LOUISVILLE DISTRICT

INCA ENGINEERS INC.

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

St. Louis, Missouri

Olmsted Floating Approach Walls

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Location Map

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Olmsted Site

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

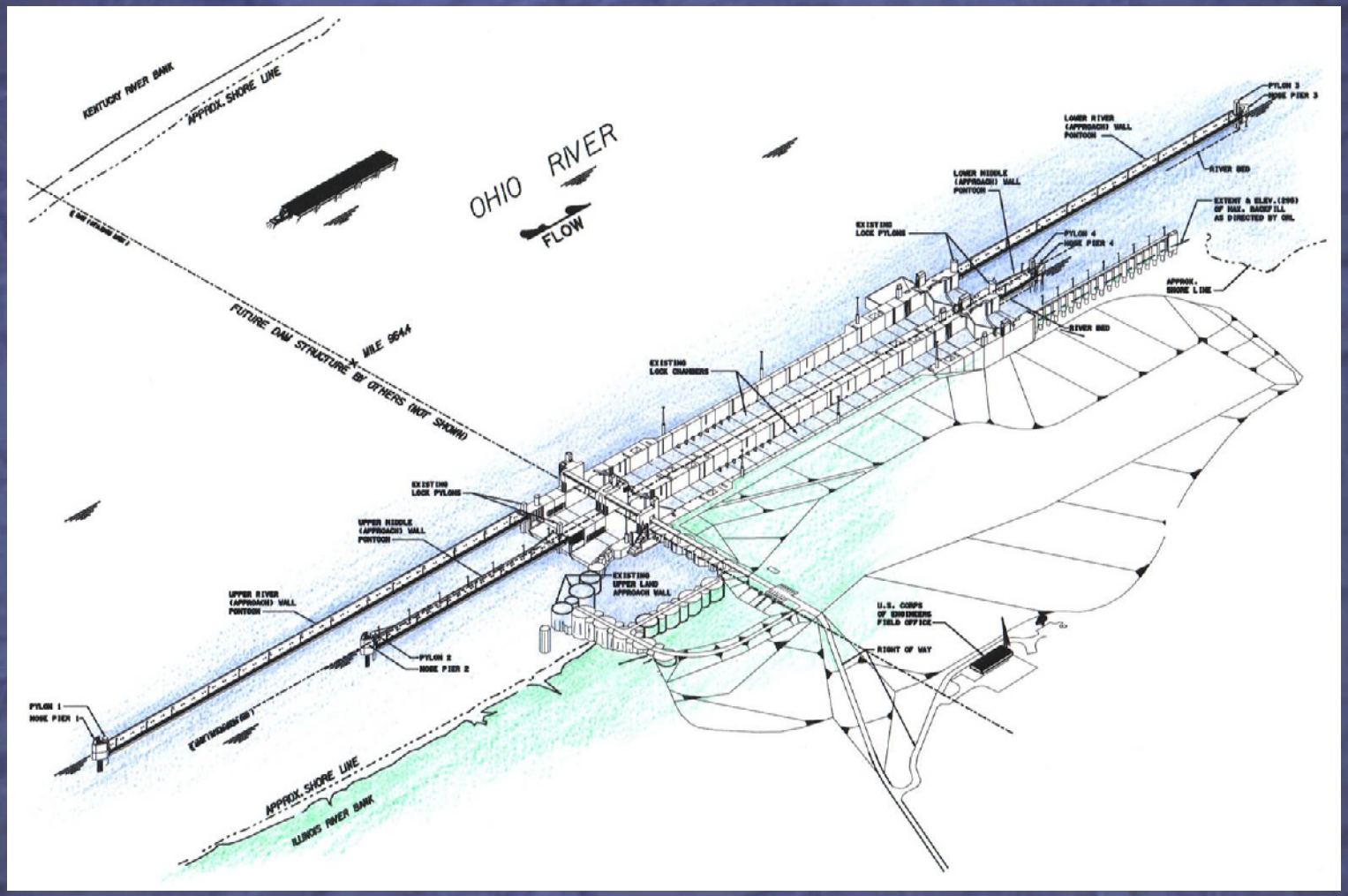
INCA ENGINEERS INC.

Introduction

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Olmsted Locks & Approach Walls



2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Olmsted Locks & Approach Walls - Today

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Olmsted Approach Walls – Design Criteria

- Maintain Open River Navigation During Construction
- Build Without Cofferdam
- Minimize Structural Mass to reduce Seismic Loads
- Water Velocities During Construction Up to 2.4 m/s (8fps)
- River Level May Change up to 18.3 m (60 ft) in one Season
- Resist Direct Barge Impact; Loads Up to 17,800 kN (4 million lbs)
- Resist Lateral Barge Impact; Loads to be Determined
- Minimize the Use of Divers During Construction of Divers

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

INCA ENGINEERS INC.

Barge Impact

LOUISVILLE DISTRICT

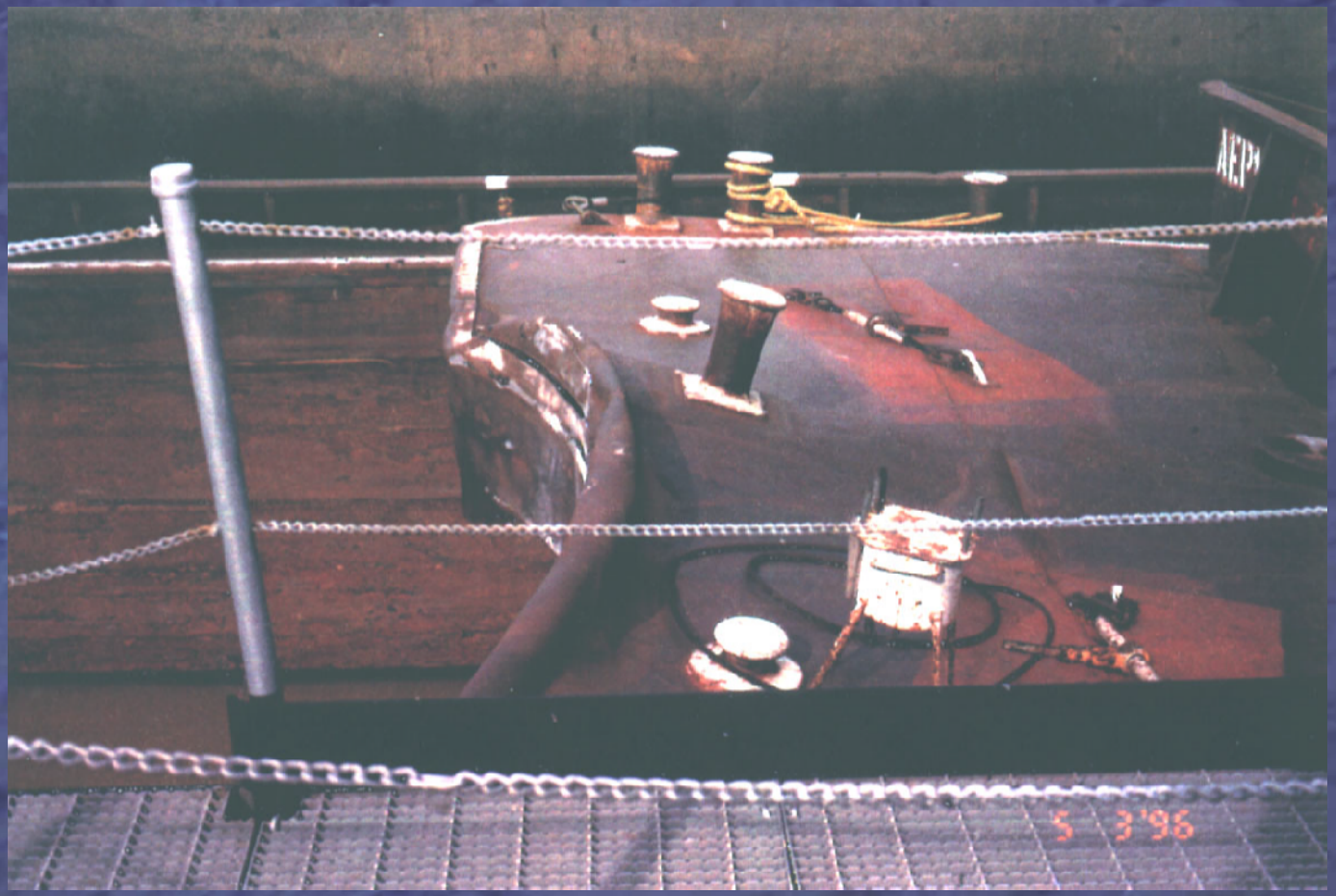
INCA ENGINEERS INC.

