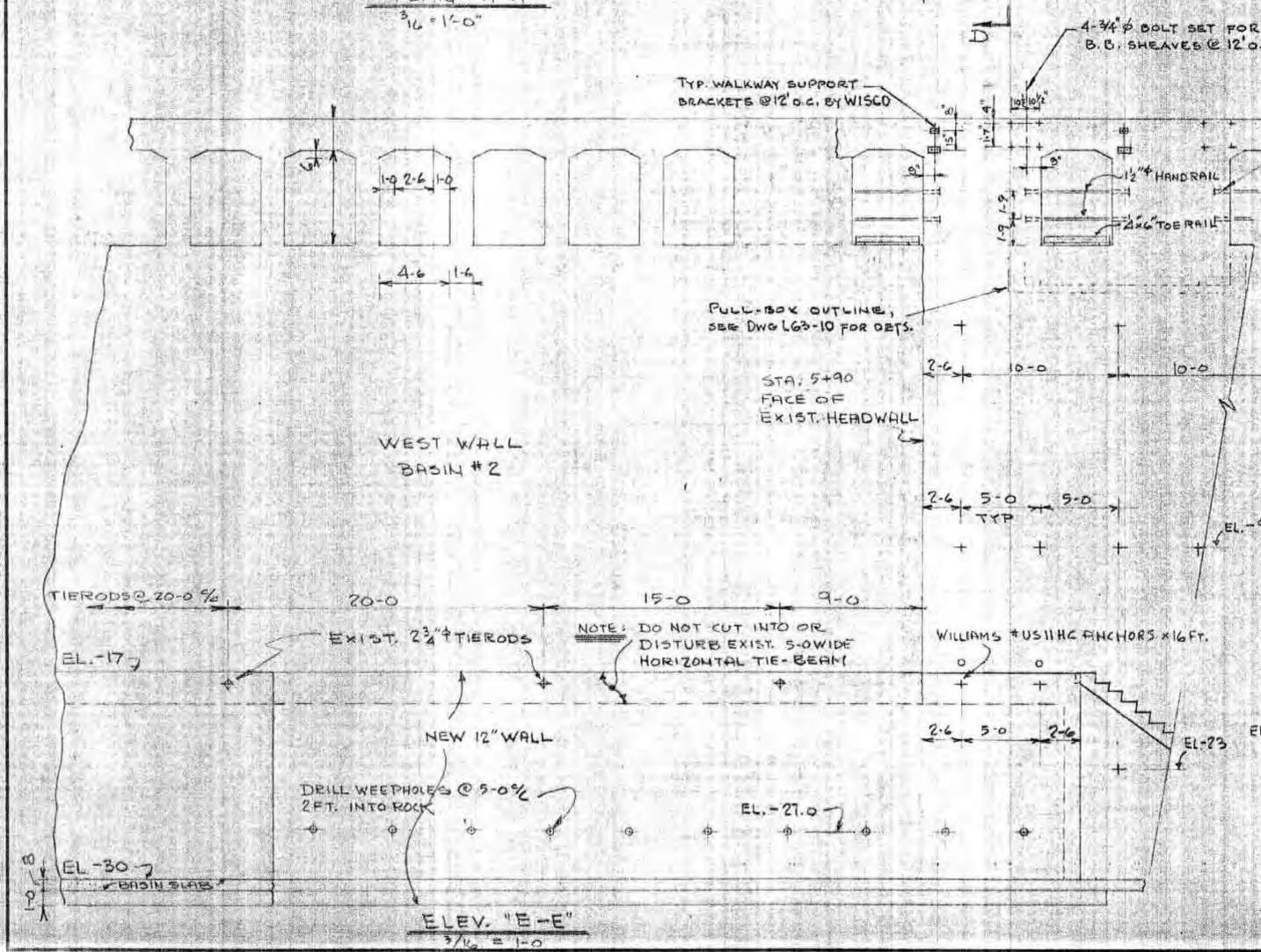
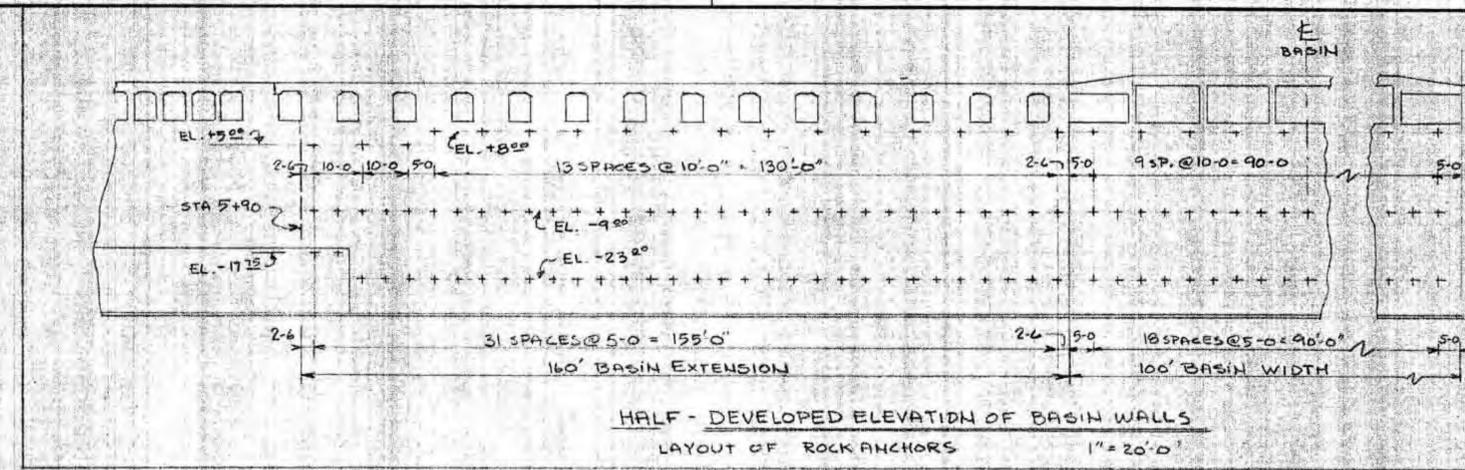
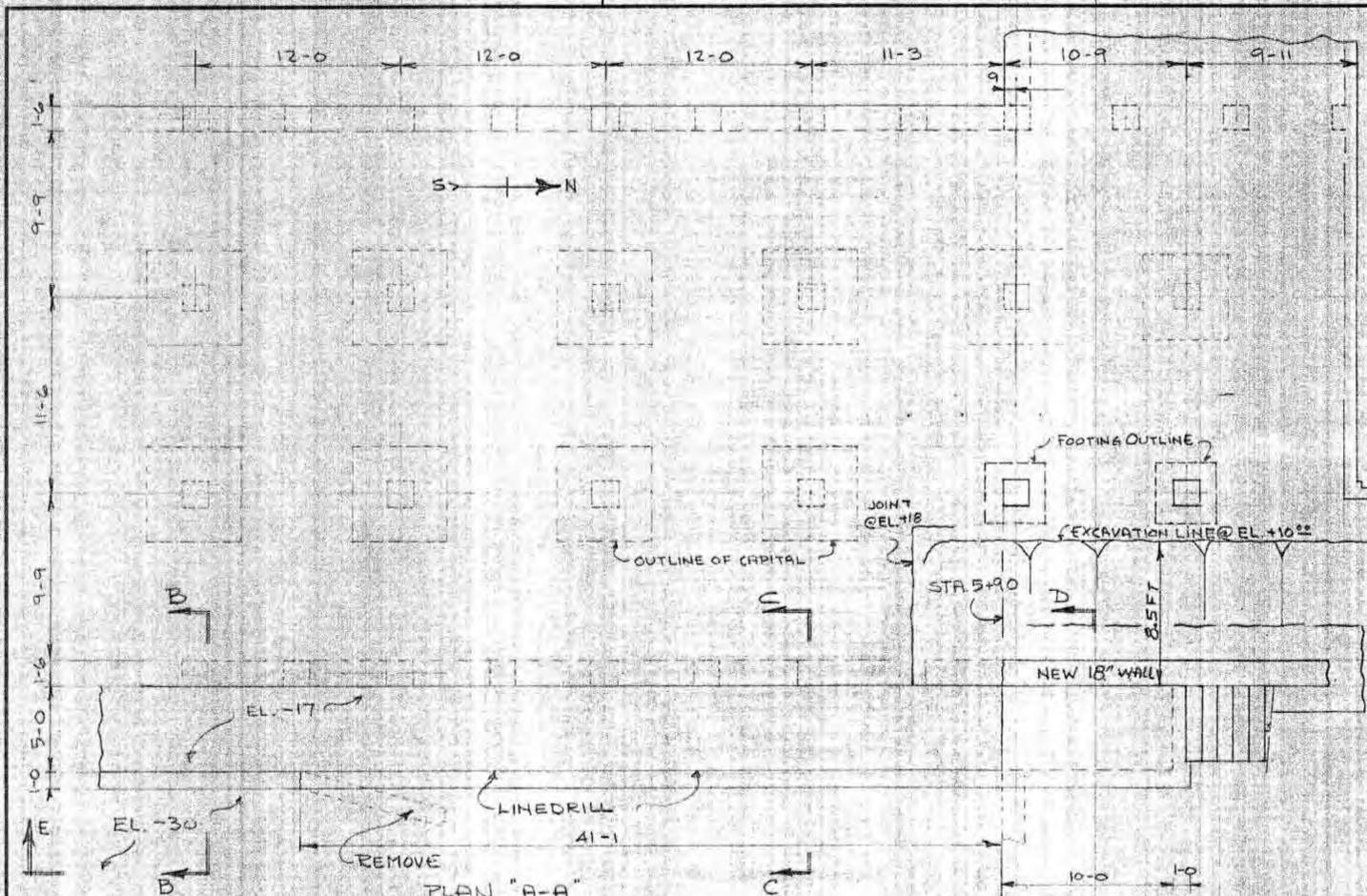
APPROX. OUTLINE OF EXIST.
SLAB AFTER REMOVAL



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GUY F. ATKINSON COMPANY CONTRACTORS AND ENGINEERS SOUTH SAN FRANCISCO				
LONG BEACH	PORTLAND SEATTLE DENVER			
GALLERY FLOOR @ EL. +10.00				
RE: WISCO-RICHMOND BASIN #2 EXTENSION				
DRAWN: KEH 230619	APPROVED:			
CHKD: _____	BY: _____ DATE: _____			
1	5-12-70 JAR REV. FOR AS-BUILT COND.			
2	11/21/79 KEH ISSUED FOR CONSTRUCTION			
REV. NO.	DATE	BY	DESCR. OF REVISION	APPROVED
B'-1-0 U.N.				2266-H-V-X-L63-B

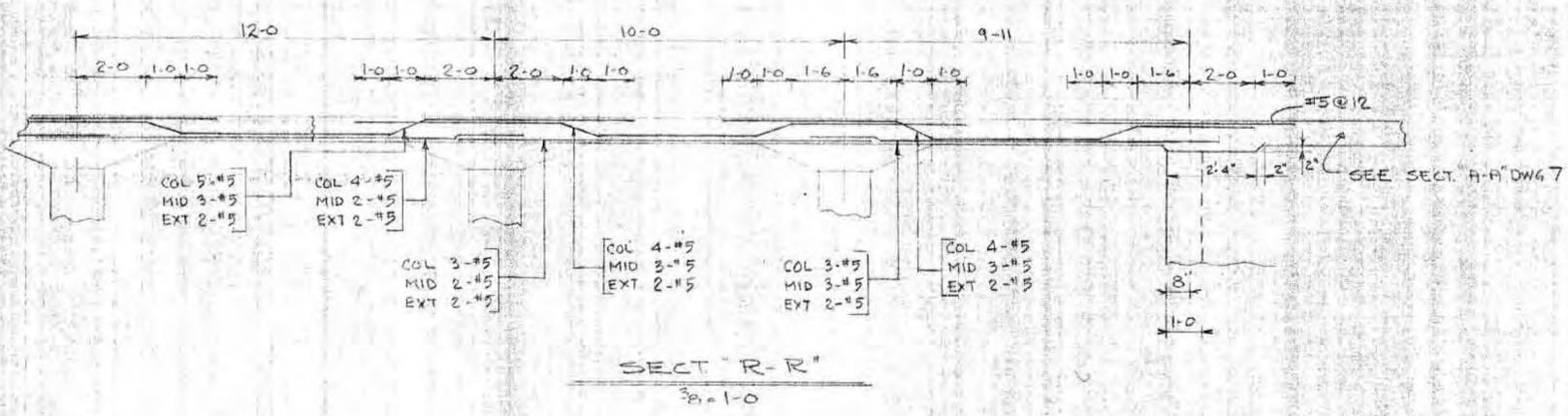
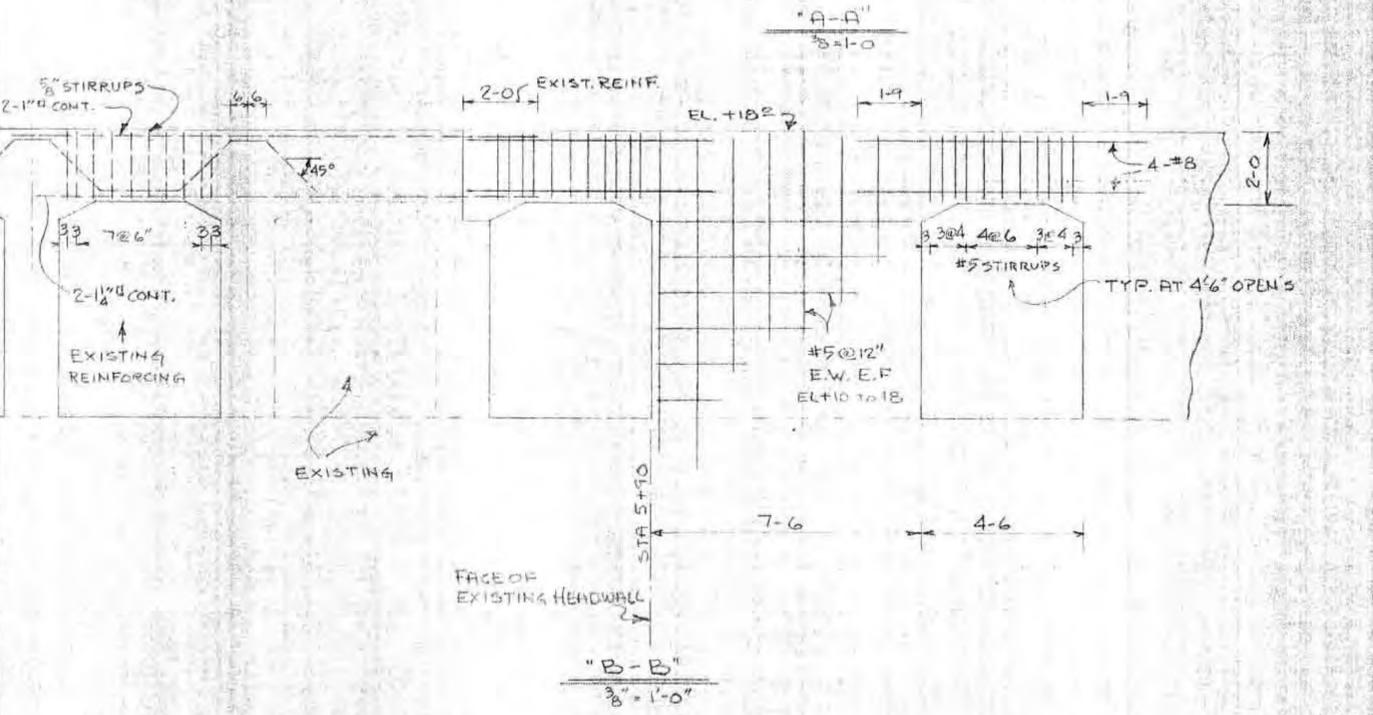
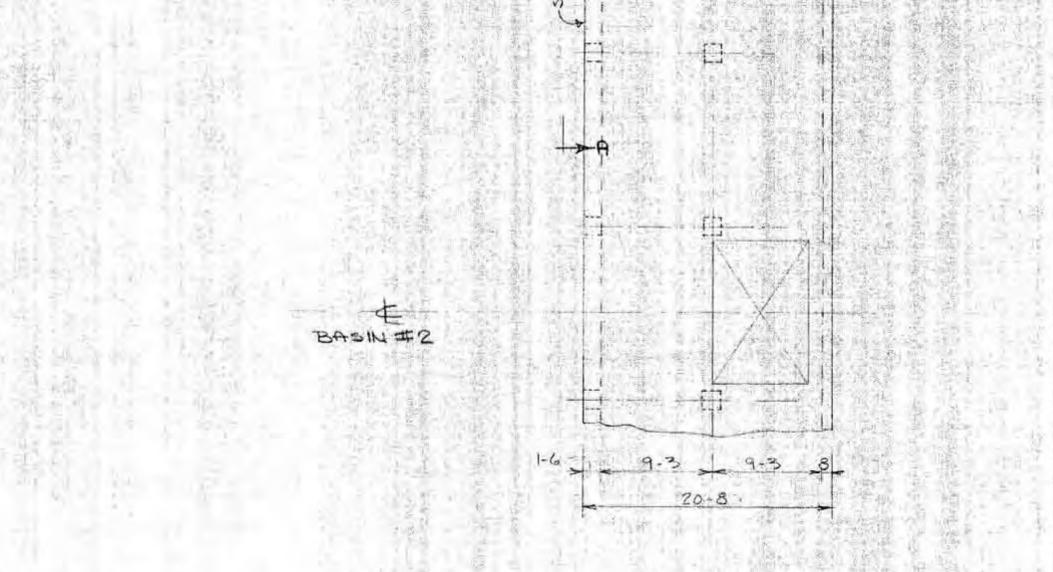
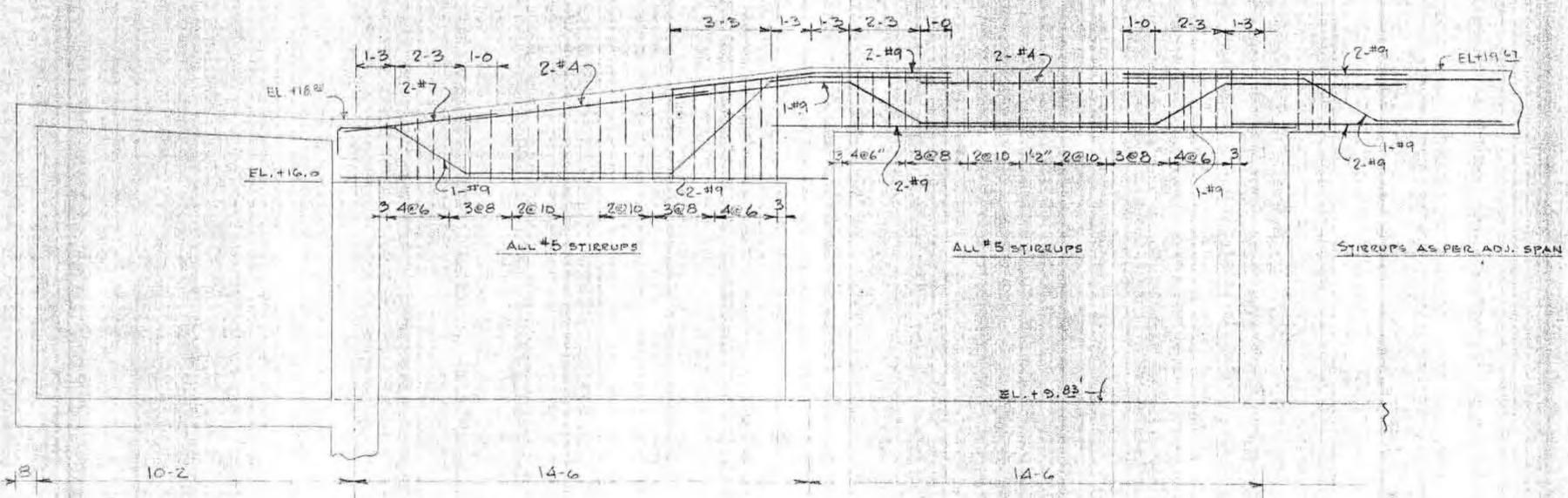
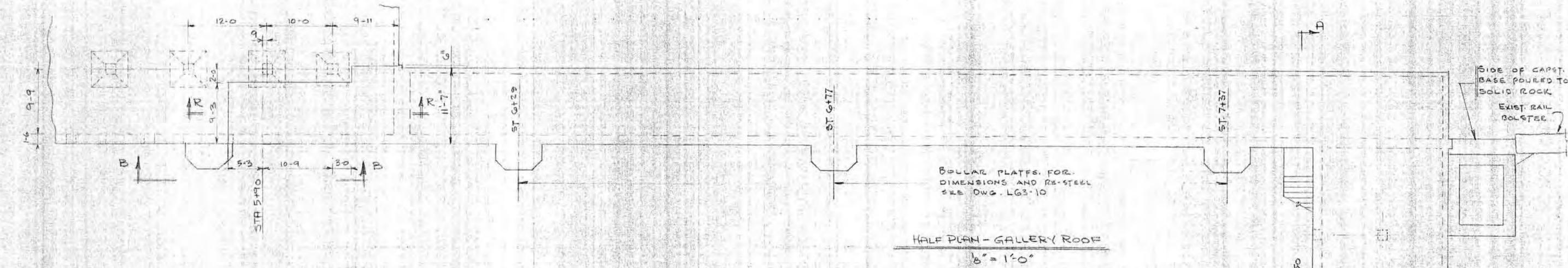


