US Army Corps
of Engineers
Louisville District

U.S. Army Corps of Engineers

Louisville District

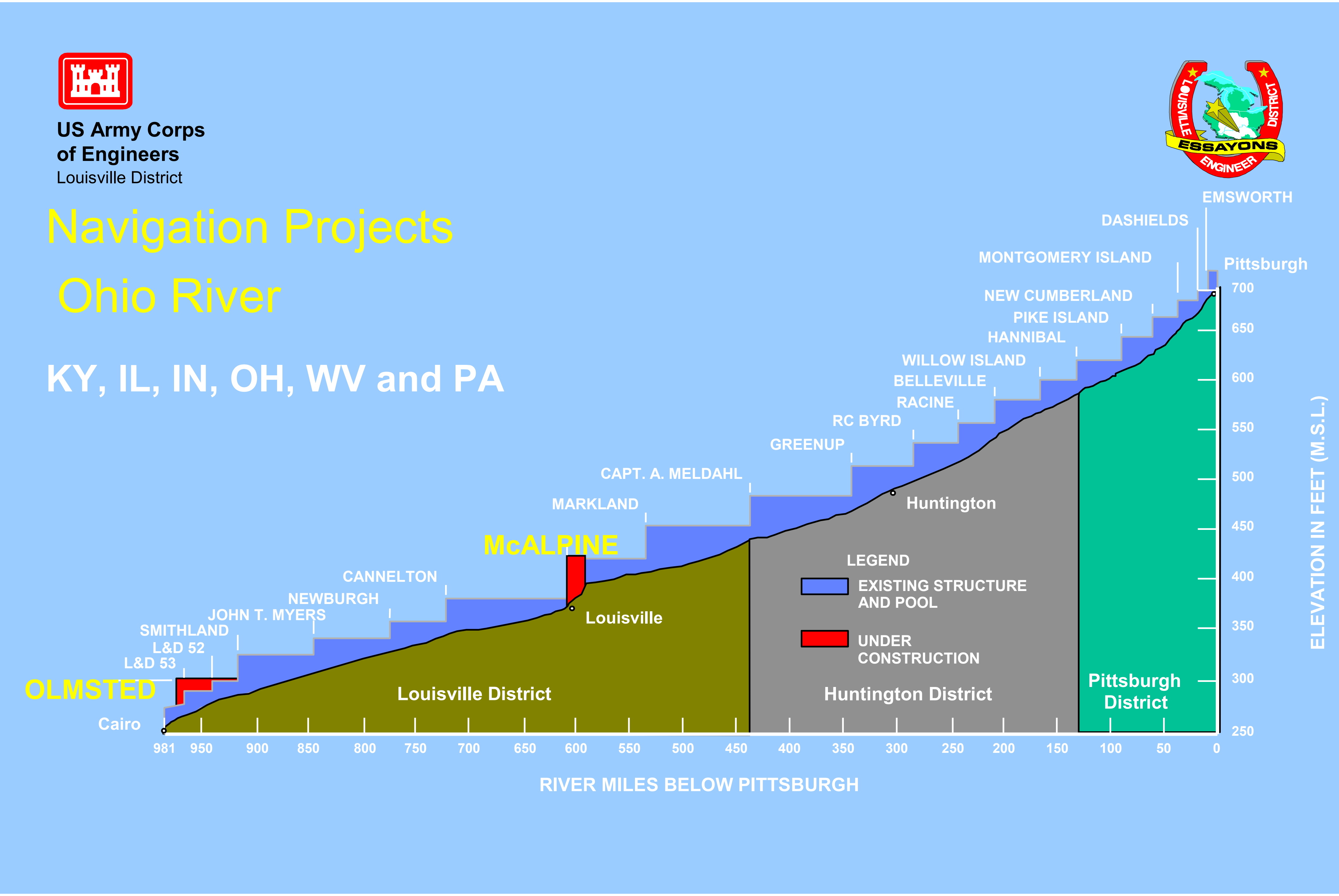
Olmsted L&D,
Dam
In-the-wet Construction

Byron McClellan, P.E.
Dale Berner, PhD, P.E.
Kenneth Burg, P.E.