Typical Approach Walls Barge Impact

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

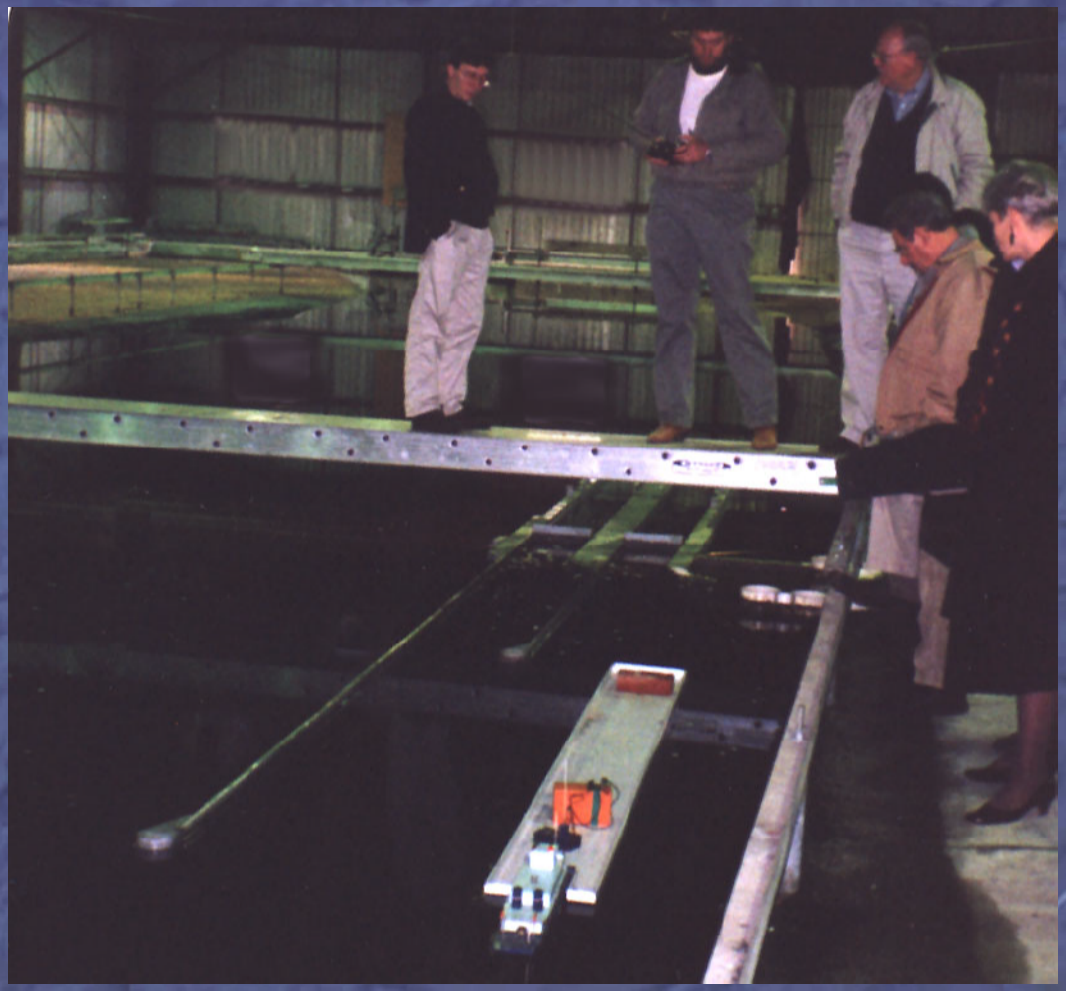
Raked Barge After Impacting a "Bullnose"



LOUISVILLE DISTRICT

INCA ENGINEERS INC.

WES Barge Impact Model Testing



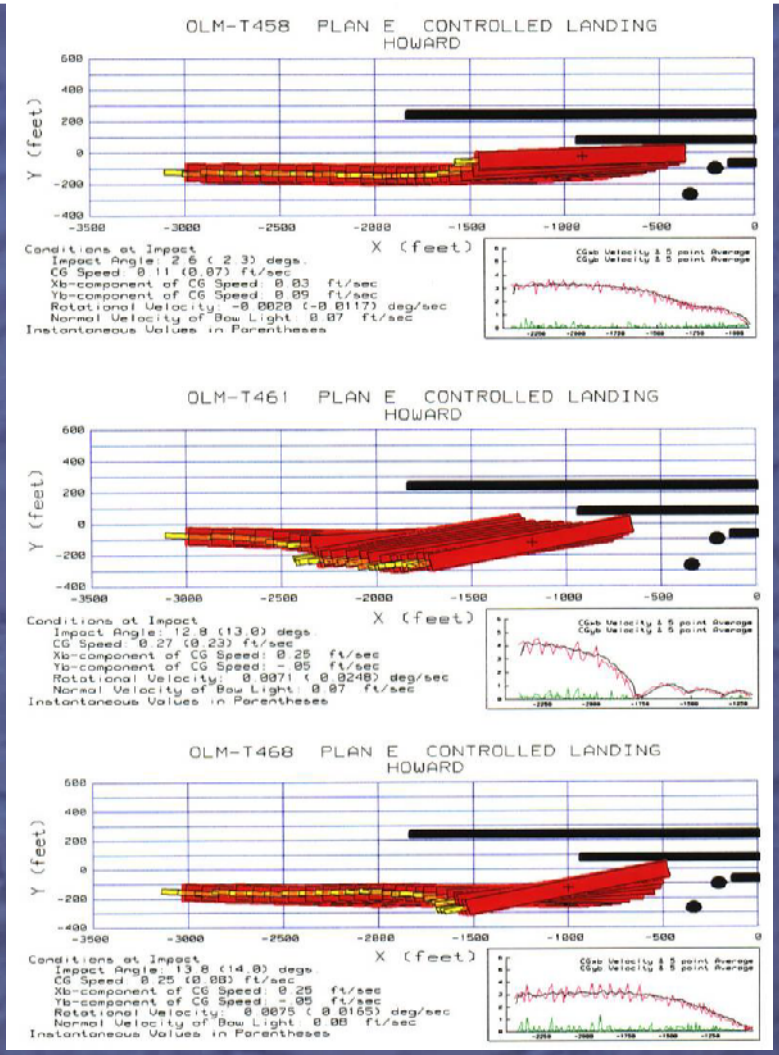
2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

WES Barge Impact Model Testing Results

Over 300 Model test impacts run by WES personnel



Model tests generated Impact Velocity and Angle of Impact

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Final Olmsted Approach Walls Design Barge Impact Loads (KIPS)

Design Condition	Lower Walls kip	Upper Middle Wall kip	Upper River Wall kip	Nose Pier kip
Usual	300	300	600	----
Unusual	450	600	900	----
Extreme	500	800	1,000	4,000