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STRUCTURAL DETAILS				
RE: WISCO-RICHMOND BASIN #2 EXTENSION				
DRAWN	APPROVED			
CHKD.	DATE			
BY	DATE			
REV. NO.	DATE	BY	DESC'N. OF REVISION	APVD.
1	4-20-70	J.A.R.	REV. FOR AS BUILT COND.	
0	10/27/69	KEH	ISSUED FOR CONSTRUCTION	
1	10/15/69	KEH	RE-STL. EL. GAL. ROOF	
2	1/29/69	KEH	ORIGINAL ISSUE	
SCALE: AS NOTED 2266-H-V-X-L63-7				

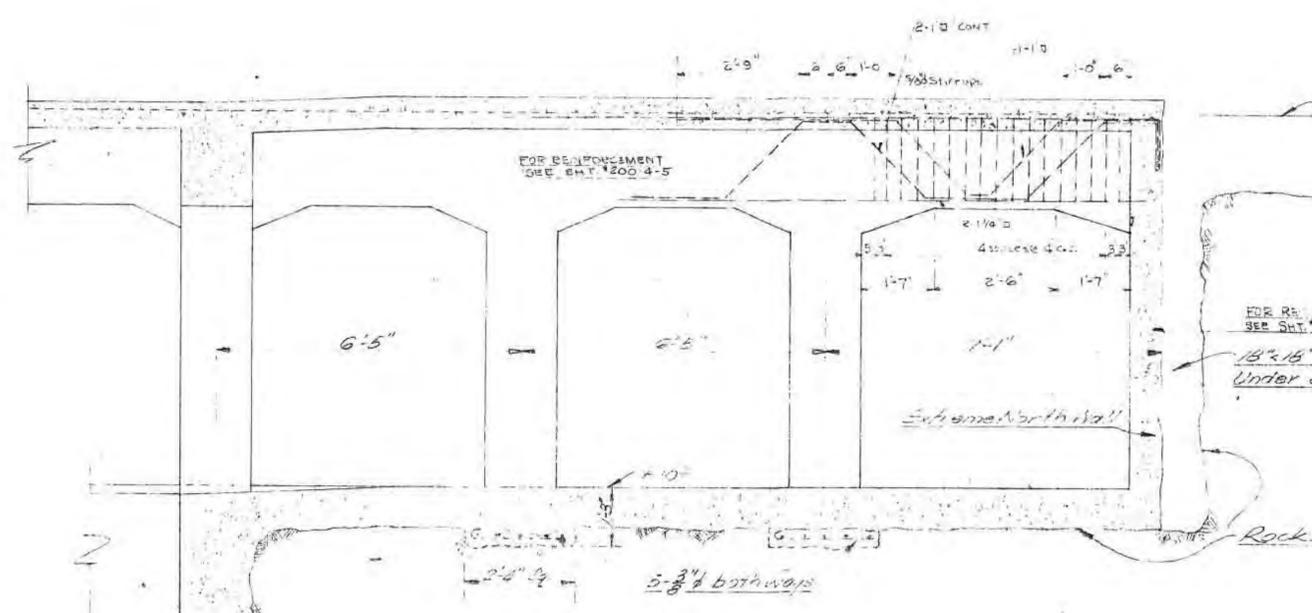
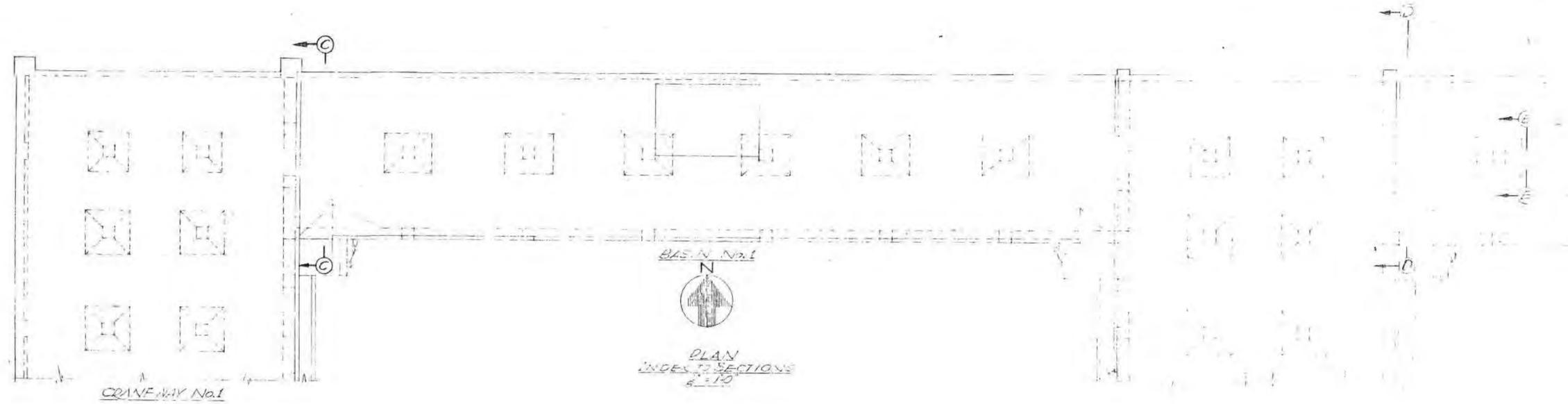


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REFERENCE DRAWINGS				
GUY F. ATKINSON COMPANY CONTRACTORS AND ENGINEERS SOUTH SAN FRANCISCO				
DETAILS AT EXISTING HEADWALL				
RE: WISCO-RICHMOND BASIN #2 EXTENSION				
DRAWN: KEN	21 SEP 69			
CHKD: [Signature]	APPROVED: [Signature]			
BY: [Signature]	DATE: 9-29-69			
REV. NO.	DATE	BY	DESC'N OF REVISION	APVD.
1	4/20/76	JAC	REV. FOR AS BUILT COND.	
2	10/24/69	KEN	ISS'D FOR CONSTR'N.	
3	7/29/69	KEN	ORIGINAL ISSUE	KH

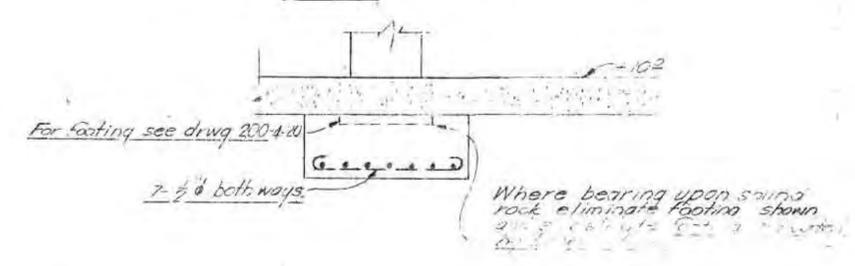




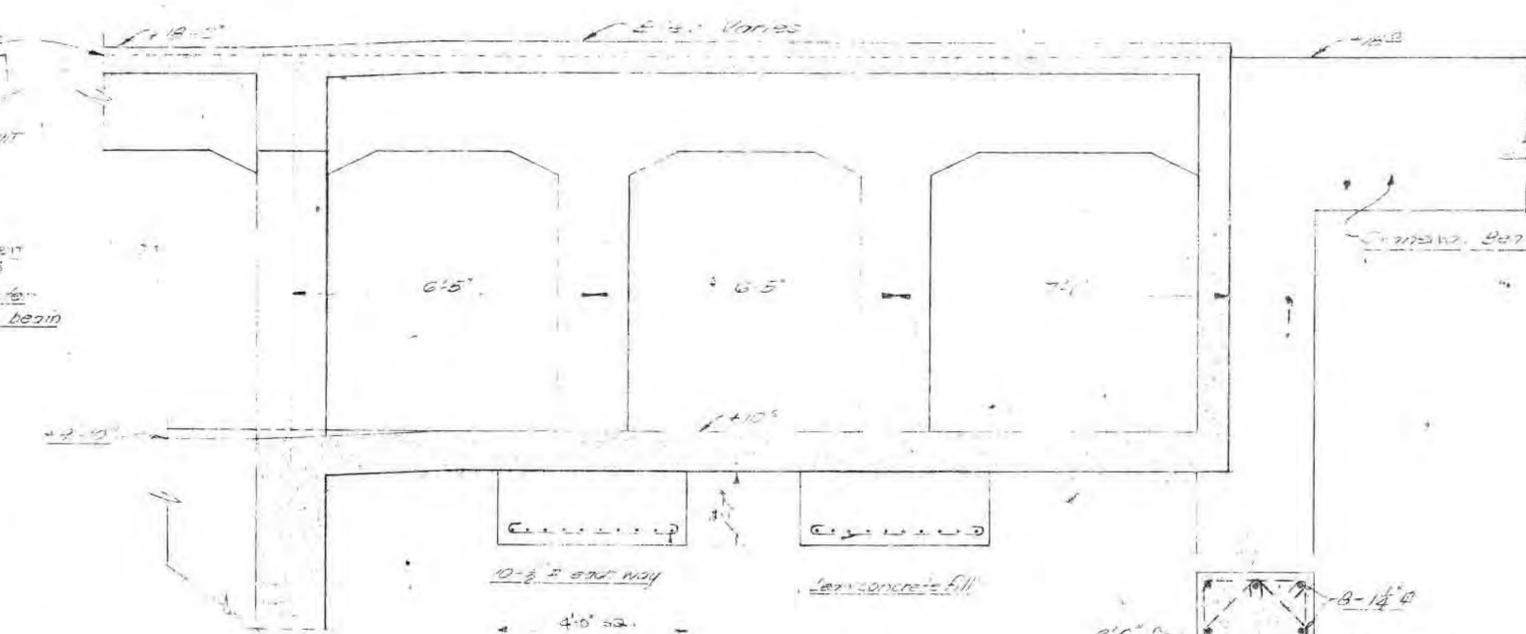
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GUY F. ATKINSON COMPANY CONTRACTORS AND ENGINEERS SOUTH SAN FRANCISCO	
LONG BEACH	PORTLAND SEATTLE DENVER
CRANE RAIL BEAMS & GALLERY COL'S	
RE: WISCO-RICHMOND - BASIN #2 EXTENSION	
DRAWN KE-H 10/29/69	APPROVED
CRD.	BY DATE DATE
1 5-8-70 JAR REV. FOR AS BUILT COND.	
2 11/29/69 KE-H ISSUED FOR CONSTN.	
REV. NO. DATE BY DES'N OF REVISION	APVD.
SCALE: A.N.	2266-H-V-X-LG3-9