US Army Corps
of Engineers
Louisville District

Olmsted Locks & Dam Project

1996 rendering of completed project


US Army Corps
of Engineers
Louisville District
Navigation Projects
Ohio River
KY, IL, IN, OH, WV and PA
LOUISVILLE DISTRICT
ESSAYONS
ENGINEER
EMSWORTH
DASHIELDS
MONTGOMERY ISLAND
Pittsburgh
NEW CUMBERLAND
PIKE ISLAND
HANNIBAL
WILLOW ISLAND
BELLEVILLE
RACINE
RC BYRD
GREENUP
CAPT. A. MELDAHL
MARKLAND
Huntington
McALPINE
CANNELTON
NEWBURGH
JOHN T. MYERS
SMITHLAND
L&D 52
L&D 53
OLMSTED
Cairo
Louisville
LEGEND
EXISTING STRUCTURE AND POOL
UNDER CONSTRUCTION
Louisville District
Huntington District
Pittsburgh District
700
650
600
550
500
450
400
350
300
250
ELEVATION IN FEET (M.S.L.)
981
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
RIVER MILES BELOW PITTSBURGH

US Army Corps
of Engineers
Louisville District

Olmsted Dam
Cost Reimbursable Contract

Contractor: Washington Group/Alberici

Award: 31 March 2004

Estimated Cost: $564,148,484.00

Completion Date: 30 November 2011

US Army Corps of Engineers
Louisville District

Olmsted Dam Cost Reimbursable Contract (Cost –Plus- Award Fee)

- Risk is shared
- Collaboration:
  - Contractor
  - Design AE
  - Corps
- Work is Controlled with "WAD's"
- Items purchased are Corps' Property
- Contractor's Award Fee based upon performance.

US Army Corps
of Engineers
Louisville District

Brief History
Dam Construction Studies

- Cellular Cofferdam
- Braced Single – Wall Cofferdam
- Mobile Cofferdam
- In - the - Wet Construction

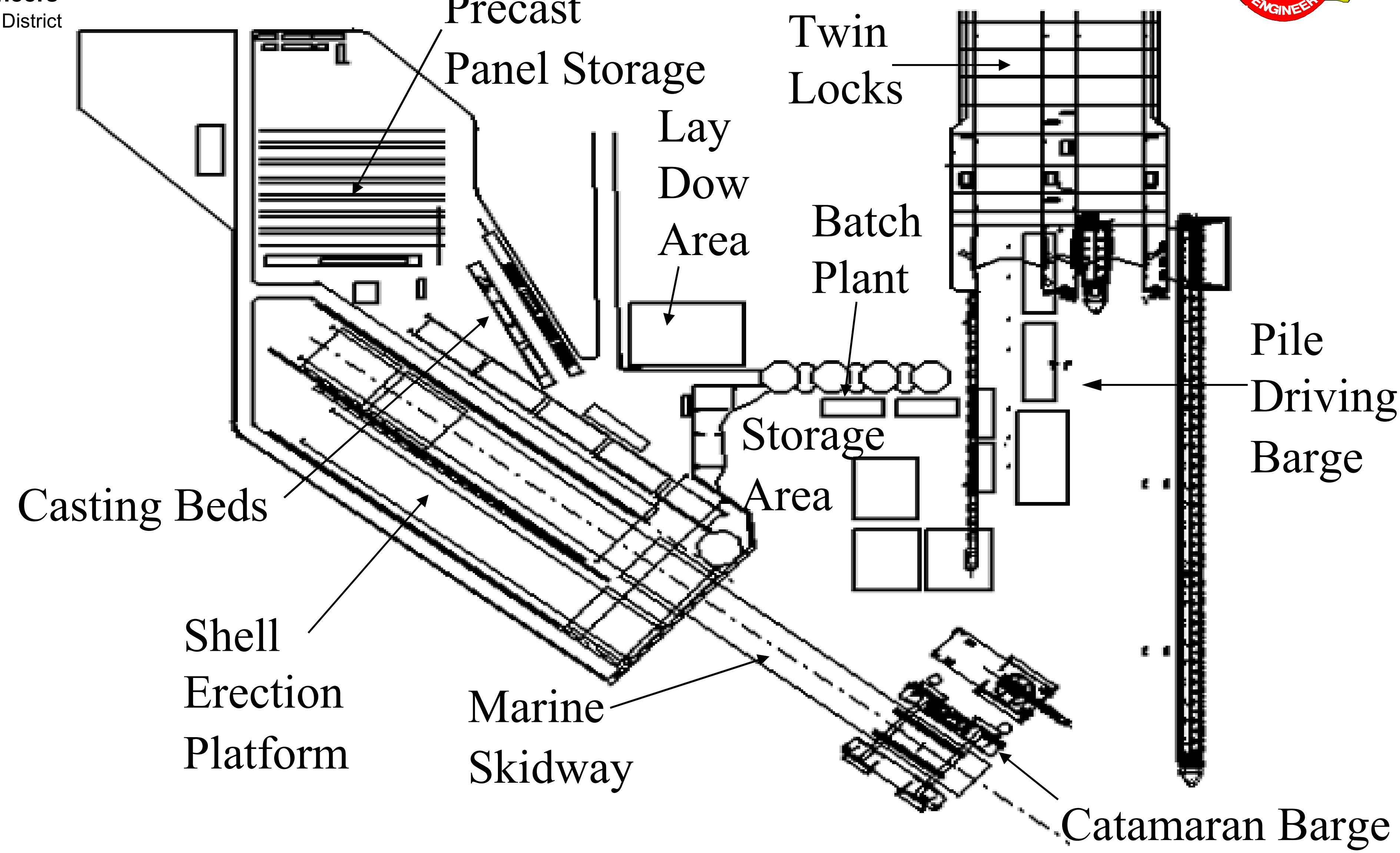
US Army Corps
of Engineers
Louisville District