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

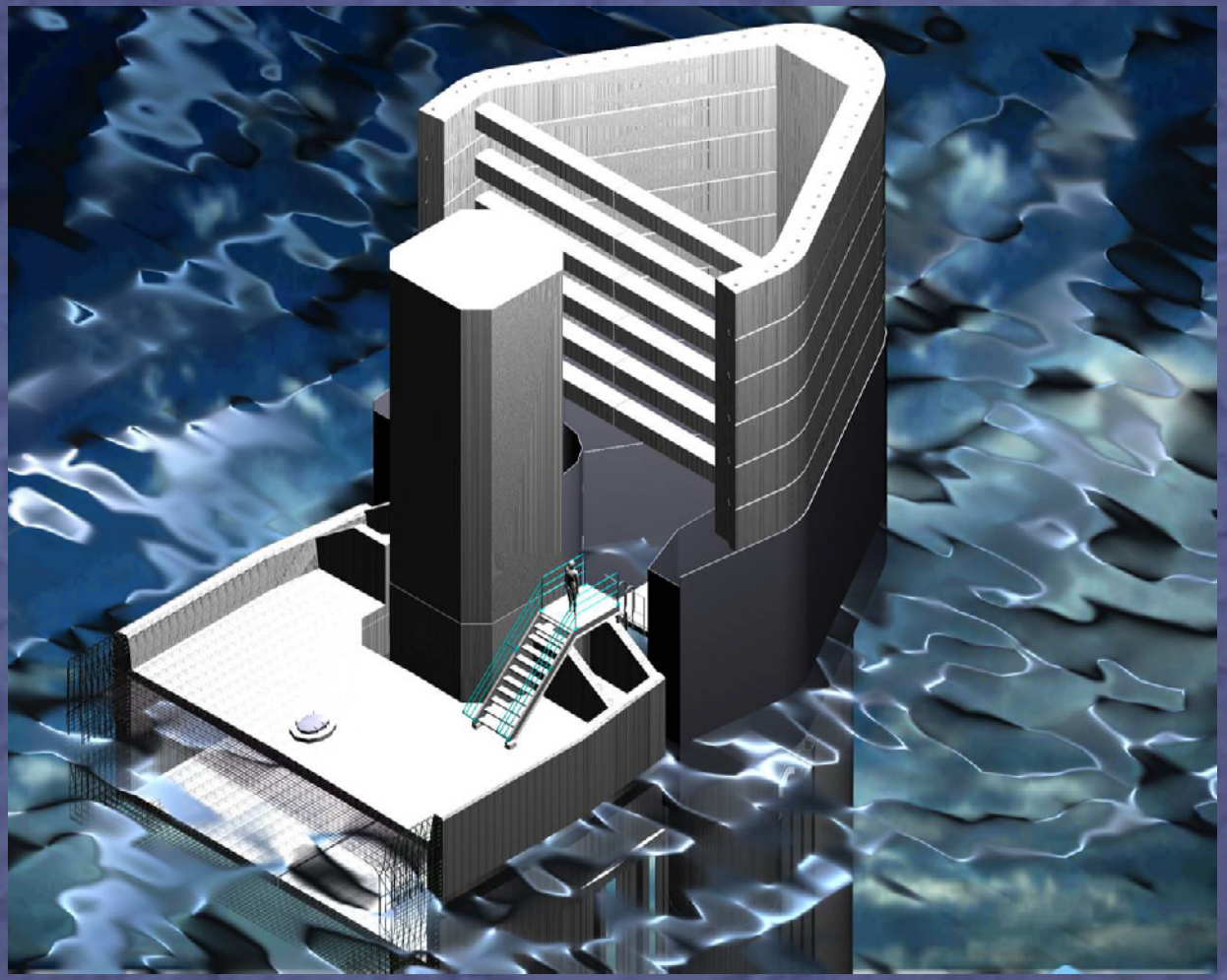
INCA ENGINEERS INC.

Nose Pier & Pylon

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Nose Piers & Pylons

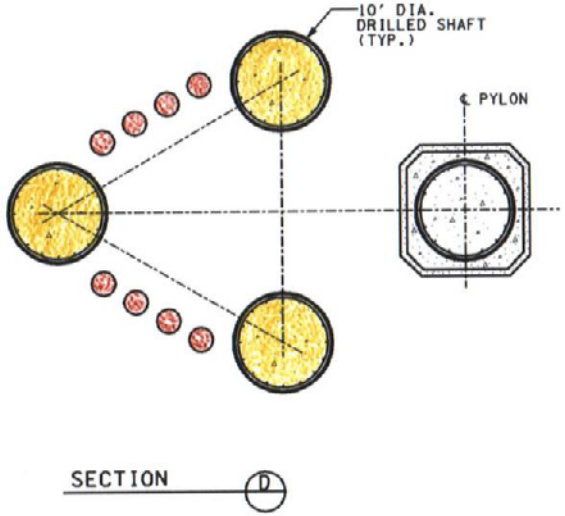


2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

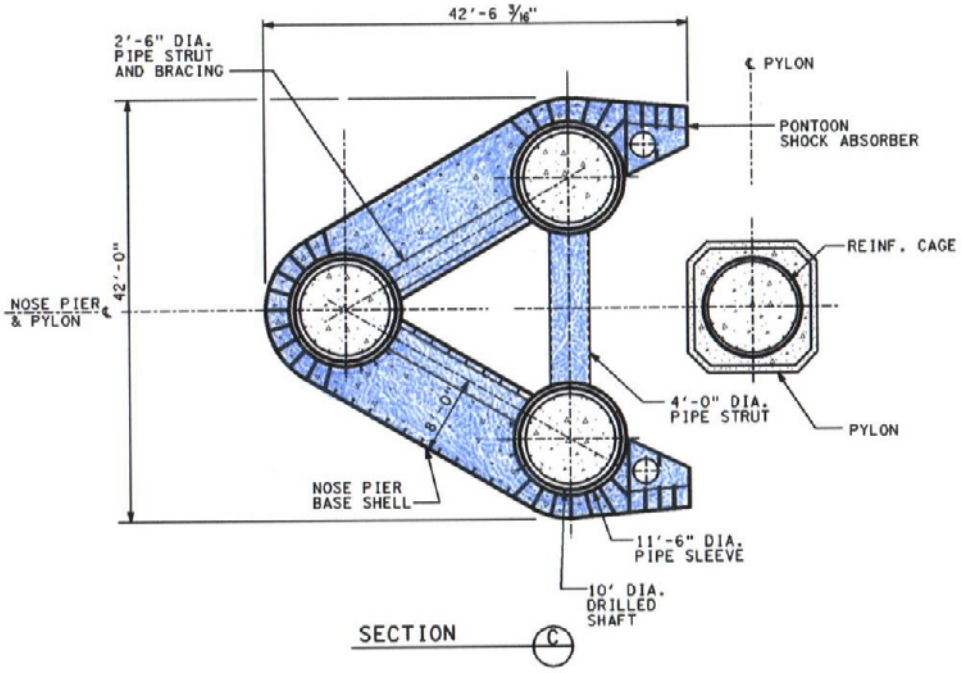
LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Precast Shell Elements Placed over Shafts



ELEVATION 257-292.0

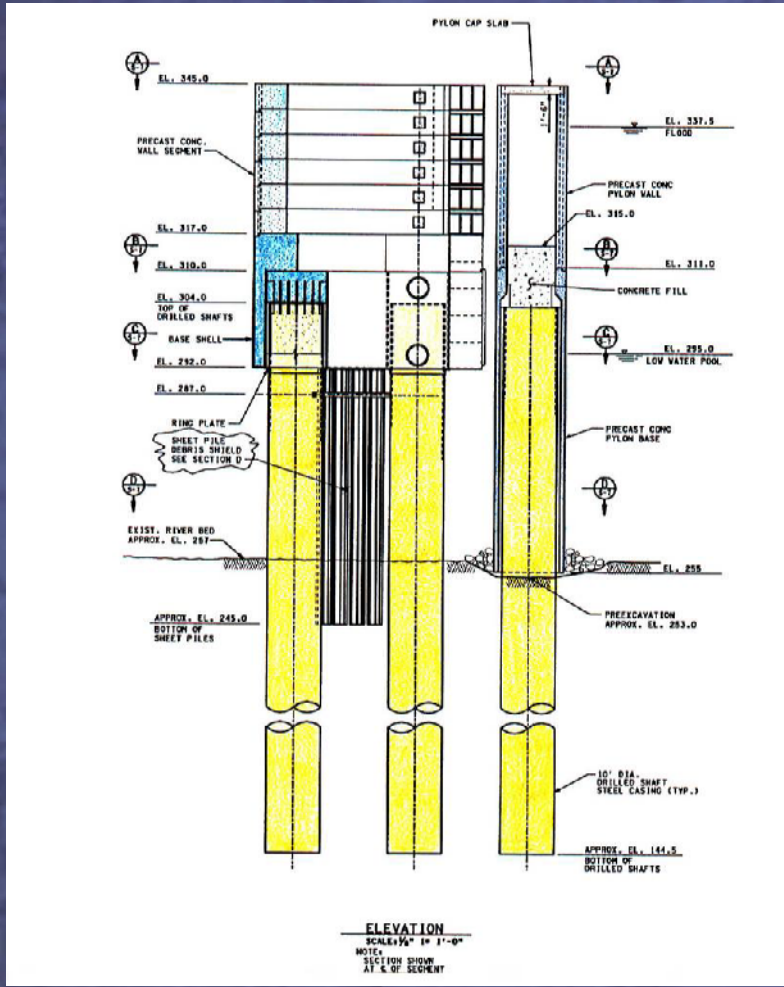


ELEVATION 292-310.0

LOUISVILLE DISTRICT

Founded on 10′ Diameter Drilled Shafts

INCA ENGINEERS INC.