SECTION DD
 APPLIES TO CRANEWAYS 2 TO 6 INCL. ONLY
 WHERE BEARING ON SOUND ROCK
 $\frac{1}{2}'' = 1'-0''$



SECTION E-E
 APPLIES TO SECTIONS BETWEEN CRANEWAYS
 $\frac{1}{2}'' = 7'-0''$

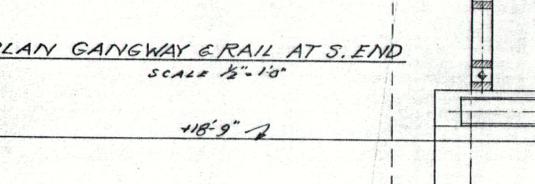
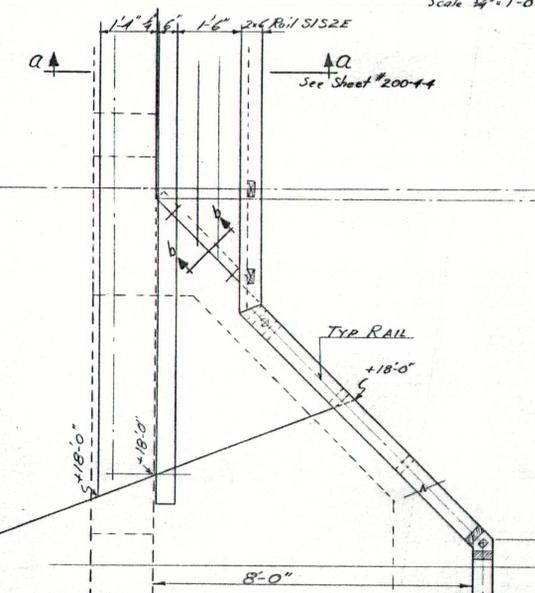
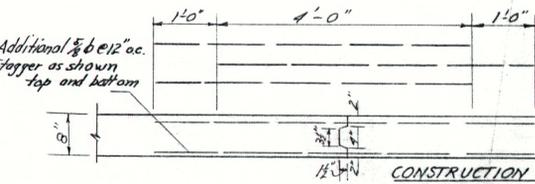
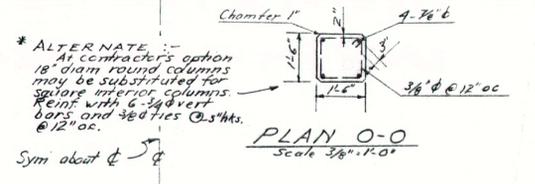
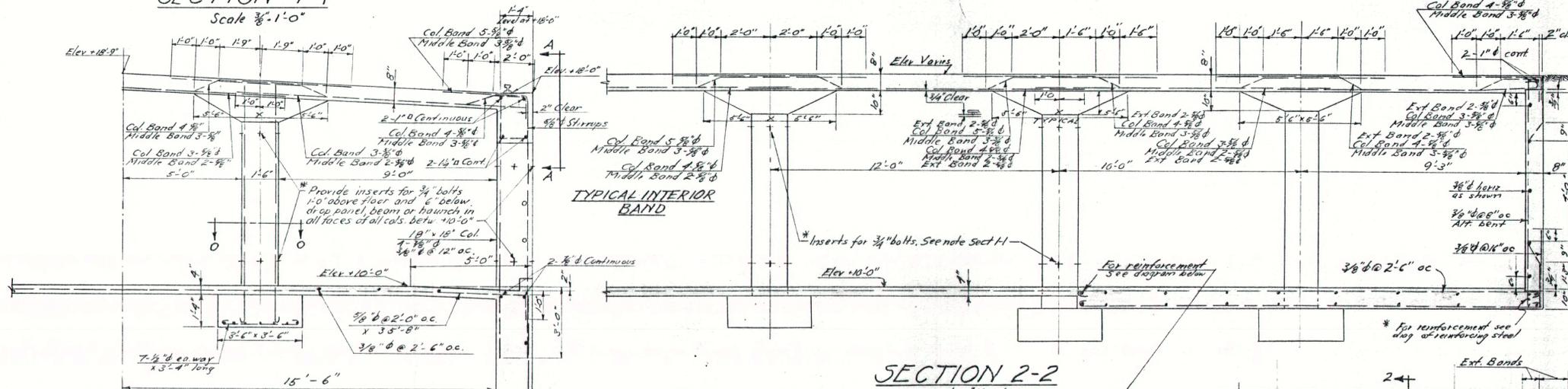


SECTION CC
 APPLIES TO CRANEWAY #1 ONLY
 $\frac{1}{2}'' = 1'-0''$

NOTE:
 This drawing supplies only information
 as given on drawings 200-4-5.

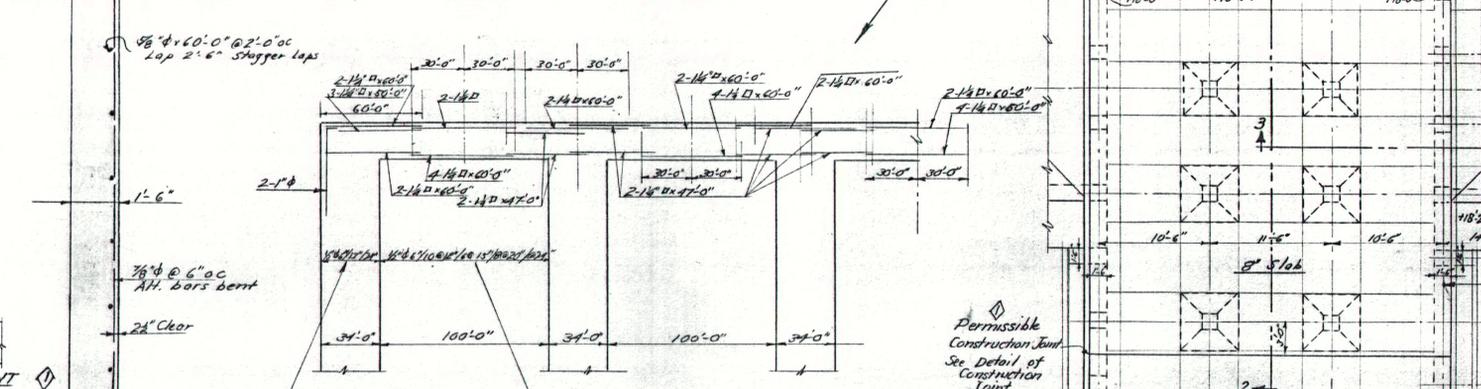
REVISIONS				KAISER COMPANY, INC.	
MK.	DATE	BY	OK	RICHMOND, CALIFORNIA	
				BASINS	
				CRANEWAY COLUMNS, WALL	
				PLASTER & FOOTING DETAILS	
				DATE 5-23-42	SUBMITTED <i>[Signature]</i>
				SCALE Notes	APPROVED <i>[Signature]</i>
				DRAWN BY ELL	200-4-21
				CHECKED BY	

SECTION 1-1
Scale 3/8"=1'-0"

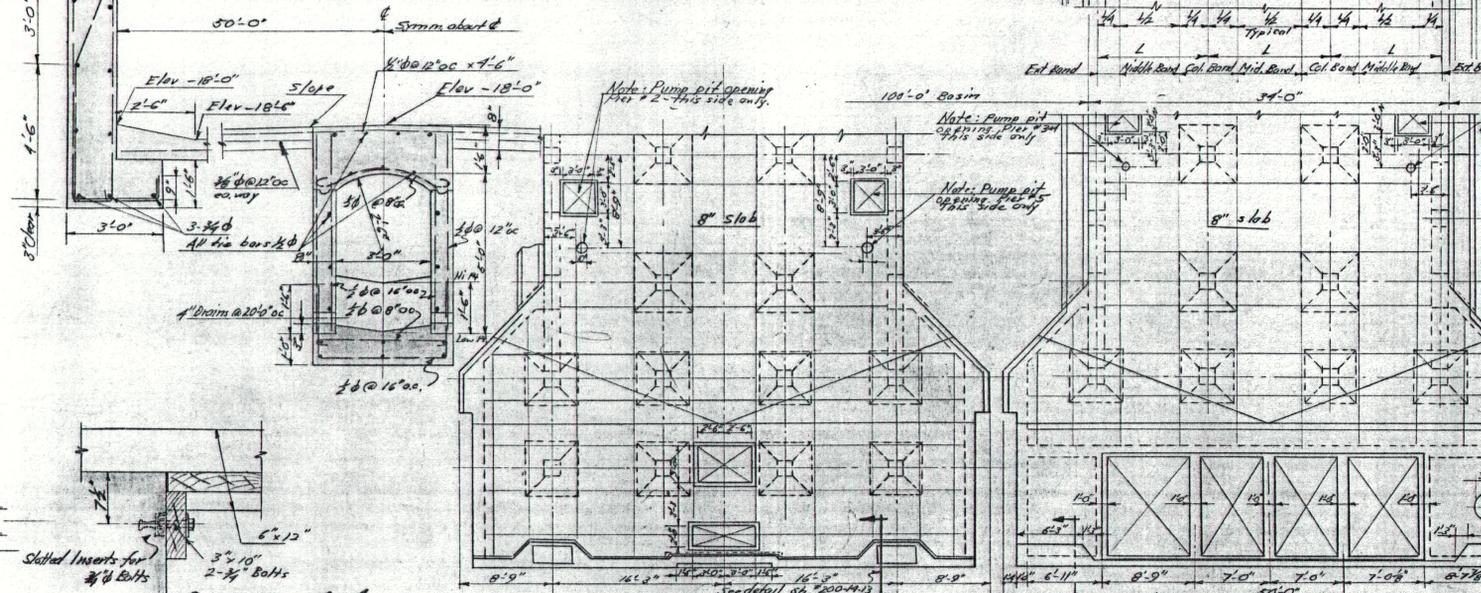


TYPICAL INTERIOR BAND

SECTION 2-2
Scale 3/8"=1'-0"

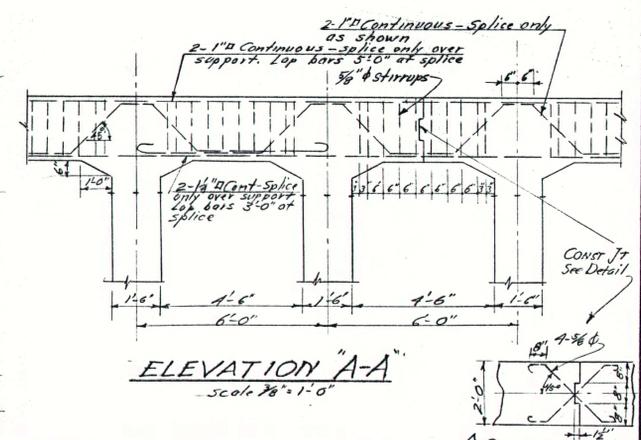


REINFORCING STEEL IN SLAB AT EL +10'-0"
NORTH END OF DOCKS

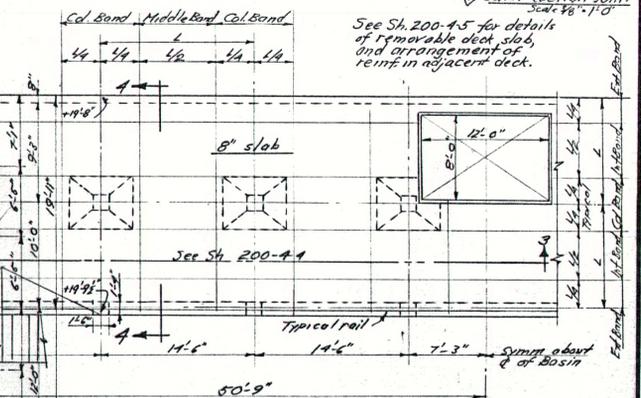


FRAMING PLAN AT INTAKE PIER

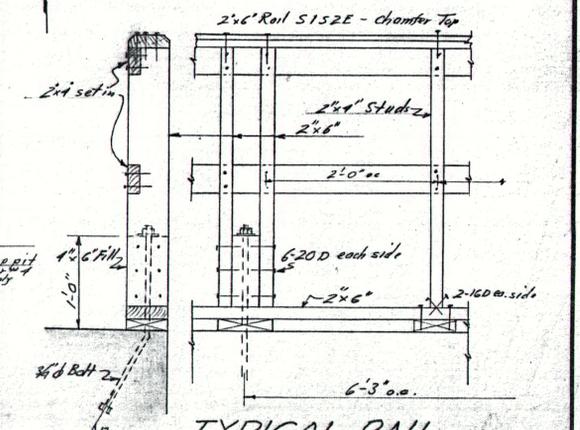
FRAMING PLAN AT PUMP HOUSE PIER



ELEVATION A-A
Scale 3/8"=1'-0"

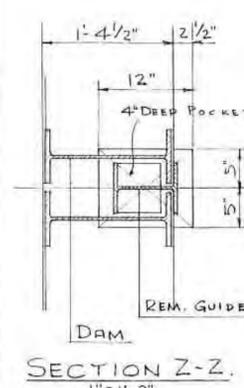
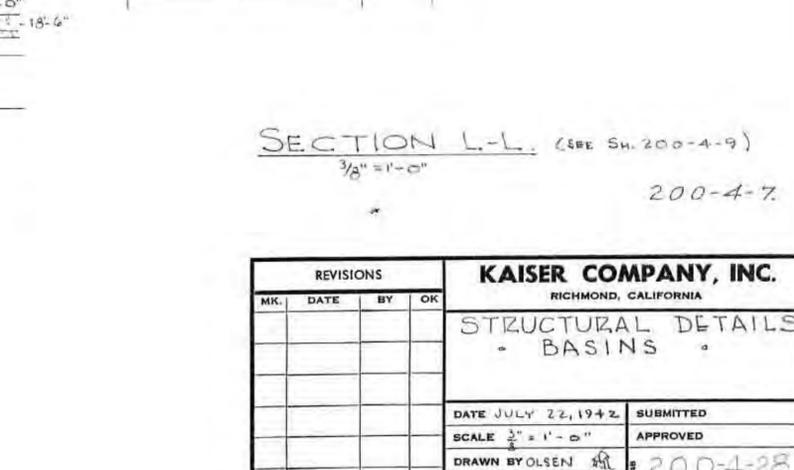
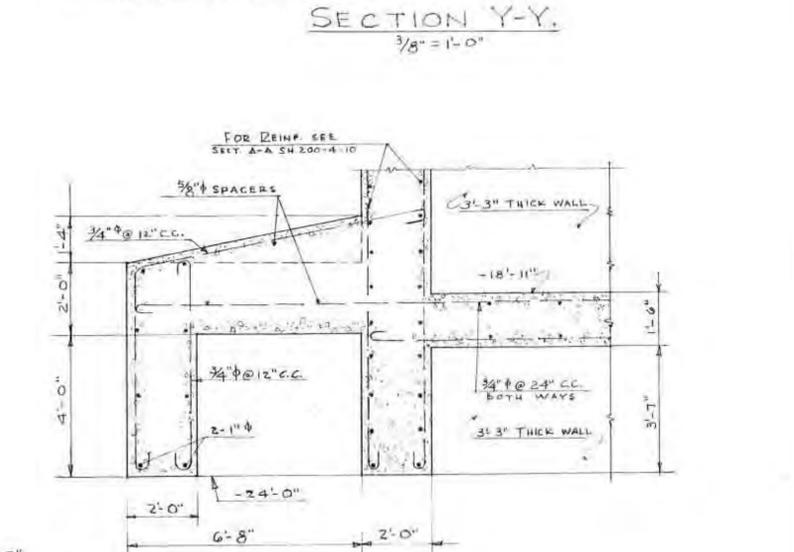
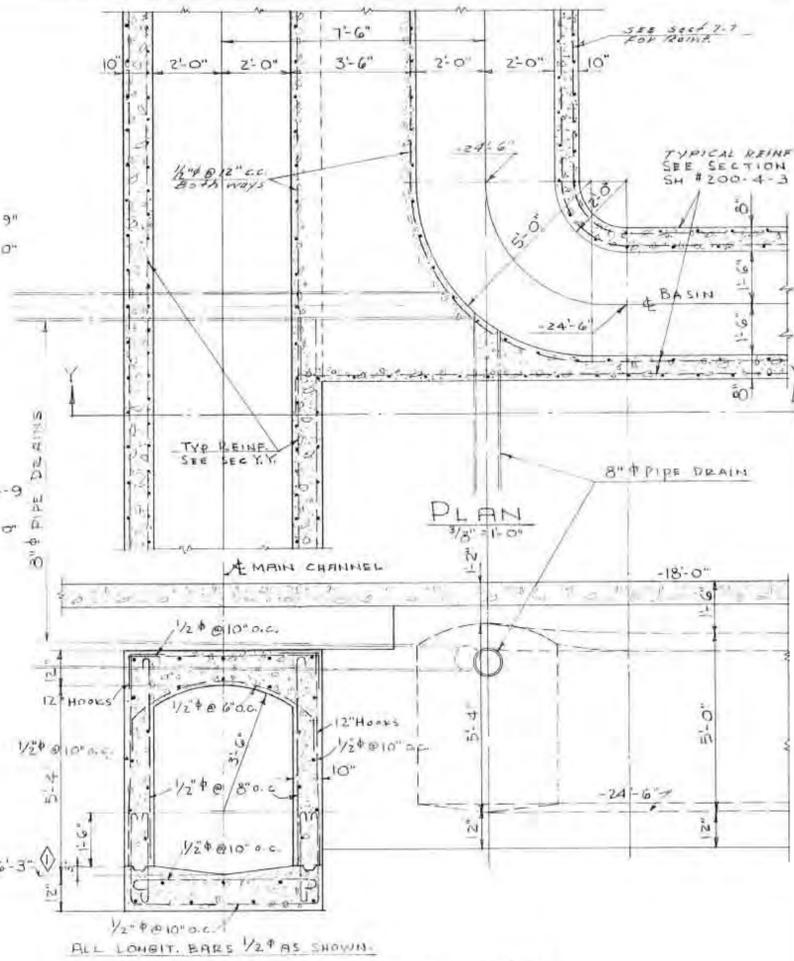
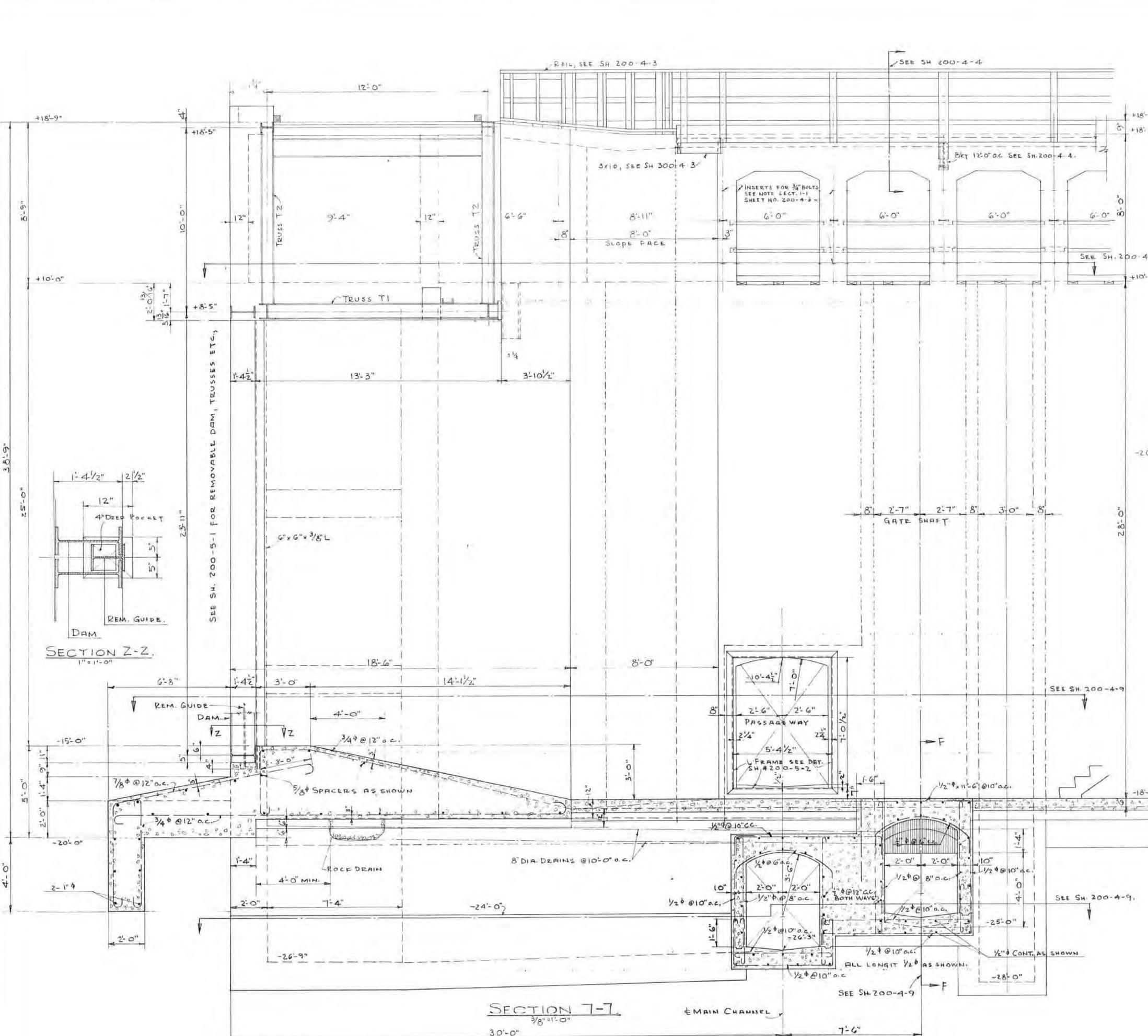