In – the – Wet Construction

- Pre-cast Shell Construction
  - On – site casting yard
  - Marine way to lower shells to river
  - Lifting frames to stiffen shells
- Foundation Prep In – the – Wet
- Set shells with catamaran barge
- Fill shells with tremie concrete
- Set Tainter Gates

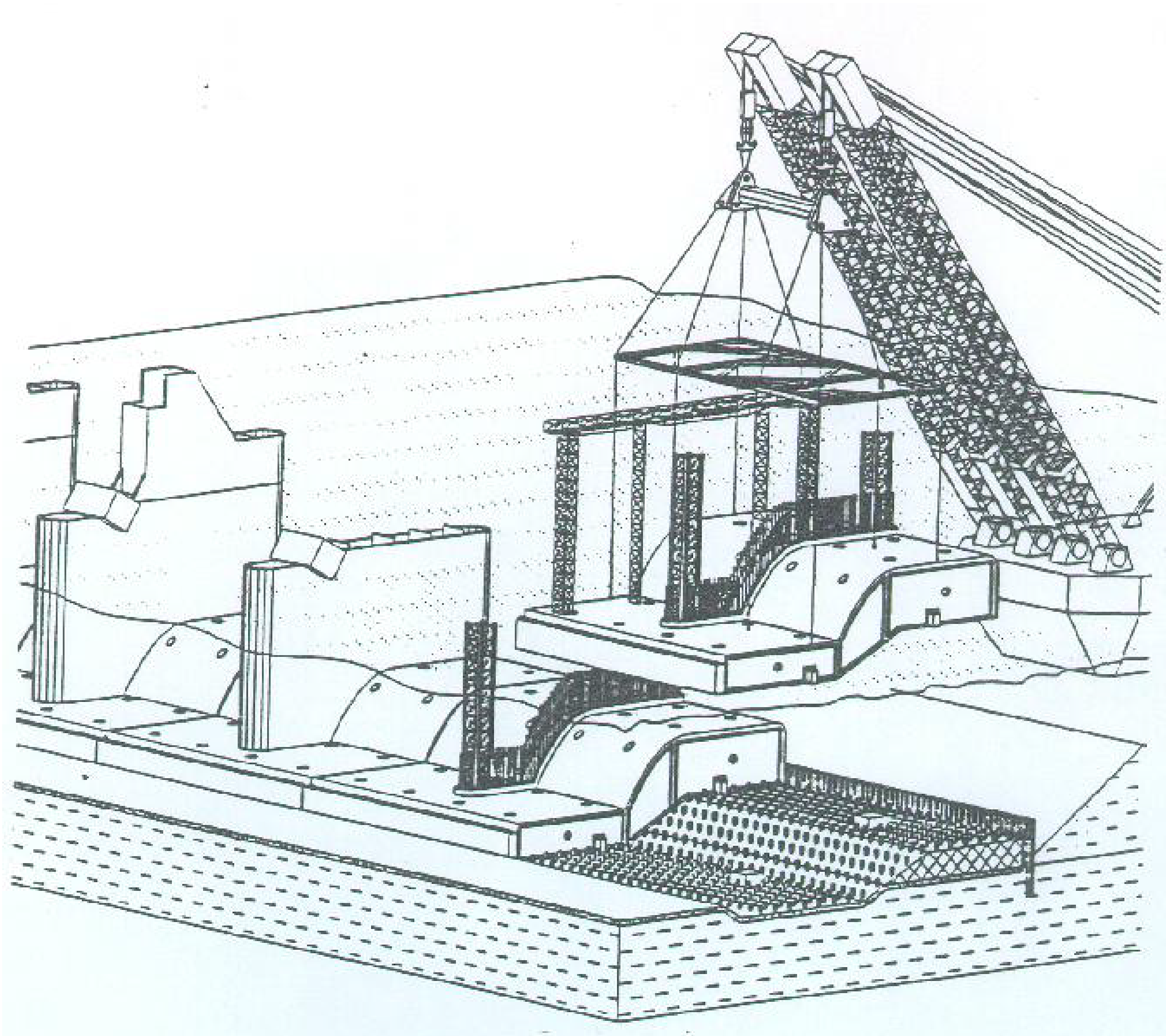
US Army Corps
of Engineers
Louisville District