- Casings were fabricated in Idaho before steel prices spiked
- Casings are 44 m long, in one piece
- Casing thickness Varies from 2 – 3 cm

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

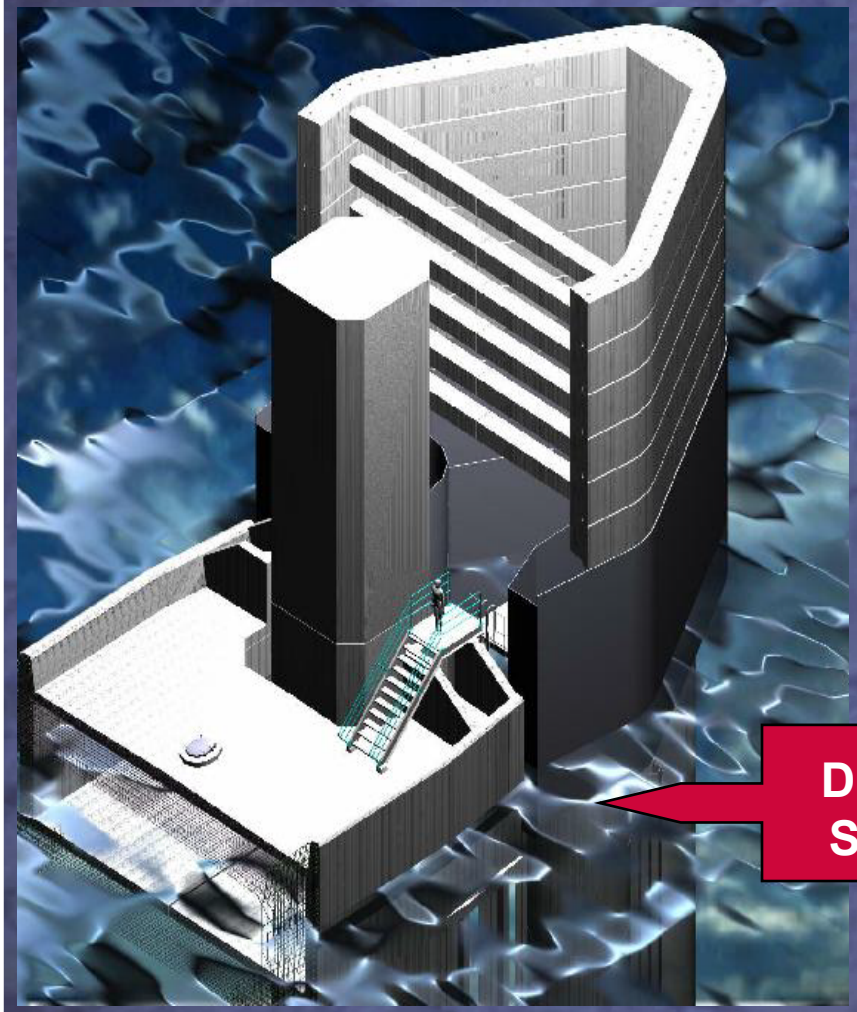
10-Ft Diameter Casing & Custom Vibratory Hammer

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Approach Wall Pylon & Nose Pier



DRILLED SHAFTS

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

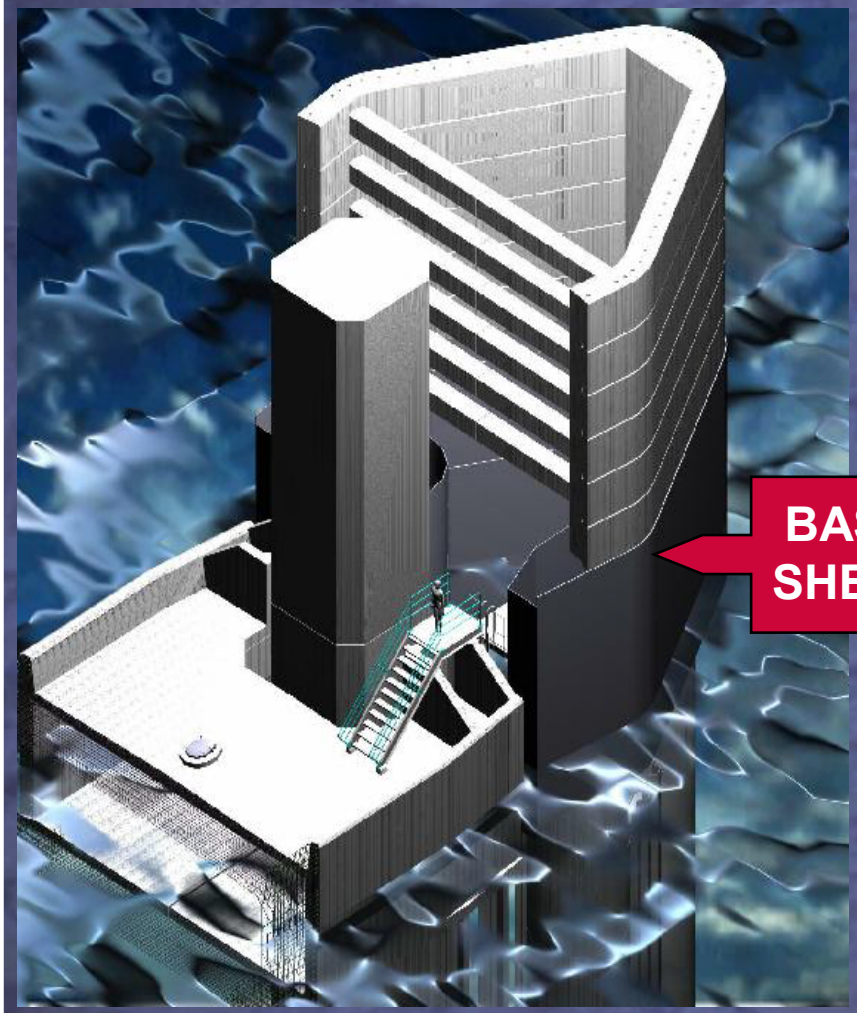
INCA ENGINEERS INC.

Positioning & Driving a Casing – Ringer Crane Mounted on Jumbo Barge

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Approach Wall Pylon & Nose Pier



BASE SHELL

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

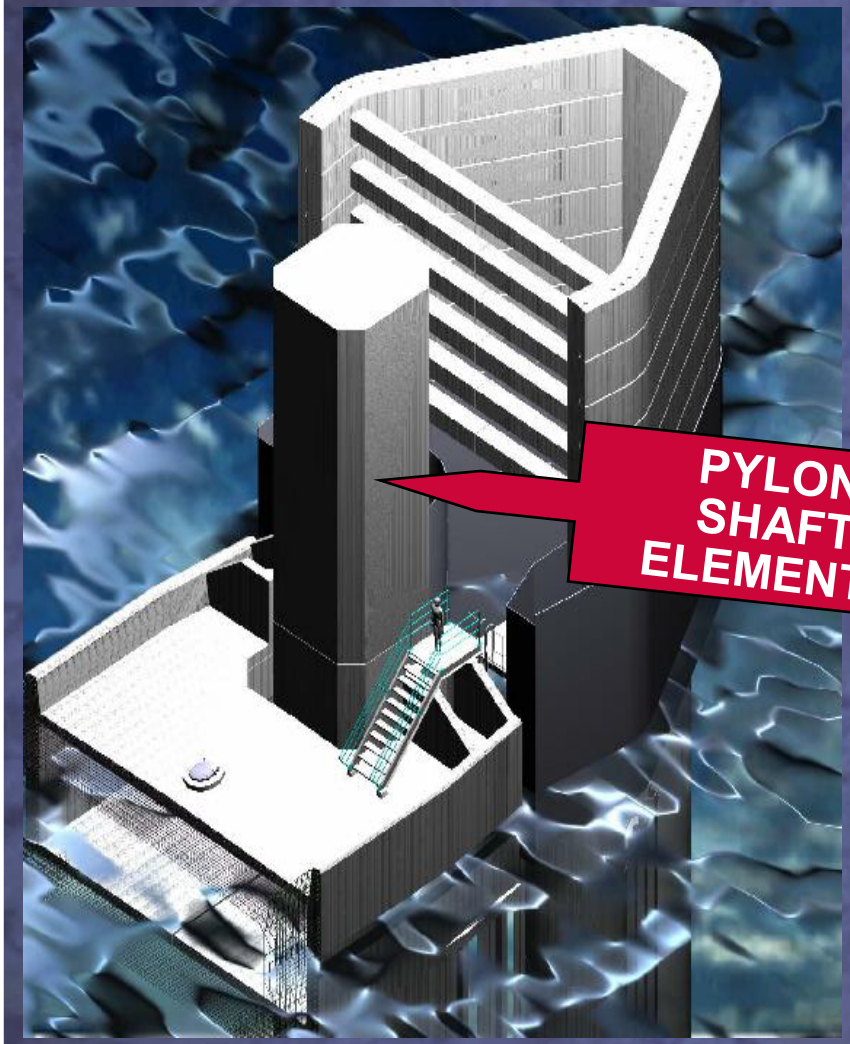
Setting Precast Concrete Top "Delta" Elements on Top of Nose Pier Base Shell

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Approach Wall Pylon & Nose Pier



PYLON SHAFT ELEMENTS

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Installing Precast Concrete Pylon Shell Elements over Drilled Shafts