FRAMING PLAN AT TOP DECK ELEVATION
Scale 1/8"=1'-0"



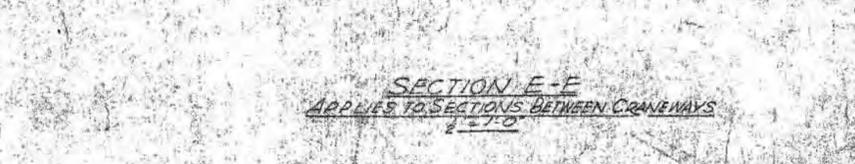
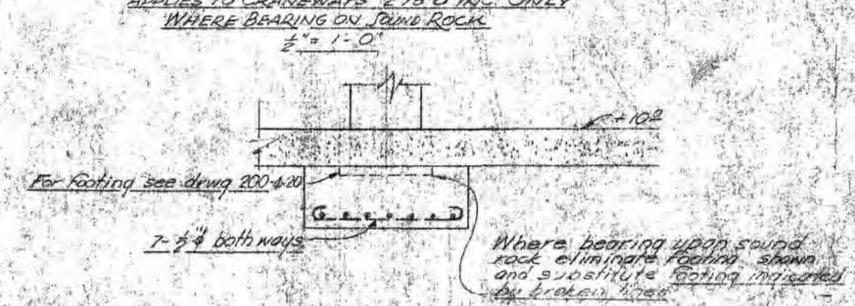
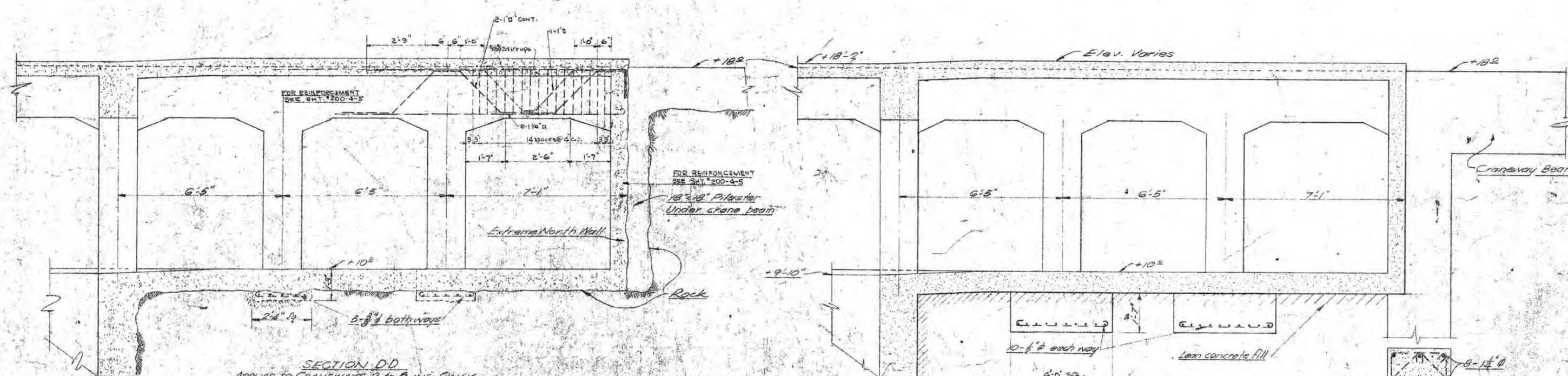
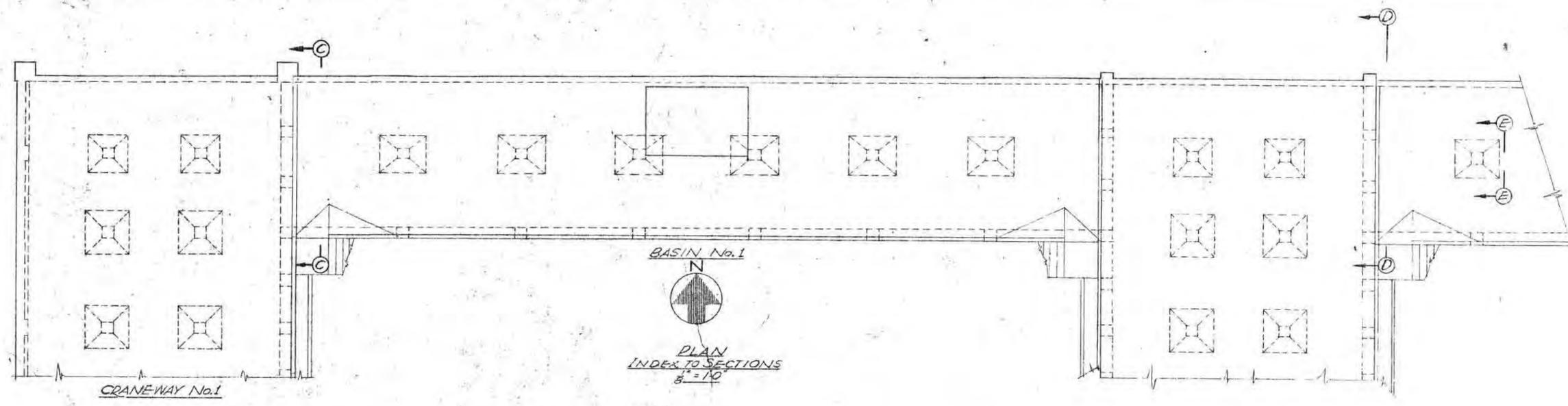
TYPICAL RAIL
Scale 1/2"=1'-0"

REVISIONS				KAISER COMPANY, INC.	
NO.	DATE	BY	CHK	RICHMOND, CALIFORNIA	
1	5/25/42	IFR		STRUCTURAL DETAILS	
				BASINS	
				DATE	SUBMITTED
				SCALE	APPROVED
				DRAWN BY	200-4-3
				CHECKED BY	



SECTION 7-7
3/8" = 1'-0"
30'-0"

REVISIONS				KAISER COMPANY, INC.	
MK.	DATE	BY	OK	RICHMOND, CALIFORNIA	
				STRUCTURAL DETAILS	
				- BASINS -	
				DATE JULY 22, 1942	SUBMITTED
				SCALE 3/8" = 1'-0"	APPROVED
				DRAWN BY OLSEN	200-4-28
				CHECKED BY	



NOTE:
This drawing supplies similar information
as given on drawing 200-4-5.

REVISIONS				KAISER COMPANY, INC.	
MK	DATE	BY	OK	RICHMOND, CALIFORNIA	
				BASINS	
				CRANEWAY COLUMNS, WALL	
				PILASTER & FOOTING DETAILS	
				DATE 5-23-42	SUBMITTED H.N.B.
				SCALE Noted	APPROVED
				DRAWN BY BALL	200-4-21
				CHECKED BY	

APPLICATION OF MEMBRANE

Preparation of concrete slab:
Surface shall be firm, smooth, and thoroughly dry, and free from all dust, loose and foreign materials.

Application:
Apply the entire surface on which waterproofing is to be applied with a minimum of one (1) gallon per 100 sq ft of primer.

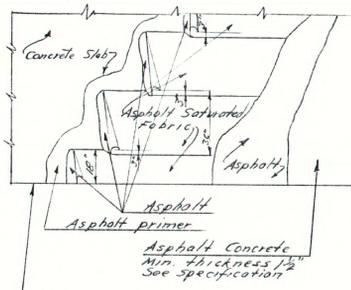
Over this primed surface, mop hot asphalt using not less than forty (40) pounds per 100 sq ft into the asphalt work for embed one (1) layer of asphalt saturated fabric, and thoroughly and uniformly mop down with hot asphalt using not less than forty (40) pounds per 100 sq ft. Fabric shall be free from wrinkles and all air bubbles and in absolute conformity with contour of surface. Fabric shall be covered completely with asphalt. All work shall be so regulated that at the close of each day's work the waterproofing of asphalt shall have been applied to all fabric in place. Special care shall be taken at all laps to see that they are thoroughly sealed down. End laps shall be six inches.

MEMBRANE

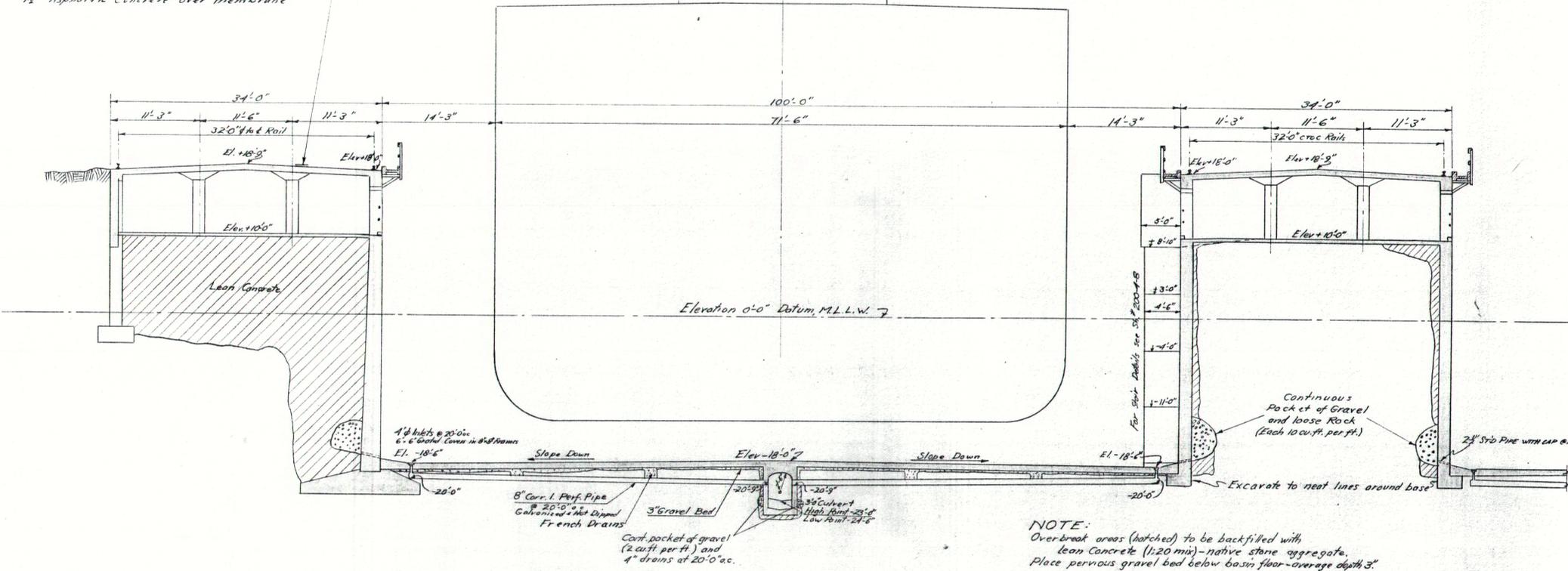
Materials:
Primer shall be in accordance with A.S.T.M. Designation D-21-26 for use with asphalt in damp-proofing and waterproofing below grade.

Asphalt shall be in accordance with A.S.T.M. Designation D-184-25 for use in damp-proofing and waterproofing above ground level.

Asphalt Saturated Fabric shall be in accordance with A.S.T.M. Designation D-172-27 for woven cotton fabric saturated with bituminous substances for use in waterproofing.



Waterproofing membrane over entire supported top deck around basin
1/2" Asphaltic Concrete over membrane



TYPICAL CROSS SECTION OF BASIN
SCALE: 1/8" = 1'-0"

GENERAL NOTES

Concrete:
All footings shall be carried down to solid rock or to lean concrete, which has been carried to solid rock. Lean concrete shall develop not less than 300 pounds per square inch strength at 28 days. Lean concrete shall be mixed in the proportion of one part of cement to 20 parts of aggregate, but not less than two sacks of cement shall be used per yard of concrete. Use available bank sand at the site as fine aggregate and native rock crushed and graded from 1/4" to 1" as coarse aggregate.

Concrete for basin slabs shall be mixed in proportion of one part cement to 6 1/2 parts of aggregate, but in no case shall less than 5 1/2 sacks of cement be used per yard of concrete. Not more than 5 1/2 gallons of water shall be used per sack of cement.

All other concrete up to and including elevation plus 10 shall be mixed in the proportion of 1 part cement to 3 1/2 parts of aggregate, but in no case shall less than 6 sacks of cement be used per yard of concrete. Not more than 5 1/2 gallons of water shall be used per sack of cement.