Precast Yard



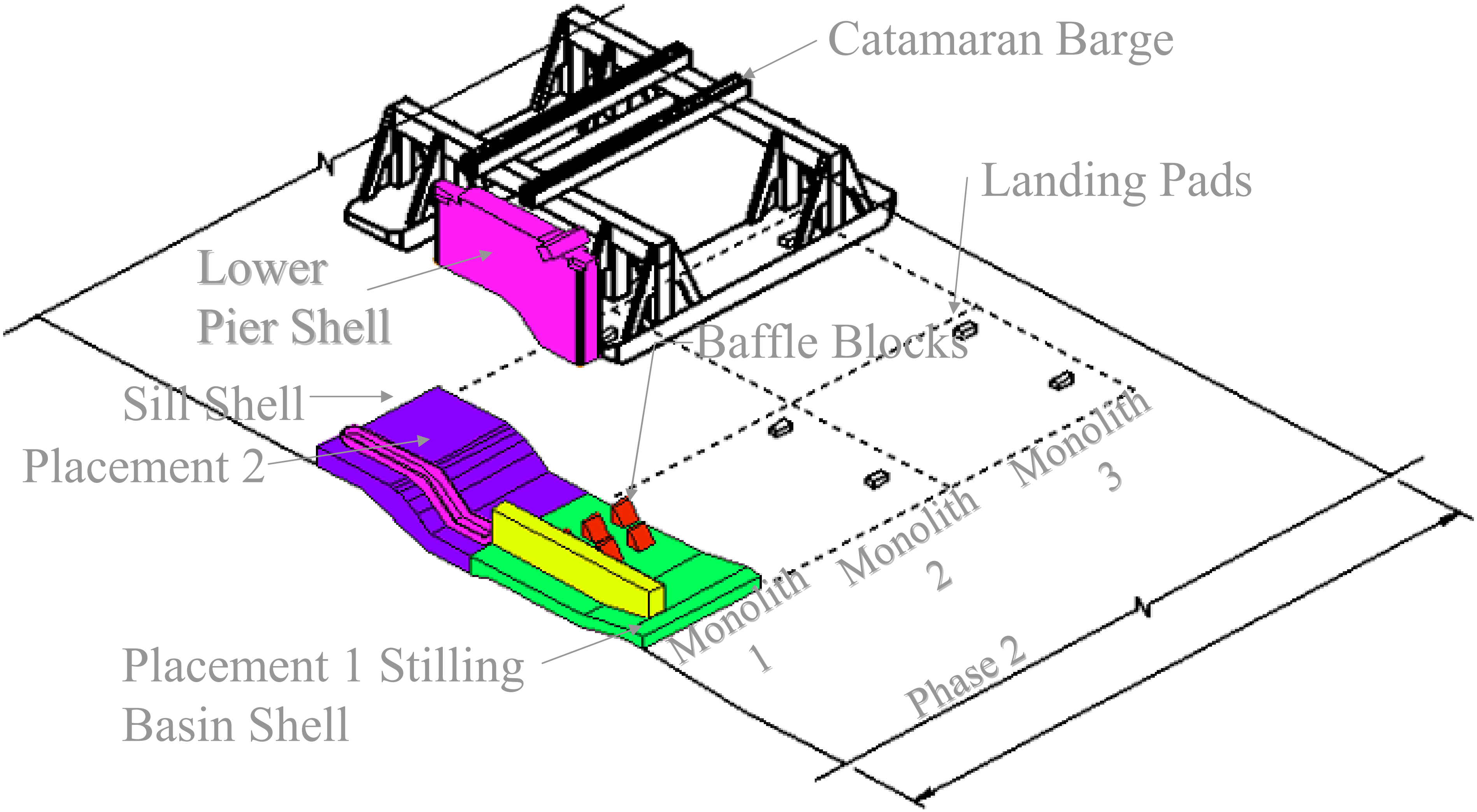
US Army Corps
of Engineers
Louisville District