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Painting for Visibility

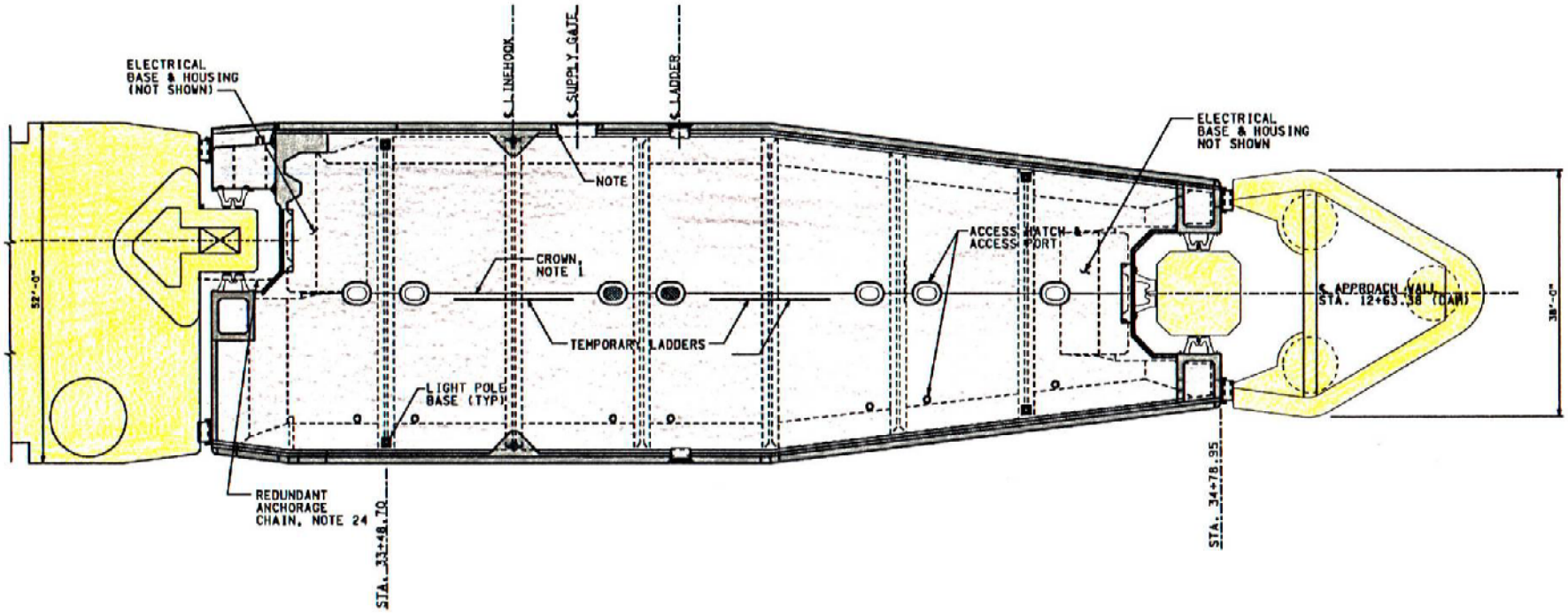
2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

INCA ENGINEERS INC.

The Pontoons

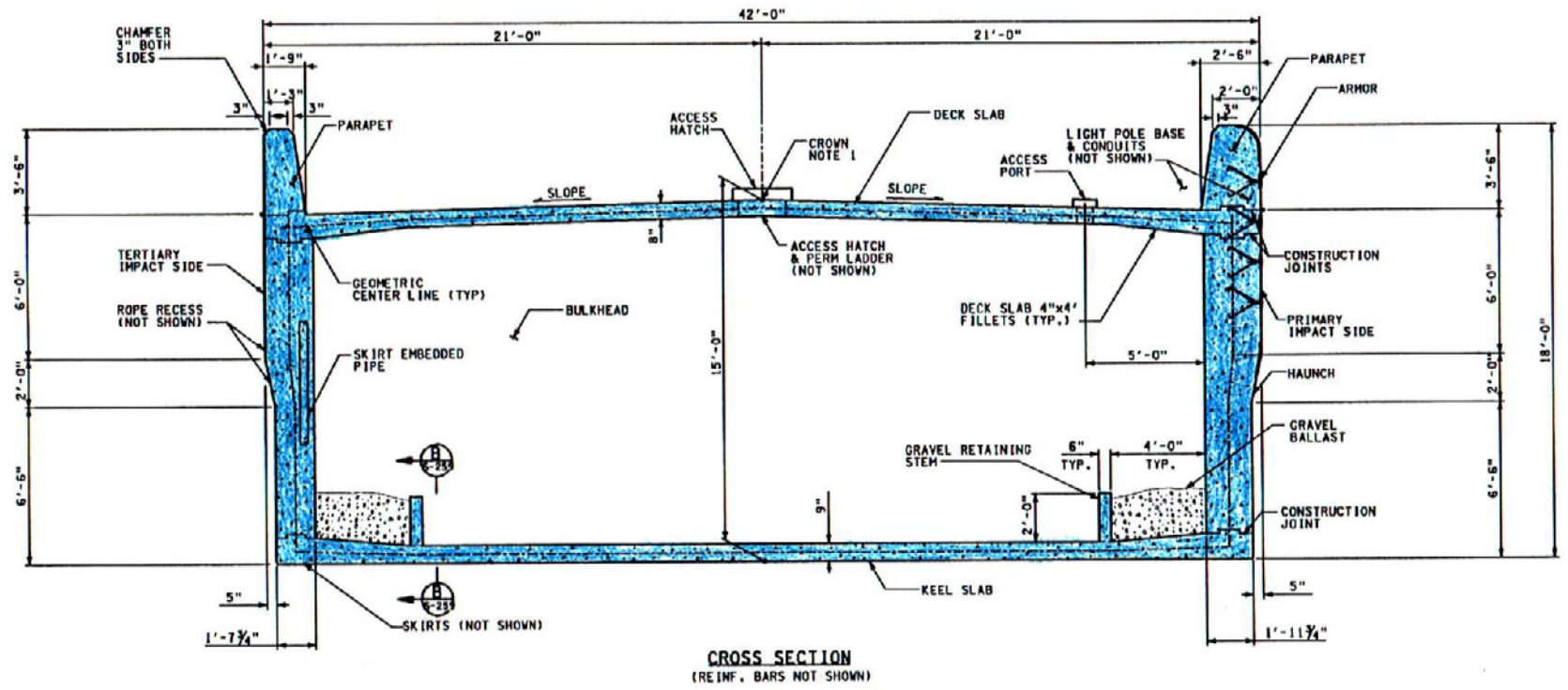


LOWER MIDDLE WALL PLAN
SCALE: 1" = 10'

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Typical Pontoon Cross Section



LOUISVILLE
DISTRICT

INCA
ENGINEERS INC.

Graving Yard & Casting Basin

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

Overview of Graving Yard Site March 1, 2001

INCA ENGINEERS INC.

Overview of Graving Dock Site March 1, 2001

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Post tensioning with over 6.9 MPa (1000 psi)

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

INCA ENGINEERS INC.