All concrete above elevations plus 10 shall be mixed in the proportion of 1 part cement to 3 1/2 parts of aggregate, but in no case shall less than 6 3/4 sacks of cement be used per yard of concrete. Not more than 5 gallons of water shall be used per sack of cement.

Fine aggregate shall range in size from 1/4" of an inch to that passing a 50 mesh sieve. Coarse aggregate shall range in size from 1/4" of an inch to 1 1/2 inches for Basin slabs, from 1/4" of an inch to 2 inches for all other concrete below elevation plus 10, and from 1/4" of an inch to 1 1/2 inches for all concrete above elevation plus 10. Aggregates shall be graded to give a minimum of voids.

All cement shall conform to A.S.T.M. specifications for Portland Cement.

Portland Cement (A.S.T.M. C-150-41 Type 1) shall be used in all concrete work except in walls, slabs, etc., in continuous contact with sea water, where Moderate Sulfate Resisting Cement (A.S.T.M. C-150-41 Type II) shall be used.

Concrete shall be placed immediately after mixing in layers of such thickness as may be directed and it shall be compacted throughout the mass by means of mechanical vibrators. Where necessary, mechanical vibrators shall be supplemented by manual tool vibrating to produce concrete free from pockets.

REINFORCING STEEL:
All reinforcing bars shall be corrugated and conform to A.S.T.M. specifications for structural grade reinforcing steel.

Unless otherwise shown or noted all bars shall be lapped not less than 40 diam. of splice points. Splices shall be well staggered with 1 1/2" minimum clearances between bars of laps.

Unless otherwise shown or noted all horizontal wall, wall beam and wall footing bars shall be continuous from end to end of wall carried to within 2 inches of end face and bent 12 inches around all corners; bars shall run thru columns and column footings.

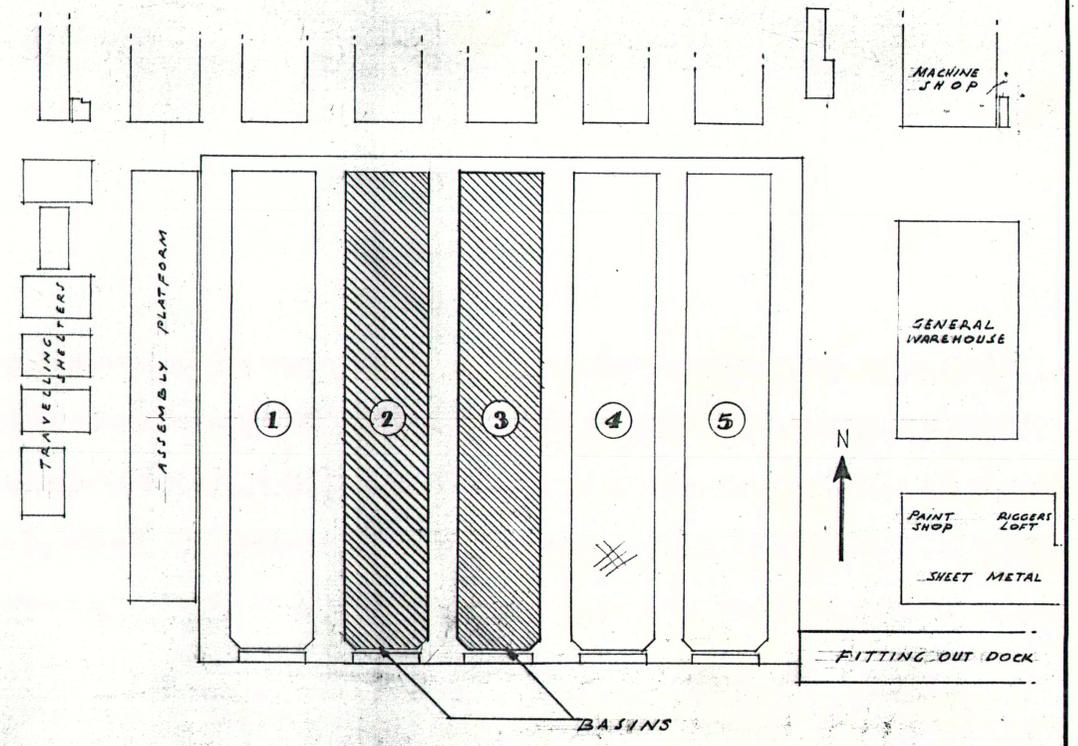
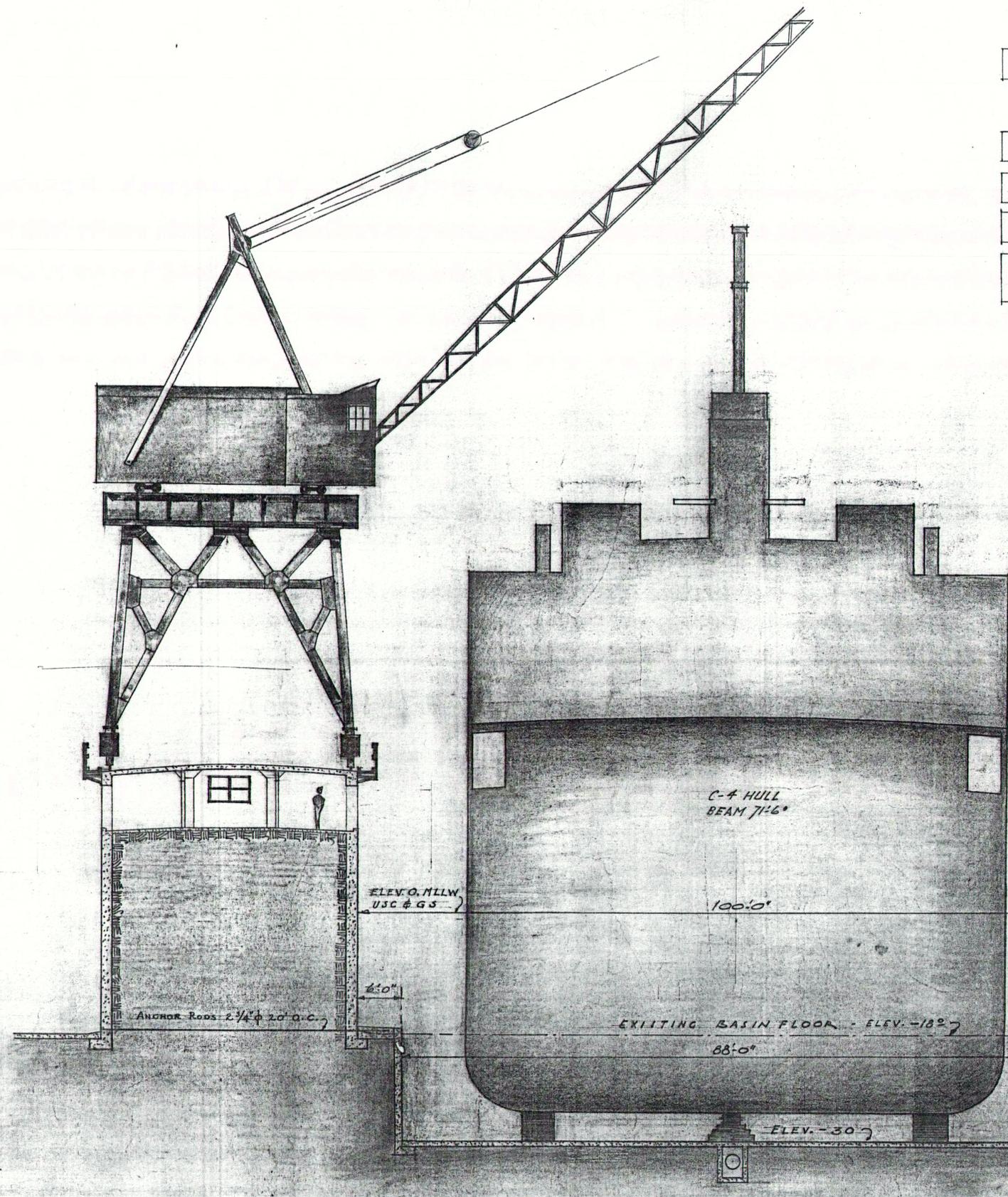
Provide tie bars and supports of an approved type to hold all reinforcing bars accurately and rigidly in place at all times.

NOTE:
Overbreak areas (hatched) to be back-filled with lean concrete (1:20 mix) - native stone aggregate. Place pervious gravel bed below basin floor - average depth 3".

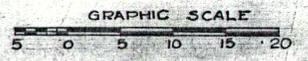
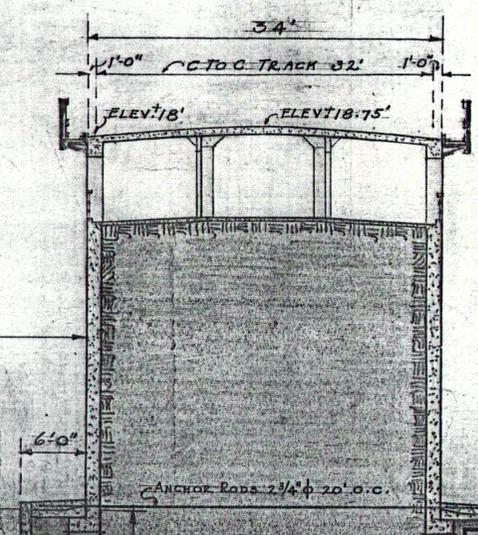
Frank J. ...

REVISIONS				KAISER COMPANY, INC.	
NO.	DATE	BY	OK	RICHMOND, CALIFORNIA	
				CROSS SECTION	
				BASINS	
				DATE	SUBMITTED
				SCALE 1/8" = 1'-0"	APPROVED
				DRAWN BY	
				CHECKED BY	200-42

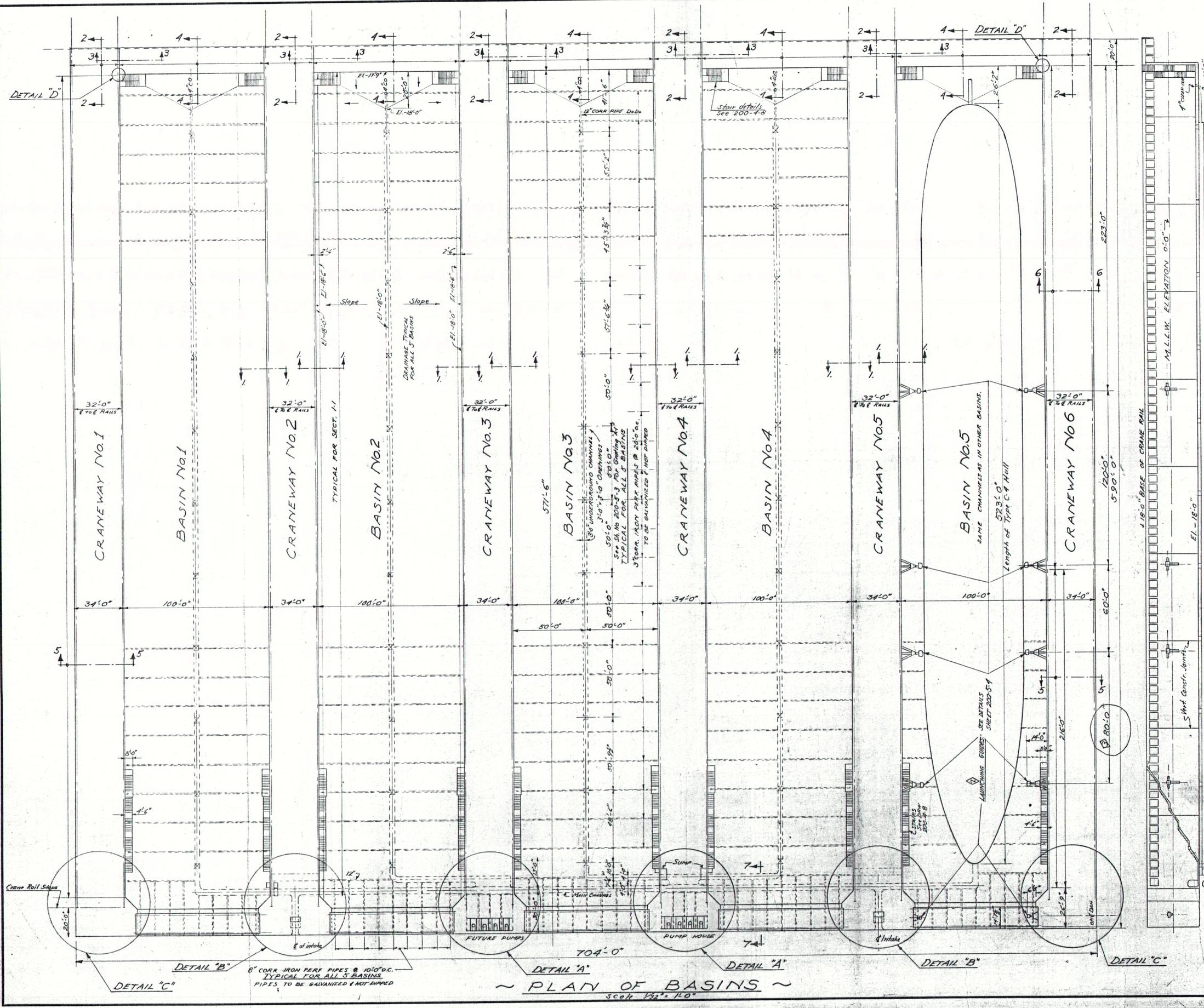
Woodward



SECTION SHOWING DEEPEMED
BASINS 2 & 3



REVISIONS				KAISER COMPANY, INC. RICHMOND, CALIFORNIA	
MK.	DATE	BY	OK	PROPOSED BASIN ALTERATION DATE 1-11-43 SUBMITTED SCALE 1/8" = 1'-0" APPROVED <i>Bernat</i> DRAWN BY WOLF CHECKED BY 200-0-7	
1	1-11-43	WOLF			



INDEX

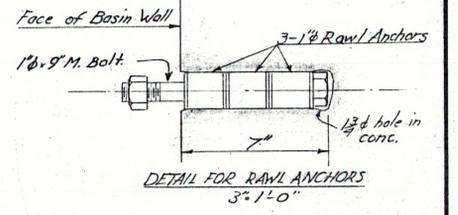
FOR SECTION 1-1	SEE SHEET	200-4-3
" " 2-2	" "	200-4-3
" " 3-3	" "	200-4-4
" " 4-4	" "	200-4-4
" " 5-5	" "	200-4-5
" " 6-6	" "	200-4-6
" " 7-7	" "	200-4-7

FOR DETAIL "A" SEE SHEET 200-4-9, 200-4-10, 200-4-10A

" " " " " "	" "	200-4-11, 200-4-12
" " " " " "	" "	200-4-13
" " " " " "	" "	200-4-14



LONGITUDINAL SECTION THRU BASIN.



Note: For relocation of lanching guides where anchor flanges have been set use 1/4 Rawl Anchors for 3 connections and use previously embedded north flange for fourth connection.

*Frank Ann
McIntosh's day*

REVISIONS				KAISER COMPANY, INC.	
MK.	DATE	BY	OK	RICHMOND, CALIFORNIA	
				GENERAL ARRANGEMENT	
				BASINS FOR THE KAISER CO. INC. RICHMOND, CALIFORNIA	
				DATE	SUBMITTED
				SCALE 1/2" = 1'-0"	APPROVED
				DRAWN BY	200-4-1
				CHECKED BY	

~ PLAN OF BASINS ~
Scale 1/2" = 1'-0"

Appendix C: USACE Port Series References



OHR

387 1
PORTS

2000

L.O.