Dam



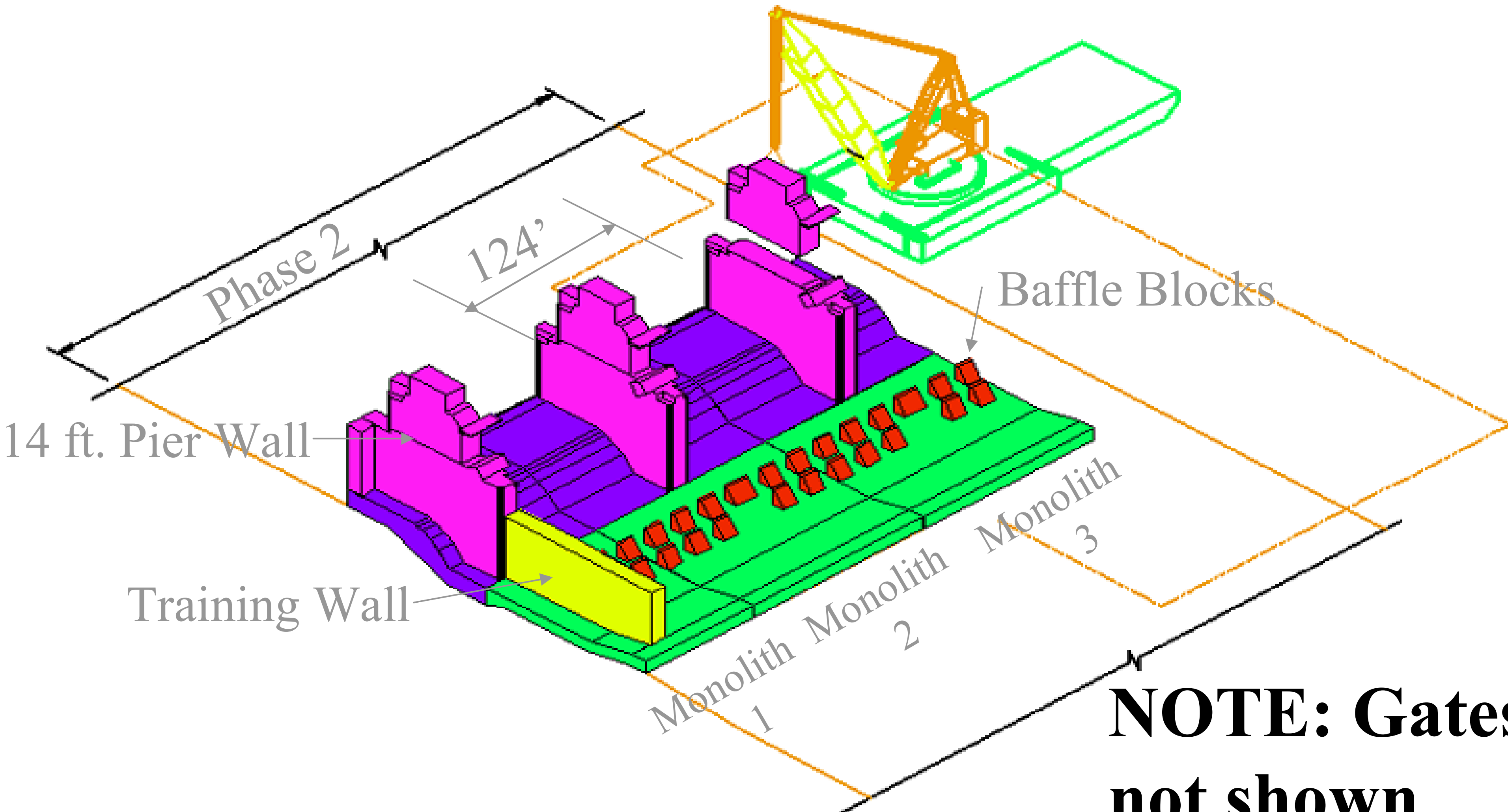
US Army Corps
of Engineers
Louisville District