Floating Off the Casting Beds

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

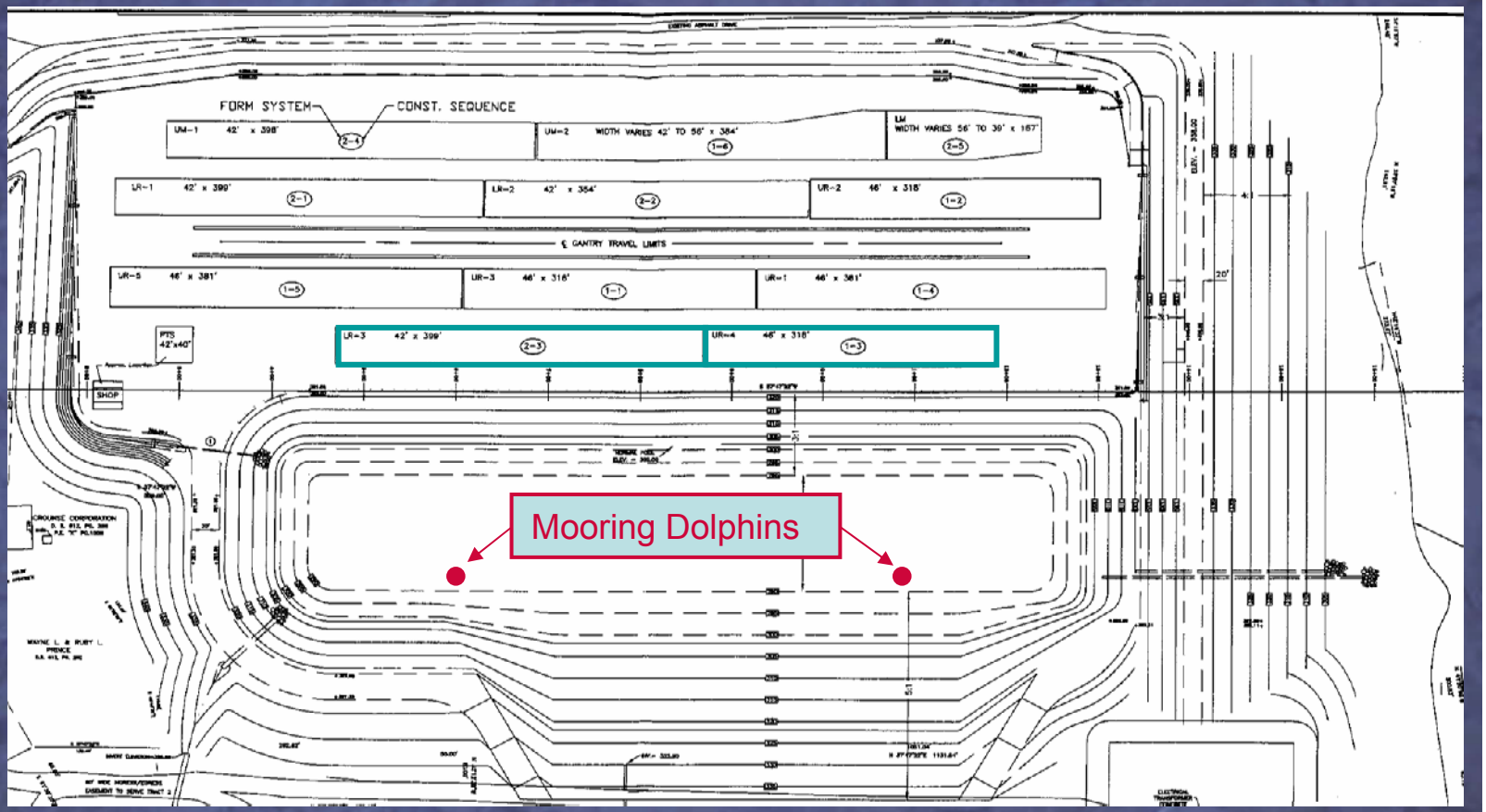
Casting Basin Flooding Begins

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Casting Yard Relationship to Float-out Storage Basin



LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Basin is flooding – pontoons at lower casting elevations get wet first

First two rows are wet, water not yet to third row

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

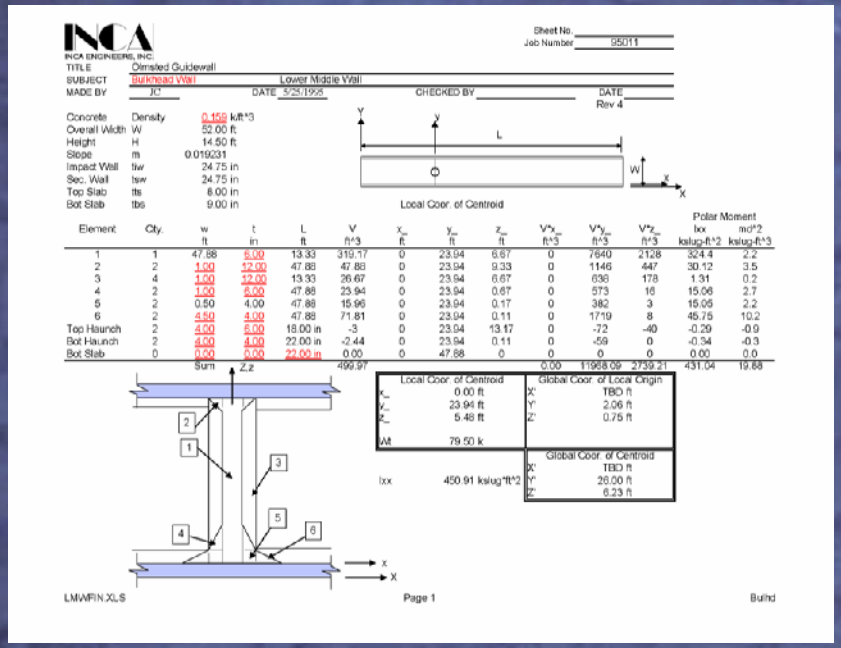
Basin Superflood Complete

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Painstaking Bouyancy Calculations



INCA ENGINEERS, INC.

Sheet No. ____ Job Number 95011

TITLE Olmsted Guidewall
SUBJECT Bulkhead Wall — Lower Middle Wall
MADE BY JC DATE 5/25/1995 CHECKED BY ____ DATE ____ Rev 4

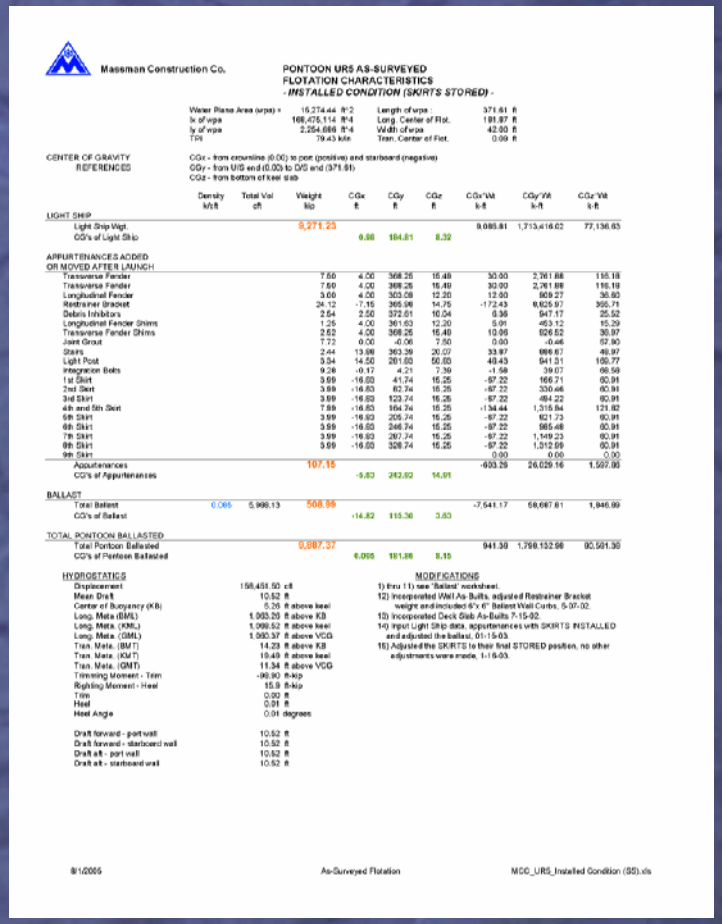
Concrete	Density	0.150 kft^3
Overall Width	W	52.00 ft
Height	H	14.50 ft
Slope	m	0.019231
Impact Wall	tiw	24.75 in
Sec. Wall	tsw	24.75 in
Top Slab	tts	8.00 in
Bot Slab	tbs	9.00 in

Local Coor. of Centroid

Element	Qty.	w ft	t in	L ft	V ft^3	x_{cc} ft	y_{cc} ft	z_{cc} ft	$V*x_{cc}$ ft^3	$V*y_{cc}$ ft^3	$V*z_{cc}$ ft^3	Polar Moment Ixx kslug-ft^2	Polar Moment mO^2 kslug-ft^3
1	1	47.88	6.00	13.33	319.17	0	23.94	6.67	0	7640	2128	324.4	2.2
2	2	1.00	12.00	47.88	47.88	0	23.94	9.33	0	1146	447	30.12	3.5
3	4	1.00	12.00	13.33	26.67	0	23.94	6.67	0	638	178	1.31	0.2
4	2	1.50	4.00	47.88	23.94	0	23.94	0.67	0	573	16	15.06	2.7
5	2	0.50	4.00	47.88	15.96	0	23.94	0.17	0	382	3	15.05	2.2
6	2	4.50	4.00	47.88	71.81	0	23.94	0.11	0	1719	8	45.75	10.2
Top Haunch	2	4.00	8.00	18.00 in	-3	0	23.94	13.17	0	-72	-40	-0.29	-0.9
Bot Haunch	2	4.00	4.00	22.00 in	-2.44	0	23.94	0.11	0	-59	0	-0.34	-0.3
Bot Slab	0	0.00	0.00	22.00 in	0.00	0	47.88	0	0	0	0	0.00	0.0
		Sum	Z.z		499.97				0.00	11968.09	2739.21	431.04	19.88

Local Coor. of Centroid		Global Coor. of Local Origin	
x_{cc}	0.00 ft	X'	TBD ft
y_{cc}	23.94 ft	Y'	2.06 ft
z_{cc}	5.48 ft	Z'	0.75 ft
Mt	79.50 k		
Ixx	450.91 kslug*ft^2	Global Coor. of Centroid X'	TBD ft
		Y'	26.00 ft
		Z'	6.23 ft

LMWFIN.XLS Page 1 Build



Massman Construction Co.