Dupe

D103.8
31
2000

PORTS OF OAKLAND,
ALAMEDA, AND RICHMOND,
AND PORTS ON CARQUINEZ
STRAIT, CALIFORNIA

FEDERAL DEPOSITORY

APR 09 2001

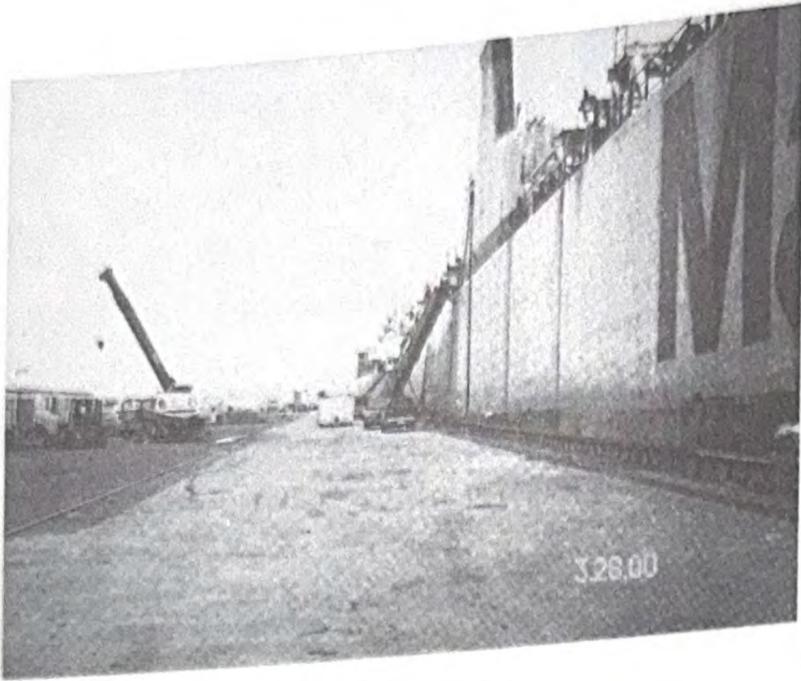
OAKLAND PUBLIC LIBRARY

PORT SERIES NO. 31
REVISED 2000

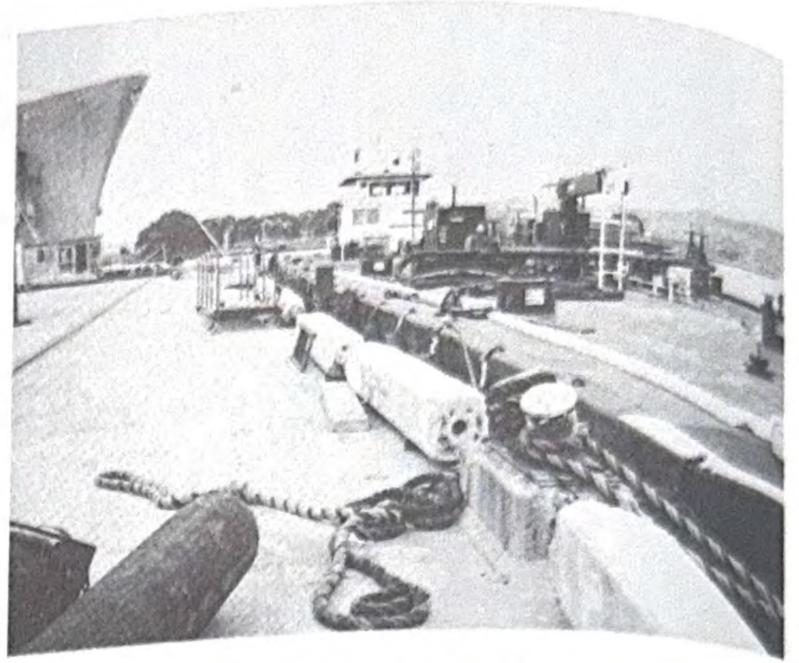


U.S. ARMY CORPS OF ENGINEERS

NDC-00-P-7



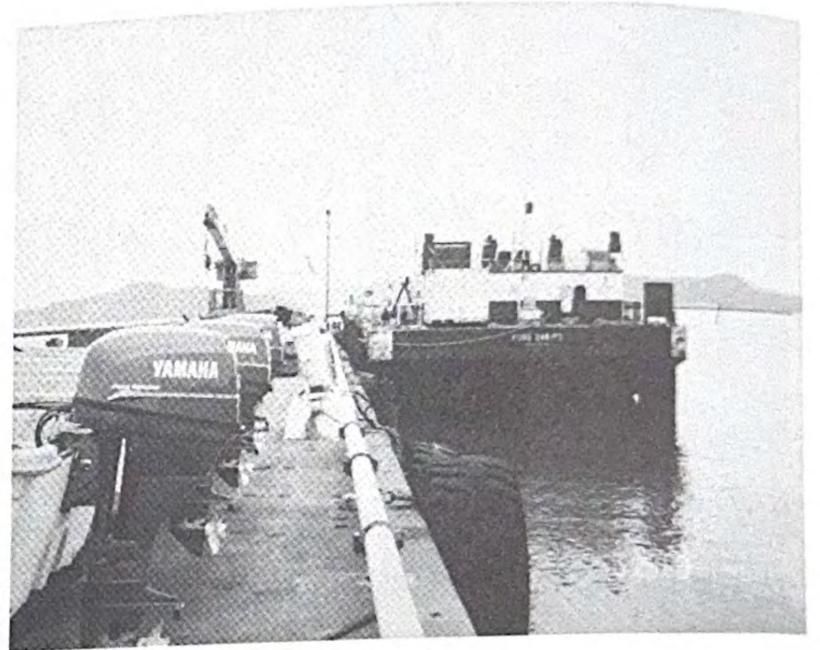
Port of Richmond,
Point Potrero Marine Terminal No. 7 Wharf
(P.W.D. Ref. No. 53)



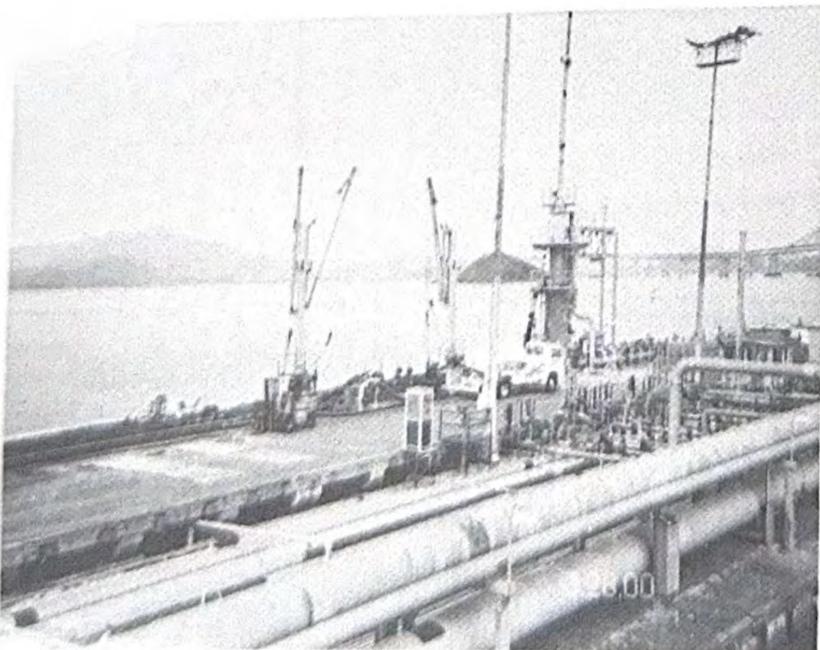
Port of Richmond,
Point Potrero Marine Terminal No. 6 Wharf
(P.W.D. Ref. No. 54)



Port of Richmond,
Point Potrero Marine Terminal, Finger Pier 1
(P.W.D. Ref. No. 56)



Port of Richmond,
Point Potrero Marine Terminal, Finger Pier 2
(P.W.D. Ref. No. 57)



Chevron Products Co., Richmond Long Wharf
(P.W.D. Ref. No. 59)



Port of Richmond, Terminal No. 4 Wharf
(P.W.D. Ref. No. 62)

THE PORT OF RICHMOND, CALIFORNIA

PORT AND HARBOR FACILITIES

PIERS, WHARVES, AND DOCKS

A total of 28 piers, wharves, and docks are described in this section of the report for the Port of Richmond, California. Two facilities are located north of the Richmond-San Rafael Bridge – one at Point San Pablo and one at Point Orient; two immediately south of the bridge; one at Port Richmond; four at Point Potrero; one at the entrance of the Ford Channel; nine on the Inner Harbor Channel's north section; seven on the Santa Fe Channel; and two on the west side of the Lauritzen Channel.

Commodities handled at the Port of Richmond consist primarily of crude oil, petroleum products, and miscellaneous dry and liquid bulk cargoes; containerized general cargo is handled at Terminal No. 3, owned by the Port of Richmond. Six oil companies have wharves, pipelines, and storage facilities for the receipt and shipment of crude oil, petroleum, and petroleum products.

Each facility is described under a separate reference number in the table of "Piers, Wharves, and Docks" beginning on page 71. These reference numbers designate facility locations on the accompanying Port Facilities Map.

The numerous waterfront facilities in the port area used exclusively by recreational or active military craft are not included in this report.

The table on the following page summarizes the functional uses of the various piers, wharves, and docks (P.W.D.s) in Richmond. Many of these facilities are used for multiple purposes, as indicated in the table; each can be identified by its respective P.W.D. reference number.

The Port of Richmond owns the only facilities – Terminal No. 3 Wharf (P.W.D. Ref. No. 36) and Terminal No. 7 Wharf (P.W.D. Ref. No. 53) – engaged in handling general cargo in the port. Terminal No. 3, located on the east side of the Richmond Inner Harbor Channel, is a concrete pile, concrete-decked, marginal type of wharf which has 1,109 feet of berthing space with depths alongside of 38 feet. The terminal has two 37-ton container-handling cranes and includes approximately 18 acres of paved, open storage area. Terminal No. 7, located on the right side of the entrance to the Richmond Inner Harbor Channel, is a concrete pile, concrete-decked wharf which has 1,615 feet of berthing space with depths alongside of 38 feet. The terminal includes approximately 40 acres of paved, open storage area.

PURPOSE FOR WHICH USED

LOCATION	A		B		C	D	SANTA FE CHANNEL				INNER HARBOR CHANNEL				E	F												
P.W.D. REFERENCE NUMBER	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
Cargo handling:																												
General cargo:																												
Conventional																												
Heavy lift items																												
Bauxite																												
Bulk cargo (dry misc.)																												
Bulk cargo (liquid misc.)																												
Caustic soda																												
Chemicals																												
Coconut oil																												
Crude oil																												
Gypsum rock																												
Limestone																												
Livestock feed																												
Oil (edible/vegetable)																												
Petrochemicals																												
Petroleum coke																												
Petroleum products																												
Scrap metal																												
Steel																												
Wax (paraffin)																												
Wood products																												
Bunkering vessels																												
Handling construction materials, supplies, and equipment																												
Landing for passenger ferries																												
Loading bunkering bages																												
Marine repair																												
Mooring:																												
Company-owned equipment																												
Floating drydocks																												
Miscellaneous																												
Oil-spill response vessels																												
SS Red Oak Victory																												
Tugboats																												
Not operated or used																												

A - FORD CHANNEL
B - INNER HARBOR CHANNEL
C - SANTA FE CHANNEL
D - LAURITZEN CHANNEL
E - POINT RICHMOND
F - RICHMOND OUTER HARBOR

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300	82300	82300
LATITUDE	37-54-34N	37-54-47N	37-54-55N
LONGITUDE	122-21-36W	122-21-42W	122-21-44W
REFERENCE NUMBER ON MAP NO. 1	35	36	37
NAME	Dock Code No. 596 Red and White Fleet, Richmond Ferry Dock.	Dock Code No. 575 Port of Richmond, Terminal No. 3 Wharf.	Dock Code No. 573 Port of Richmond, Terminal No. 2, Lower Wharf.
LOCATION ON WATERFRONT	West entrance to Ford Channel, at foot of Harbour Way South. 1453 Harbour Way South.	Left bank, Inner Harbor Channel, approximately 1,000 feet above entrance, at foot of Hall Avenue extended. 1411 Harbour Way South.	Left bank, Inner Harbor Channel, approximately 400 feet above foot of Hall Avenue extended.
OWNED BY	City of Richmond.	City of Richmond.	City of Richmond.
OPERATED BY	Red and White Fleet.	Stevedoring Services of America.	Not operated.
PURPOSE FOR WHICH USED	Landing for passenger ferries serving San Francisco.	Receipt and shipment of conventional general cargo, including steel, wood products, and heavy lift items.	Not used.
TYPE OF CONSTRUCTION	Steel float moored to steel piles with a 50- by 4-foot, steel ramp approach.	Concrete pile, asphalt-surfaced, concrete-decked wharf; fronted by steel, concrete, and rubber fender system; one breasting dolphin on lower side in line with face, and one mooring bollard on shore at rear.	Timber pile, asphalt-surfaced, timber-decked offshore wharf with one 50- by 30-foot and one 50- by 45-foot approaches from concrete bulkhead.
DESCRIPTION	Float	Face	Face
Dimensions (Feet)	80 by 20	1,009	192
Depth Alongside at MLLW (Feet)	14-16	38	38
Breasting Distance (Feet)	80	1,009	192
Total Berthing Space (Feet)	80	1,109 w/dolphin.	192*
Width of Apron (Feet)	Open.	Open.	28 & open.
Height of Deck at MLLW (Feet)	-	13	13
Load Capacity (Lbs. per Sq. Ft.)	-	1,000	-
Lighted or Unlighted	Lighted.	Lighted.	Lighted.
TRANSIT SHEDS Number and Description	None.	One - steel frame, metal siding, with asphalt floor.	None.
Length and Width (Feet)		800 by 100	
Height Inside (Feet)		27	
Floor Area for Cargo (Sq. Ft.)		80,000	
Load Capacity (Lbs. per Sq. Ft.)		1,000	
Cargo Doors		Shipside: four, 24 by 24 and six, 20 by 20; Ends: one, each 24 by 24.	
MECHANICAL HANDLING FACILITIES	None.	Two 37-ton, electric, traveling, container-handling cranes, each with hinged boom having 110-foot outboard reach and 30-foot back reach. Fourteen 4- to 26-ton, diesel, forklift trucks. Additional equipment is available as required.	None.
RAILWAY CONNECTIONS	None.	None.	None.
HIGHWAY CONNECTIONS	Via driveway, asphalt, 24 feet wide; from foot of Harbour Way South, asphalt, 52 feet wide.	Via Harbour Way South, asphalt, 52 feet wide.	Via Harbour Way South, asphalt, 52 feet wide.
WATER SUPPLY (For Vessels)	None.	Through five 2-inch lines.	None.
ELECTRIC CURRENT (For Vessels)	A.C., 110 volts.	A.C., 120/240 volts.	None.
FIRE PROTECTION (Other than City)	Hand extinguishers.	Hydrants, hose, hand extinguishers, and security patrol.	Hydrants, hand extinguishers, and security patrol.
REMARKS	Vessels operate to Fisherman's Wharf (Pier 43 1/2) and to Ferry Building (Pier 1/2) in San Francisco. Parking lot is located at rear.	Face of wharf is in line with face of adjacent wharves (Ref. Nos. 37 and 38), providing approximately 1,780 feet of continuous berthing. Approximately 18 acres of paved, open storage area are located in rear.	*Face of wharf is in line with face of adjacent wharves (Ref. Nos. 36 and 38), providing approximately 1,780 feet of continuous berthing space.

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300	82300	82300	82300
LATITUDE	37-54-59N	122-21-44W	37-55-05N	122-21-51W
LONGITUDE				37-55-16N
REFERENCE NUMBER ON MAP NO. 1	38	Dock Code No. 573	39	Dock Code No. 556
NAME	Port of Richmond, Terminal No. 2, Upper Wharf.		Shore Terminals, Richmond Wharf.	Levin-Richmond Terminal Corp., Richmond Wharf, Berths A, B, and C.
LOCATION ON WATERFRONT	Left bank, Inner Harbor Channel, approximately 900 feet above foot of Hall Avenue extended. 1145 Harbour Way South.		North side of junction of Inner Harbor Channel and Santa Fe Channel. 488 Wright Avenue.	North side of Santa Fe Channel, and left bank of Lauritzen Canal. 402 Wright Avenue.
OWNED BY	City of Richmond.		Shore Terminals LLC.	Levin-Richmond Terminal Corp.
OPERATED BY	California Oils Corp.		Shore Terminals LLC.	Levin-Richmond Terminal Corp.
PURPOSE FOR WHICH USED	Receipt and shipment of edible oils.		Receipt and shipment of petroleum products.	Shipment of scrap metal and petroleum coke; receipt of miscellaneous dry bulk commodities, including coke, bauxite, limestone, and livestock feed.
TYPE OF CONSTRUCTION	Concrete pile, concrete-decked wharf fronted by timber fender system; 2 concrete breasting dolphins in line with face on upper side, connected by concrete pile, timber-decked catwalk.		Steel pile, concrete-decked, offshore wharf with 100- by 12-foot approach, fronted by timber fender system; 2 steel pile breasting dolphins on each side in line with face; and one steel pile mooring dolphin at rear of face and one mooring bollard on shore at rear.	Timber pile, timber-decked wharf fronted by timber fender system.
DESCRIPTION		Face	Face	Berth A
Dimensions (Feet)	55		70	600
Depth Alongside at MLLW (Feet)	38		33	37
Breasting Distance (Feet)	300 w/dolphins.		210 w/dolphins.	600
Total Berthing Space (Feet)	300*		700 w/dolphins.	600
Width of Apron (Feet)	Open.		Open.	Open.
Height of Deck at MLLW (Feet)	13		12	13
Load Capacity (Lbs. per Sq. Ft.)	-		1,000	500
Lighted or Unlighted	Lighted.		Lighted.	Lighted.
MECHANICAL HANDLING FACILITIES	None.		None.	Three 50-ton, diesel-hydraulic, and two 25-ton, electric, traveling, full-portal gantry cranes, each with 100- to 110-foot boom; one diesel, mobile ship-loader with 48-inch conveyor having approximately 35-foot outboard reach, served by eighteen, 48-inch, portable conveyors, loading rate approximately 600 tons per hour; two 15-ton, diesel, forklift trucks; and six 12- and four 7-cubic-yard, diesel, front-end loaders. All cranes are equipped with magnets, slings, and buckets.
RAILWAY CONNECTIONS	Surface track serving terminal at rear; connects with Burlington Northern Santa Fe Railway and Union Pacific Railroad.		One 3-car-capacity surface track serving tank car loading rack at west side of terminal connects with Parr Terminal Railroad, Burlington Northern Santa Fe Railway, and Union Pacific Railroad.	One surface track on inner section of wharf joins additional tracks serving yard; connect with Parr Terminal Railroad, Burlington Northern Santa Fe Railway, and Union Pacific Railroad.
HIGHWAY CONNECTIONS	Via Harbour Way South, asphalt, 52 feet wide.		Via Wright Avenue, asphalt, 40 feet wide.	Via Wright Avenue, asphalt, 40 feet wide.
WATER SUPPLY (For Vessels)	None.		Through 2-inch line.	Eight 2 1/2-inch lines.
ELECTRIC CURRENT (For Vessels)	A.C., 110/220 volts.		A.C., 110/220 volts.	None.
FIRE PROTECTION (Other than City)	Hydrants, hose, hand extinguishers, and security patrol.		Hydrants, hose, hand extinguishers, and chemical carts.	Hydrants, hose, hand extinguishers, sprinkler system under wharf deck, and security patrol.
REMARKS	*Face of wharf is in line with face of adjacent wharves (Ref. Nos. 36 and 37), providing approximately 1,780 feet of continuous berthing space. Three 6-inch pipelines extend from wharf to 10 storage tanks located at processing plant in rear, total capacity 2,000,000 gallons.		Five 10- and one 8-inch pipelines extend from wharf to 25 steel storage tanks, total capacity 618,000 barrels.	Approximately 5 acres of open storage area are located at rear of face, and an additional 10 acres are located at rear.

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE LATITUDE	LONGITUDE	82300	82300	82300
REFERENCE NUMBER ON MAP NO. 1	37-55-27N	122-22-02W	37-55-22N	122-22-03W
NAME	41	Dock Code No. 530	42	Dock Code No. 530
LOCATION ON WATERFRONT	37-55-16N	122-22-09W	43	Dock Code No. 515
Manson Construction Co., Richmond Mooring.	Inner end, west side of Lauritzen Canal. 200 Cutting Boulevard.	Manson Construction Co., Richmond Wharf.	West side, Lauritzen Canal, approximately 500 feet above entrance. 200 Cutting Boulevard.	IMTT-Richmond-CA, Richmond Wharf. Left bank, Santa Fe Channel, above entrance to Lauritzen Canal. 100 Cutting Boulevard.
OWNED BY	Jim Peterson and Manson Construction Co.	Jim Peterson and Manson Construction Co.	Jim Peterson and Manson Construction Co.	IMTT-Richmond-CA.
OPERATED BY	Manson Construction Co.	Manson Construction Co.	Manson Construction Co.	IMTT-Richmond-CA.
PURPOSE FOR WHICH USED	Mooring company-owned floating equipment.	Mooring company-owned floating equipment; handling construction materials, supplies, and equipment.	Mooring company-owned floating equipment; handling construction materials, supplies, and equipment.	Receipt and shipment of petroleum products; receipt of caustic soda and paraffin wax.
TYPE OF CONSTRUCTION	Steel deck barge fronting row of 2 timber breasting dolphins.	One 15- by 25- and one 25- by 80-foot, steel pile, steel-decked loading platforms; timber and concrete pile, timber-decked wharf fronted by timber fender system; row of steel pile breasting dolphins on lower side.	One 15- by 25- and one 25- by 80-foot, steel pile, steel-decked loading platforms; timber and concrete pile, timber-decked wharf fronted by timber fender system; row of steel pile breasting dolphins on lower side.	Timber pile, timber-decked, offshore wharf with one 35- by 15-foot, and one 75- by 15-foot, angular, vehicle approaches to each end, and catwalk approach to center; one steel breasting dolphin at each end in line with face, connected by catwalk.
DESCRIPTION	Face	Face	Face	Face
Dimensions (Feet)	200	240+133	240+133	600
Depth Alongside at MLLW (Feet)	10-15	15-20	15-20	38
Breasting Distance (Feet)	200	640+133 w/dolphins.	640+133 w/dolphins.	650 w/dolphins.
Total Berthing Space (Feet)	200	640+133 w/dolphins.	640+133 w/dolphins.	650 w/dolphins.
Width of Apron (Feet)	Open.	Open.	Open.	Open.
Height of Deck at MLLW (Feet)	-	7	7	8
Load Capacity (Lbs. per Sq. Ft.)	-	-	-	-
Lighted or Unlighted	Unlighted.	Partly lighted.	Partly lighted.	Lighted.
MECHANICAL HANDLING FACILITIES	None.	One 60-ton, floating, revolving crane with 110-foot boom. Additional floating cranes up to 600-ton capacity are available as required.	One 60-ton, floating, revolving crane with 110-foot boom. Additional floating cranes up to 600-ton capacity are available as required.	Three electric, hose-handling cranes, each with 40-foot boom.
RAILWAY CONNECTIONS	None.	None.	None.	None.
HIGHWAY CONNECTIONS	Via private road, partly paved, 20 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.	Via private road, partly paved, 20 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.	Via private road, partly paved, 20 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.	Via terminal road, asphalt, 15 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.
WATER SUPPLY (For Vessels)	None.	Through 1 1/2-inch line.	Through 1 1/2-inch line.	Through 4-inch line with 2-inch connection.
ELECTRIC CURRENT (For Vessels)	None.	A.C., 110/220/440 volts.	A.C., 110/220/440 volts.	None.
FIRE PROTECTION (Other than City)	Hand extinguishers.	Hand extinguishers.	Hand extinguishers.	Hydrants, under deck fire curtain, electric pump with 8-inch salt water line, hand extinguishers, and security patrol.
REMARKS		Contractor's storage yard is located at rear.	Contractor's storage yard is located at rear.	One 12-, two 10-, three 8-, and nine 6-inch pipelines extend from wharf to 38 petroleum products storage tanks in rear, total capacity 441,200 barrels, to one 4,200,000-gallon caustic soda storage tank, and to three paraffin wax storage tanks, total capacity 2,520,000 gallons. A 21-foot boom boat and 1,650 feet of floating boom for pollution containment is stored on wharf.

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300	82300	82300	
LATITUDE	37-55-23N	37-55-26N	37-55-28N	
LONGITUDE	122-22-19W	122-22-26W	122-22-32W	
REFERENCE NUMBER ON MAP NO. 1	44	45	46	
	Dock Code No. 503	Dock Code No. 500	Dock Code No. 497	
NAME	Bay Ship & Yacht Co., Richmond Wharf.	Keefe Kaplan Maritime Wharf.	Richmond Boat Works Wharf.	
LOCATION ON WATERFRONT	Left bank, Santa Fe Channel, at entrance to Richmond Yacht Harbor. 310 West Cutting Boulevard.	Left bank, Santa Fe Channel, approximately 0.5 mile from entrance. 530 West Cutting Boulevard.	Left bank, inner end, at head of Santa Fe Channel. 616 West Cutting Boulevard.	
OWNED BY	Bay Ship & Yacht Co.	Keefe Kaplan Maritime, Inc.	Maritime Transit Corp.	
OPERATED BY	Bay Ship & Yacht Co.	Keefe Kaplan Maritime, Inc.	Maritime Transit Corp., d.b.a. Richmond Boat Works, Inc.	
PURPOSE FOR WHICH USED	Mooring small vessels for repair.	Mooring small vessels for repair; mooring floating drydocks.	Mooring small vessels for repair.	
TYPE OF CONSTRUCTION	Series of timber floats with two timber ramps extending from concrete bulkhead; steel pile, steel-decked piers for vertical boat lift are located at lower side of floats.	Timber pile, timber-decked wharf, fronted by 4-foot-wide timber floats; upper and lower ends: steel sheet pile bulkhead with concrete-surfaced solid fill; two 85- by 3-foot, concrete pile, concrete-decked piers for vertical boat lift, and 3-foot walkway alongside at upper end.	Timber pile, timber-decked pier. A 90- by 65-foot, T-shaped, timber float with three parallel, 30- to 35-foot, small boat stalls on inner side of cross arm extends from face.	
DESCRIPTION	Floats	Face	Pier	Float, face
Dimensions (Feet)	120 by 4	80+500+70	60 by 10	65
Depth Alongside at MLLW (Feet)	20	20	5	20
Breasting Distance (Feet)	120	500+drydocks.	-	65
Total Berthing Space (Feet)	120	500+drydocks.	-	65
Width of Apron (Feet)	Open.	Open.	Open.	
Height of Deck at MLLW (Feet)	-	8	8	
Load Capacity (Lbs. per Sq. Ft.)	-	500	-	
Lighted or Unlighted	Partly lighted.	Lighted.	Lighted.	
MECHANICAL HANDLING FACILITIES	One 77-ton, diesel, mobile, vertical boat lift; one 10-ton, diesel, mobile crane with 40-foot telescopic boom.	One 88- and one 60-ton, mobile, vertical boat lifts; one 15-ton, diesel, mobile crane with 90-foot boom and 20-foot jib; and one 2-ton, diesel, forklift truck.	One 1/2-ton, pneumatic, timber, mast-and-boom derrick with 25-foot boom.	
RAILWAY CONNECTIONS	None.	None.	None.	
HIGHWAY CONNECTIONS	Via private road, asphalt, 24 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.	Via driveway, asphalt, 34 feet wide; from Cutting Boulevard, asphalt, 70 feet wide.	Via Cutting Boulevard, asphalt, 70 feet wide.	
WATER SUPPLY (For Vessels)	Through 1 1/4-inch line with 3/4-inch hose connection.	Through 2-inch line with 3/4-inch hose connection.	Through 1-inch line with 3/4-inch hose connection.	
ELECTRIC CURRENT (For Vessels)	A.C., 110/220 volts.	A.C., 110/220 volts.	A.C., 110 volts.	
FIRE PROTECTION (Other than City)	Hose, hand extinguishers, and security system.	Hydrant, hose, pumps, hand extinguishers, and security patrol.	Hose and hand extinguishers.	
REMARKS	One 20-ton, mobile, vertical boat lift serves yard at rear.	One 200- and one 100-ton floating drydocks are located at lower end of and perpendicular to wharf.	One 20-ton marine railway is located on lower side of wharf.	

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE LONGITUDE	82300 37-55-21N 122-22-26W	82300 37-55-10N 122-22-06W	82300 37-54-58N 122-21-56W
REFERENCE NUMBER ON MAP NO. 1	47 Dock Code No. 488	48 Dock Code No. 470	49 Dock Code No. 458
NAME	Castrol North America, Richmond Wharf.	National Gypsum Co., Richmond Dock.	Tosco Refining Co., Richmond Barge Wharf.
LOCATION ON WATERFRONT	Right bank, near head of Santa Fe Channel. 801 Wharf Street.	Right bank, Santa Fe Channel, opposite entrance to Lauritzen Canal. 1040 Canal Boulevard.	Right bank, Inner Harbor Channel, south of entrance to Santa Fe Channel. 1300 Canal Boulevard.
OWNED BY	Castrol North America, Inc.	National Gypsum Co., Gold Bond Building Products.	Tosco Refining Co., a division of Tosco Corp.
OPERATED BY	Castrol North America, Inc.	National Gypsum Co., Gold Bond Building Products.	Tosco Refining Co.
PURPOSE FOR WHICH USED	Receipt and shipment of petroleum products by barge and vessel.	Receipt of gypsum rock by self-unloading vessel.	Shipment and occasional receipt of petroleum products; loading barges for bunkering vessels at berth.
TYPE OF CONSTRUCTION	Timber pile, timber-decked, offshore wharf with 138- by 14-foot curved approach; one timber pile breasting dolphin on each side in line with face, connected by catwalks, and one mooring dolphin on each side, connected to shore by catwalks.	Three steel pile, concrete-capped, breasting dolphins with rubber and timber fender system, connected by 3 1/2-foot-wide, steel beam, timber-decked walkways, which in turn are connected to shore by 67- by 6-foot walkways of same construction; one similar breasting dolphin on lower side in line with face, with catwalk approach from shore.	Concrete pile, concrete-decked, offshore wharf, with one 50- by 22-foot approach; row of 3 timber breasting dolphins at lower end and one steel pile breasting dolphin at upper end with steel catwalk approach; wharf fronted by timber fender system. Lower side of wharf is connected to Tanker Dock (Ref. No. 50) by a concrete pile, timber-decked walkway.
DESCRIPTION	Face	Breasting dolphins	Face Upper side Lower side
Dimensions (Feet)	38	233	148 36 50
Depth Alongside at MLLW (Feet)	32	38	37 - -
Breasting Distance (Feet)	207 w/dolphins.	600 w/dolphins.	300 w/dolphins. - -
Total Berthing Space (Feet)	700 w/dolphins.	600 w/dolphins.	836 w/Ref. No. 50 - -
Width of Apron (Feet)	Open.	Open.	Open. -
Height of Deck at MLLW (Feet)	7	9, dolphins; 11, walkway.	12 -
Load Capacity (Lbs. per Sq. Ft.)	400	-	Lighted.
Lighted or Unlighted	Lighted.	Lighted.	Mobile hoist for handling hose.
MECHANICAL HANDLING FACILITIES	One pneumatically operated, mast-and-boom derrick with 25-foot boom for handling hoses.	Receiving hopper on center dolphin for self-unloading vessels serves a 36-inch, electric, belt-conveyor system extending to one steel storage dome, maximum rate 1,400 tons per hour, normal rate 1,000 tons per hour. Material is reclaimed by bulldozers into a ground-level hopper serving an electric, belt-conveyor system extending to plant in rear.	
RAILWAY CONNECTIONS	None.	Two platform-level tracks inside warehouse in rear connect with Burlington Northern Santa Fe Railway.	Tracks serving loading racks and warehouse at plant in rear connect with Burlington Northern Santa Fe Railway.
HIGHWAY CONNECTIONS	Via private road, asphalt, 15 feet wide; from Wharf Street, asphalt, 50 feet wide; and Canal Boulevard.	Via Canal Boulevard, asphalt, dual lane.	Via private road, asphalt, 25 feet wide; from Canal Boulevard, asphalt, 50 feet wide.
WATER SUPPLY (For Vessels)	Through 3-inch line.	Through 2 1/2-inch line.	Through 3-inch line.
ELECTRIC CURRENT (For Vessels)	A.C., 110/440 volts.	A.C., 110 volts.	A.C., 110/440 volts.
FIRE PROTECTION (Other than City)	Hydrants, hose, hand extinguishers, and security patrol.	Automatic fire detection system, portable pumps, hose, and hand extinguishers.	One 6-inch fire line, pumps, monitor nozzles, hand extinguishers, hydrant, monitors, and security patrol.
REMARKS	Two 6- and twelve 4-inch pipelines extend from wharf to 53 steel storage tanks located at rear, total capacity 85,000 barrels.	Gypsum rock is obtained from San Marco Island, Baja California, Mexico. Storage dome located at rear has capacity for 40,000 tons of gypsum rock.	One 6-inch pipeline extends from wharf to one 5,000-barrel-capacity sloop tank at rear. Ten 6-inch pipelines extend to storage tanks described under Ref. No. 50. Terminal is connected by pipeline with company-owned refinery at Rodeo, California. (See Ref. No. 63 in the Carquinez Strait section of this report.)