PONTOON URS AS-SURVEYED
FLOTATION CHARACTERISTICS
- INSTALLED CONDITION (SKIRTS STORED) -

Water Plane Area (wpa) =	15,274.44 ft^2	Length of wpa :	371.61 ft
Ix of wpa	168,475,114 ft^4	Long. Center of Flot.	191.87 ft
Iy of wpa	2,264,686 ft^4	Width of wpa	42.00 ft
TPI	79.43 k/in	Tran. Center of Flot.	0.00 ft

CENTER OF GRAVITY REFERENCED
CGx - from centerline (0.00) to port (positive) and starboard (negative)
CGy - from U/S end (0.00) to D/S end (371.61)
CGz - from bottom of keel slab

	Density k/ft	Total Vol cft	Weight kip	CGx ft	CGy ft	CGz ft	CGx*Wt k-ft	CGy*Wt k-ft	CGz*Wt k-ft
LIGHT SHIP									
Light Ship Wgt			9,271.23				8,085.81	1,713,416.62	77,136.63
CG's of Light Ship				0.88	184.81	8.32			
APPURTENANCES ADDED OR MOVED AFTER LAUNCH									
Transverse Fender			7.50	4.00	368.25	16.48	30.00	2,761.88	116.18
Transverse Fender			7.50	4.00	368.25	16.49	30.00	2,761.88	116.18
Longitudinal Fender			3.00	4.00	363.08	12.20	12.00	909.27	36.60
Restrainer Bracket			24.12	-7.15	365.96	14.75	-172.43	8,825.97	355.71
Debris Inhibitors			2.64	2.50	372.61	16.04	6.36	947.17	25.52
Longitudinal Fender Shims			1.25	4.00	361.63	12.20	5.01	453.12	15.29
Transverse Fender Shims			2.62	4.00	368.25	16.49	10.06	926.52	30.97
Joint Grout			7.72	0.00	-0.06	7.50	0.00	-0.46	57.90
Stairs			2.44	13.98	363.39	26.00	33.97	886.67	46.97
Light Post			9.04	14.50	201.03	50.00	40.43	941.51	160.77
Integracon Bolts			9.26	-0.17	4.21	7.39	-1.58	39.07	68.58
1st Skirt			3.99	-16.83	41.74	16.25	-67.22	166.71	60.91
2nd Skirt			3.99	-16.83	82.74	16.25	-67.22	330.46	60.91
3rd Skirt			3.99	-16.83	123.74	16.25	-67.22	494.22	60.91
4th and 5th Skirt			7.99	-16.83	164.74	16.25	-134.44	1,316.84	121.82
5th Skirt			3.99	-16.83	205.74	16.25	-67.22	821.73	60.91
6th Skirt			3.99	-16.83	246.74	16.25	-67.22	985.48	60.91
7th Skirt			3.99	-16.83	287.74	16.25	-67.22	1,149.23	60.91
8th Skirt			3.99	-16.83	328.74	16.25	-67.22	1,312.99	60.91
9th Skirt							0.00	0.00	0.00
Appurtenances			107.15				-693.29	26,029.16	1,597.90
CG's of Appurtenances				-6.83	242.92	14.91			
BALLAST									
Total Ballast	0.065	5,966.13	508.96				-7,541.17	58,687.81	1,946.99
CG's of Ballast				-14.82	115.30	3.83			
TOTAL PONTOON BALLASTED									
Total Pontoon Ballasted			9,887.37				941.38	1,799,132.96	80,581.36
CG's of Pontoon Ballasted				0.095	181.96	8.15			

HYDROSTATICS

Displacement	158,451.50 clt
Mean Draft	10.52 ft
Center of Buoyancy (KB)	5.26 ft above keel
Long. Meta (BML)	1,993.26 ft above KB
Long. Meta. (KML)	1,998.52 ft above keel
Long. Meta. (GML)	1,980.37 ft above VCG
Tran. Meta. (BMT)	14.23 ft above KB
Tran. Meta. (KMT)	19.49 ft above keel
Tran. Meta. (GMT)	11.34 ft above VCG
Trimming Moment - Trim	-99.90 ft-kip
Righting Moment - Heel	15.9 ft-kip
Trim	0.00 ft
Heel	0.01 ft
Heel Angle	0.01 degrees
Draft forward - port wall	10.52 ft
Draft forward - starboard wall	10.52 ft
Draft aft - port wall	10.52 ft
Draft aft - starboard wall	10.52 ft

MODIFICATIONS
1) thru 11) see "Ballast" worksheet.
12) Incorporated Wall As-Built, adjusted Restrainer Bracket weight and included 6"x 6" Ballast Wall Curbs, 5-07-02.
13) Incorporated Deck Slab As-Built's 7-15-02.
14) Input Light Ship data, appurtenances with SKIRTS INSTALLED and adjusted the ballast, 01-15-03.
15) Adjusted the SKIRTS to their final STORED position, no other adjustments were made, 1-15-03.

8/1/2005 As-Surveyed Flotation MCC_URS_Installed Condition (SS).xls

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Pontoons all Afloat and Have Been Moored to Dolphins

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Completed Pontoons Ready to Transport to Olmsted Site

Note Breached Dike

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Transporting a Completed Pontoon from Casting Yard to Olmsted Site

LOUISVILLE
DISTRICT

INCA
ENGINEERS INC.

Completed Pontoon Arriving at Olmsted

LOUISVILLE DISTRICT

Olmsted Floating Approach Walls

INCA ENGINEERS INC.

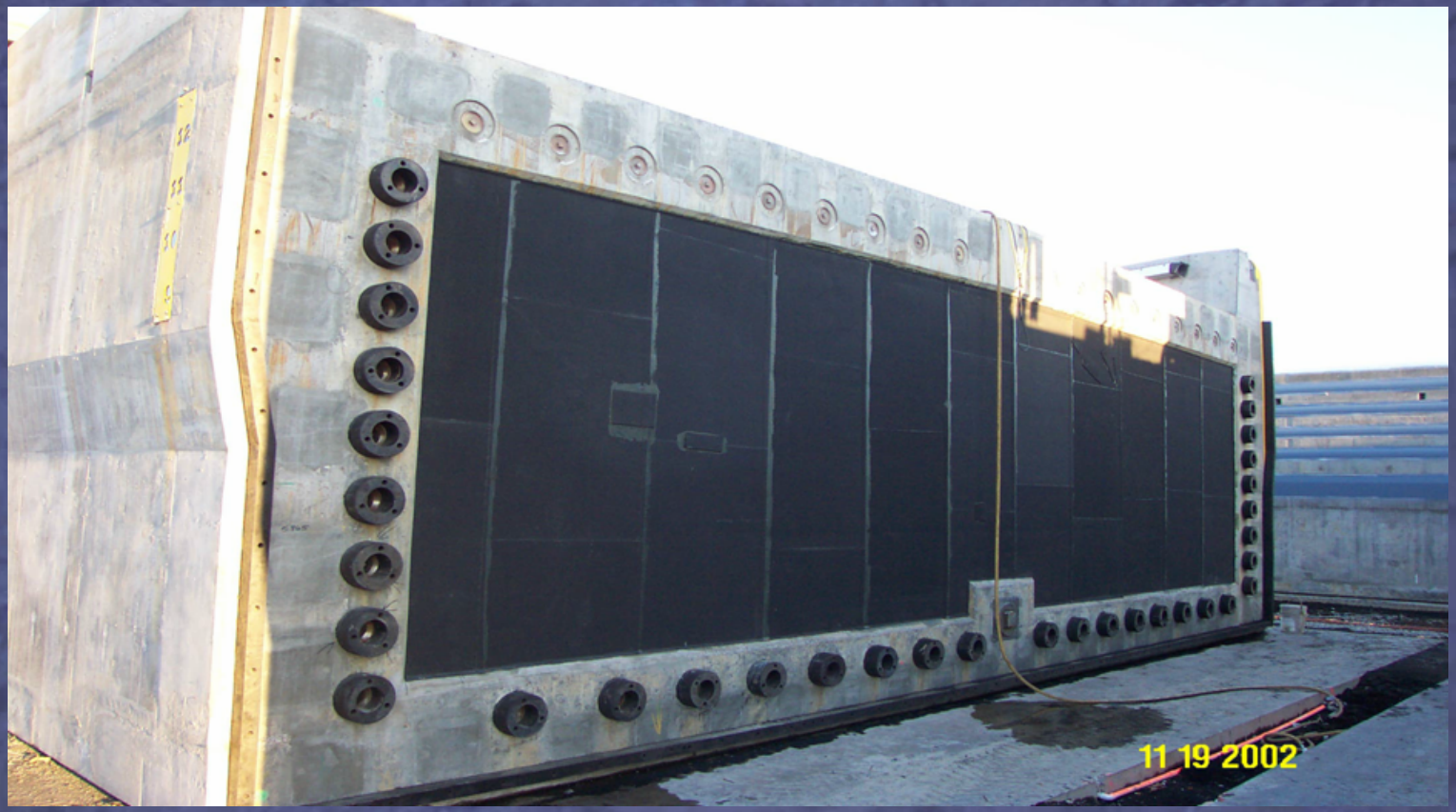
Integration and Installation at The Olmsted Site

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Integrating Pontoons at Olmsted

Integration Bolt Holes with Rubber “Donuts” surrounding each hole



LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Integrating Pontoons at Olmsted

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

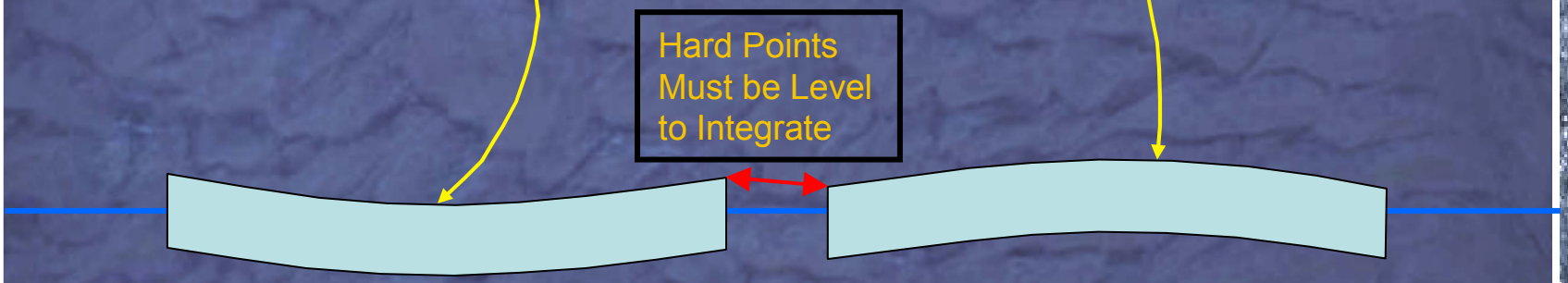
LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Aligning Pontoons for Integration

Pontoon in shadow; water temperature warmer than air or pontoon

Pontoon in the sun; water temperature cooler than air or pontoon



Temperature Extremes

- Air -14 to +108 deg F
- Water +37 to +87 deg F

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Checking Horizontal Alignment on Primary Impact face at Olmsted

LOUISVILLE DISTRICT

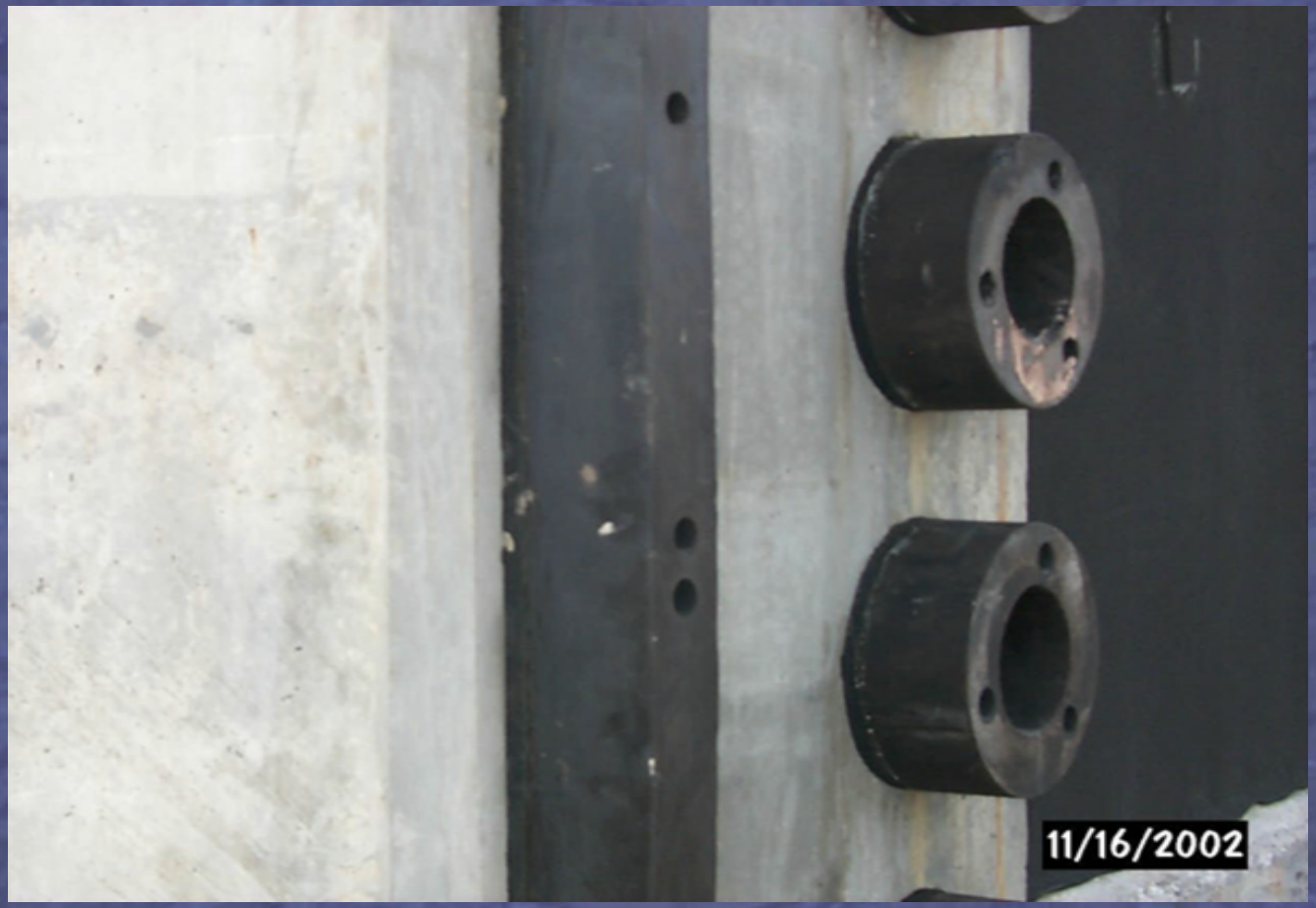
INCA ENGINEERS INC.

Dewatering box in case future repairs are necessary below the water line

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Integration Seals at Perimeter of Pontoon and around each Bolt Hole



LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Integrating Pontoons at Olmsted

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Installing an Integrated Floating Wall

This was a 90 Minute Operation!

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Final Installation of 508 m (1667 ft) Long Upper River Wall in February 2004

Duration of Installation: 1½ hours

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

High Mast Lighting was installed after pontoons were integrated and installed in final positions

LOUISVILLE
DISTRICT

INCA
ENGINEERS INC.

River in Flood January 2005
Pontoons Ride the Floods

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Construction Cost

Award Amount

$98,981,000

Final Amount

$106,360,000

7.45% Growth

LOUISVILLE DISTRICT

INCA ENGINEERS INC.

Olmsted Approach Walls Team

INCA Engineers
Glosten Associates
Geomatrix
Elcon Associates
John Priedeman
Washington DOT

USACE
Louisville District
Headquarters
Portland District
Nashville District
ERDC (WES)

Massman Construction Co.

SUBCONTRACTORS:
Bar-Tie Reinforcing Inc.
Gerald Chambers & Sons, Inc.
Luhr Bros., Inc.
Plateau Electrical Constructors, Inc.
Thomas Industrial Coatings

SUPPLIERS:
Alfab, Inc.
AmeriSteel
Eaton Metal Products Co.
Egyptian Concrete Co.
Federal Materials Concrete
Steven M. Hain Co.
Hydraulic Power Systems, Inc.
Ingram Barge Co.
James Marine Inc.
Steward Machine Co.
VSL/Vstructural

LOUISVILLE
DISTRICT

INCA
ENGINEERS INC.

THANK YOU!

2005 TRI-SERVICE INFRASTRUCTURE SYSTEMS CONFERENCE