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300		82300		82300	
LATITUDE	37-54-54N	122-21-55W	37-54-48N	122-21-54W	37-54-43N	122-21-53W
LONGITUDE						
REFERENCE NUMBER ON MAP NO. 1	50	Dock Code No. 462	51	Dock Code No. 454	52	Dock Code No. 450
NAME	Tosco Refining Co., Richmond Tanker Wharf.		ARCO Products Co., Richmond Barge Wharf.		ARCO Products Co., Richmond Tanker Wharf.	
LOCATION ON WATERFRONT	Right bank, Inner Harbor Channel, approximately 0.1 mile below entrance to Santa Fe Channel. 1300 Canal Boulevard.		Right bank, Inner Harbor Channel, approximately 0.2 mile below entrance to Santa Fe Channel. 1306 Canal Boulevard.		Right bank, Inner Harbor Channel, approximately 0.3 mile below entrance to Santa Fe Channel. 1306 Canal Boulevard.	
OWNED BY	Tosco Refining Co., a division of Tosco Corp.		ARCO Products Co.		ARCO Products Co.	
OPERATED BY	Tosco Refining Co. and GATX Terminals Corp.		ARCO Products Co.		ARCO Products Co.	
PURPOSE FOR WHICH USED	Receipt and shipment of petroleum products and liquid bulk products, including solvents, vegetable oils, coconut oil, and caustic soda.		Mooring oil-spill response vessel <i>Clean Bay I</i> .		Receipt and occasional shipment of petroleum products.	
TYPE OF CONSTRUCTION	Concrete pile, concrete-decked, offshore wharf with two 48- by 20-foot truck approaches from shore; 3 timber breast-ing dolphins in line with face on upper side; wharf is fronted by timber fender system with steel coil springs.		Concrete pile, concrete-decked, offshore wharf with one 58- by 18-foot approach; fronted by timber fender system. Lower side of wharf is con-nected to Tanker Wharf (Ref. No. 52) by a concrete pile, timber-decked walkway; fronted by 2 timber mooring dolphins.		Concrete pile, concrete-decked, offshore wharf with two 65- by 17-foot truck approaches from shore; wharf fronted by rubber fender system.	
DESCRIPTION						
	Face	Sides	Face	Sides	Face	Sides
Dimensions (Feet)	228	50, each.	151	30, each.	247	40, each.
Depth Alongside at MLLW (Feet)	37	-	35	-	38	-
Breasting Distance (Feet)	370 w/dolphins.	-	151	-	247	-
Total Berthing Space (Feet)	836 w/Ref. No. 49	-	710 w/Ref. No. 52	-	710 w/Ref. No. 51	-
Width of Apron (Feet)	Open.		Open.		Open.	
Height of Deck at MLLW (Feet)	12		12		12	
Load Capacity (Lbs. per Sq. Ft.)	-		-		-	
Lighted or Unlighted	Lighted.		Lighted.		Lighted.	
MECHANICAL HANDLING FACILITIES	Mobile hoist for handling hose.		None.		One mobile hoist with 45-foot retractable boom for handling hoses.	
RAILWAY CONNECTIONS	Tracks serving loading racks and warehouse at plant in rear; connect with Burlington Northern Santa Fe Railway.		Tracks serving tank car loading racks in rear connect with Burlington Northern Santa Fe Railway.		Tracks serving tank car loading racks in rear connect with Burlington Northern Santa Fe Railway.	
HIGHWAY CONNECTIONS	Via private road, asphalt, 25 feet wide; from Canal Boulevard, asphalt, 50 feet wide.		Via private road, asphalt, 25 feet wide; from Canal Boulevard, asphalt, 50 feet wide.		Via private road, asphalt, 25 feet wide; from Canal Boulevard, asphalt, 50 feet wide.	
WATER SUPPLY (For Vessels)	Through 3-inch line.		Through 2 1/2-inch line.		Through 2 1/2-inch line with 2- and 3/4-inch connections.	
ELECTRIC CURRENT (For Vessels)	A.C., 110/440 volts.		A.C., 110/220 volts.		A.C., 110/220 volts.	
FIRE PROTECTION (Other than City)	One 6-inch fire line, pumps, monitor nozzles, hand extinguishers, hydrant, monitors, and security patrol.		Pumps, hydrants, hand extinguishers, fireboat connection, and security patrol.		Pumps, hydrants, hand extinguishers, fireboat connection, and security patrol.	
REMARKS	Wharf is connected to Barge Wharf (Ref. No. 49) by a walkway. Tosco Refining Co.: Two 10- and six 8-inch pipelines extend from wharf to 82 steel storage tanks located at rear, total capacity 237,300 barrels. GATX Terminals Corp.: Six 8- and sixteen 6-inch pipelines extend from wharf to 135 steel storage tanks located at rear, total capacity 620,000 barrels. Facility is operated as a public liquid bulk terminal.		Nine 8-inch pipelines extending from wharf to storage tanks described under Ref. No. 52 were not in use at time of survey (2000).		Wharf is connected to Barge Wharf (Ref. No. 51) by a walkway. Ten 6- (not in use at time of survey 2000) and five 8-inch pipelines extend from wharf to 46 steel storage tanks located at rear, total capacity 737,000 barrels. Storage tanks at terminal are connected with interstate pipeline system of Kinder Morgan Energy Partners LLC.	

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300	82300	82300			
LATITUDE	37-54-27N	37-54-18N	37-54-17N			
LONGITUDE	122-21-50W	122-21-51W	122-21-59W			
REFERENCE NUMBER ON MAP NO. 1	53	54	55			
NAME	Dock Code No. 442	Dock Code No. 430	Dock Code No. 420			
LOCATION ON WATERFRONT	Port of Richmond, Point Potrero Marine Terminal, No. 7 Wharf. Right side of entrance to Inner Harbor Channel, east side of Point Potrero. 1301 Canal Boulevard.	Port of Richmond, Point Potrero Marine Terminal, No. 6 Wharf. Inner Harbor Channel, south side of Point Potrero. 1318 Canal Boulevard.	Port of Richmond, Point Potrero Marine Terminal, Berths Nos. R6-1 thru R6-5. Inner Harbor Channel, south side of Point Potrero. 1313 Canal Boulevard.			
OWNED BY	City of Richmond.	City of Richmond.	City of Richmond.			
OPERATED BY	Pasha Group.	Marin Tug & Barge, Inc.	Port of Richmond.			
PURPOSE FOR WHICH USED	Occasional receipt and shipment of general cargo.	Mooring company-owned tug and bunkering barge.	Mooring vessels.			
TYPE OF CONSTRUCTION	Concrete pile, asphalt-surfaced, concrete-decked wharf; fronted by timber and rubber fender system.	Concrete pile, part asphalt-surfaced, concrete-decked wharf; fronted by part timber and part rubber fender system.	Five slips, formerly graving docks, formed by concrete walls and four concrete piers.			
DESCRIPTION	Face	Inner end, Berth B	Outer end, Berth A	Berths R6-1, 4 & 5	Berth R6-2	Berth R6-3
Dimensions (Feet)	1,615	266	450	576 by 84	748 by 84	587 by 84
Depth Alongside at MLLW (Feet)	38	32	24	15*	27*	27*
Breasting Distance (Feet)	1,615	266	450	576, each.	748	587
Total Berthing Space (Feet)	1,615	266	450	576, each.	748	587
Width of Apron (Feet)	Open.	Open.		Open.	Open.	Open.
Height of Deck at MLLW (Feet)	12	12		12	12	12
Load Capacity (Lbs. per Sq. Ft.)	-	-		-	-	*over sill
Lighted or Unlighted	Lighted.	Partly lighted.		Lighted.		
MECHANICAL HANDLING FACILITIES	Stevedore equipment is available as required.	None.		None.		
RAILWAY CONNECTIONS	Trackage serving terminal in rear connects with Burlington Northern Santa Fe Railway.	Trackage serving terminal in rear connects with Burlington Northern Santa Fe Railway.		None.		
HIGHWAY CONNECTIONS	Via terminal road, asphalt, various widths; from foot of Canal Boulevard, asphalt, 50 feet wide.	Via terminal road, asphalt, various widths; from foot of Canal Boulevard, asphalt, 50 feet wide.		Via terminal road, asphalt, various widths; from foot of Canal Boulevard, asphalt, 50 feet wide.		
WATER SUPPLY (For Vessels)	Through 3-inch line with 2 1/2-inch connection.	Through 2 1/2-inch and 3/4-inch connections.		Through 2 1/2-inch and 3/4-inch connections.		
ELECTRIC CURRENT (For Vessels)	A.C., 110 volts.	A.C., 110/220/440 volts.		A.C., 110/220/440 volts.		
FIRE PROTECTION (Other than City)	Hydrants, hose, hand extinguishers, and security patrol.	Hydrants, hose, hand extinguishers, and security patrol.		Hydrants, hose, hand extinguishers, and security patrol.		
REMARKS	Pasha Group has preferential berthing at terminal. There are 40 acres of paved, open storage area for automobiles at rear and an additional 50 acres of unpaved area owned by the Port of Richmond.	Dispatch office is located at rear.		Berth R6-1 (Dock No. 1) is on the west end, Berth R6-5 (Dock No. 5) on the east end.		

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300		82300		82300	
LATITUDE	37-54-18N	122-22-18W	37-54-20N	122-22-23W	37-54-30N	122-23-13W
LONGITUDE	122-22-18W		122-22-23W		122-23-13W	
REFERENCE NUMBER ON MAP NO. 1	56	Dock Code No. 403	57	Dock Code No. 401	58	Dock Code No. 356
NAME	Port of Richmond, Point Potrero Marine Terminal, Finger Pier 1.		Port of Richmond, Point Potrero Marine Terminal, Finger Pier 2.		Port of Richmond Terminal, No. 1 Wharf.	
LOCATION ON WATERFRONT	North side, Inner Harbor Channel, approximately 0.4 mile west of Point Potrero. 1314 Canal Boulevard.		North side, Inner Harbor Channel, approximately 0.4 mile west of Point Potrero. 1316 Canal Boulevard.		Point Richmond, east of foot of Garrard Boulevard. 860 S. Garrard Boulevard.	
OWNED BY	City of Richmond.		City of Richmond.		City of Richmond.	
OPERATED BY	Marine Spill Response Corp.		Foss Maritime Co.		City of Richmond.	
PURPOSE FOR WHICH USED	Mooring oil-spill response vessels.		Mooring company-owned floating equipment, including tugs and bunkering barges.		Mooring SS Red Oak Victory.	
TYPE OF CONSTRUCTION	Concrete pile, concrete-decked pier; fronted by steel, timber, and rubber fender system.		Concrete pile, concrete-decked pier; fronted by steel and timber fender system.		Concrete pile, asphalt-surfaced, concrete-decked wharf; fronted by timber fender system.	
DESCRIPTION	Face	Lower side	Upper side	Pier	Face	Sides
Dimensions (Feet)	48	547	547	547 by 48	557	90, each.
Depth Alongside at MLLW (Feet)	30	12	30	10-19	29	-
Breasting Distance (Feet)	48	522	472	547+547	557	-
Total Berthing Space (Feet)	48	522	472	547+547	557	-
Width of Apron (Feet)	Open.	Open.	Open.	Open.	18	
Height of Deck at MLLW (Feet)	12		12		13.5	
Load Capacity (Lbs. per Sq. Ft.)	500		500		1,000	
Lighted or Unlighted	Lighted.		Lighted.		Lighted.	
TRANSIT SHEDS Number and Description	None.		None.		One - steel frame, concrete walls; asphalt-surfaced, concrete floor.	
Length and Width (Feet)					525 by 67	
Height Inside (Feet)					23	
Floor Area for Cargo (Sq. Ft.)					34,075	
Load Capacity (Lbs. per Sq. Ft.)					1,000	
Cargo Doors					Shipside: nineteen; Rear: same; all 16 by 24, steel roll-up type.	
MECHANICAL HANDLING FACILITIES	None.		None.		None.	
RAILWAY CONNECTIONS	None.		None.		None.	
HIGHWAY CONNECTIONS	Via terminal road, asphalt, various widths; from foot of Canal Boulevard, asphalt, 50 feet wide.		Via terminal road, asphalt, various widths; from foot of Canal Boulevard, asphalt, 50 feet wide.		Via Brickyard Cove Road, asphalt, 25 feet wide; from foot of Garrard Boulevard, asphalt, 48 feet wide.	
WATER SUPPLY (For Vessels)	Through 2 1/2-inch and 3/4-inch connections.		Through 2 1/2-inch and 3/4-inch connections.		Through 2-inch line.	
ELECTRIC CURRENT (For Vessels)	A.C., 110/220/440 volts.		A.C., 110/220/440/460 volts.		A.C., 110/220 volts.	
FIRE PROTECTION (Other than City)	Hydrants, hose, and hand extinguishers.		Hydrants, hose, and hand extinguishers.		Hydrants, hose, hand extinguishers, and security patrol.	
REMARKS	Pier forms 280-foot-wide slip with Finger Pier 2 (Ref. No. 57). Pacific Responder and MSRC-452 are based at pier.		Pier forms 280-foot-wide slip with Finger Pier 1 (Ref. No. 56). Dispatch office is located at rear.			

PIERS, WHARVES, AND DOCKS

CORPS OF ENGRS WATERWAY CODE	82300		82300			
LATITUDE	37-55-19N	122-24-39W	37-55-18N	122-24-30W		
LONGITUDE	82300		82300			
REFERENCE NUMBER ON MAP NO. 1	59	Dock Code No. 214	60	Dock Code No. 214		
NAME	Chevron Products Co., Richmond Long Wharf.		Chevron Products Co., Richmond Long Wharf Mooring Dock.			
LOCATION ON WATERFRONT	Easterly side, Richmond Outer Harbor Maneuvering Area, approximately 0.8 mile south of Richmond-San Rafael Bridge. 841 Chevron Way.		Richmond Outer Harbor, on southeast side of Long Wharf (Ref. No. 59) approach, 275 feet in rear of face of main wharf. 841 Chevron Way.			
OWNED BY	Chevron Products Co.		Chevron Products Co.			
OPERATED BY	Chevron Products Co.		Chevron Products Co.			
PURPOSE FOR WHICH USED	Receipt of crude oil; receipt and shipment of petroleum products; bunkering vessels; loading bunkering barges.		Mooring tugs.			
TYPE OF CONSTRUCTION	Concrete pile, asphalt-surfaced, concrete-decked offshore wharf with 4,200- by 26-foot approach; 3 concrete breasting dolphins on north side and one on south side in line with face, and one concrete mooring dolphin on each end, all connected by catwalks. Width of wharf varies from 112 and 132 feet at south and north ends, respectively, with 60-foot width through central section.		Concrete pile, concrete-decked pier with timber fender system along sides; pier extends from south side of approach to Long Wharf (Ref. No. 59).			
DESCRIPTION	Face, Berths 1 thru 4	Rear of face, Berth 5	Rear of face, Berths 9 and 11	Outer side	Face	Inner side
Dimensions (Feet)	2,463	630	1,660	451	53	425
Depth Alongside at MLLW (Feet)	40-50	20	20	15	15	15
Breasting Distance (Feet)	3,065 w/dolphins.	630	1,660	451	53	425
Total Berthing Space (Feet)	3,065	630	1,660	451	53	425
Width of Apron (Feet)	Open.			Open.		
Height of Deck at MLLW (Feet)	15	15	13	15		
Load Capacity (Lbs. per Sq. Ft.)	300 & 450			350		
Lighted or Unlighted	Lighted.			Lighted.		
MECHANICAL HANDLING FACILITIES	Five 16-, three 14- (vapor recovery), eight 12-, and two 8-inch, swivel-jointed, pipeline loading arms; and 4 pneumatic, mast-and-boom derricks.		One 5-ton, electric, pedestal crane with 35-foot telescopic boom. Forklift trucks, mobile cranes, and other equipment are available as required.			
RAILWAY CONNECTIONS	Tracks serving terminal at rear connect with Burlington Northern Santa Fe Railway and Union Pacific Railroad.		Tracks serving terminal at rear connect with Burlington Northern Santa Fe Railway and Union Pacific Railroad.			
HIGHWAY CONNECTIONS	Via Chevron Way (private road), asphalt, 24 feet wide.		Via Chevron Way (private road), asphalt, 24 feet wide.			
WATER SUPPLY (For Vessels)	Through 6-inch line with 1 1/2-inch hose connections.		Through 6-inch line with 1 1/2-inch hose connections.			
ELECTRIC CURRENT (For Vessels)	A.C., 120/480 volts.		A.C., 120/480 volts.			
FIRE PROTECTION (Other than City)	Pumps, hydrants, hose, foam generators, hand extinguishers, security patrol, and plant fire department.		Pumps, hydrants, hose, foam generators, hand extinguishers, security patrol, and plant fire department.			
REMARKS	Tankers and barges berth at face, and barges at rear of face. One 36-, one 30-, two 16-, fourteen 12-, nine 8-, five 6-, and two 4-inch pipelines extend from wharf to approximately 350 steel storage tanks at refinery in rear; total capacity 20,280,000 barrels.		Buildings located along the main wharf approach contain offices.			