Catamaran with Lower Pier Shell



US Army Corps
of Engineers
Louisville District

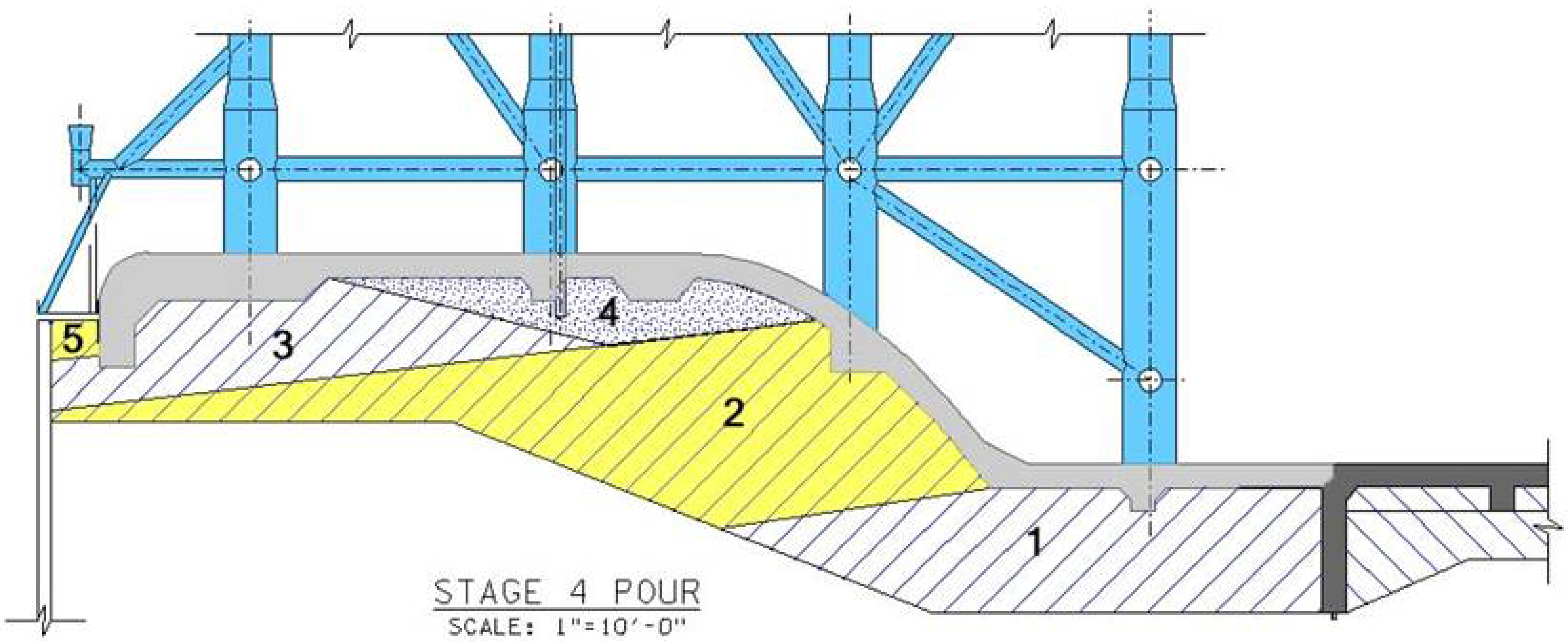
Placement of Upper Pier Shell Elements



NOTE: Gates not shown

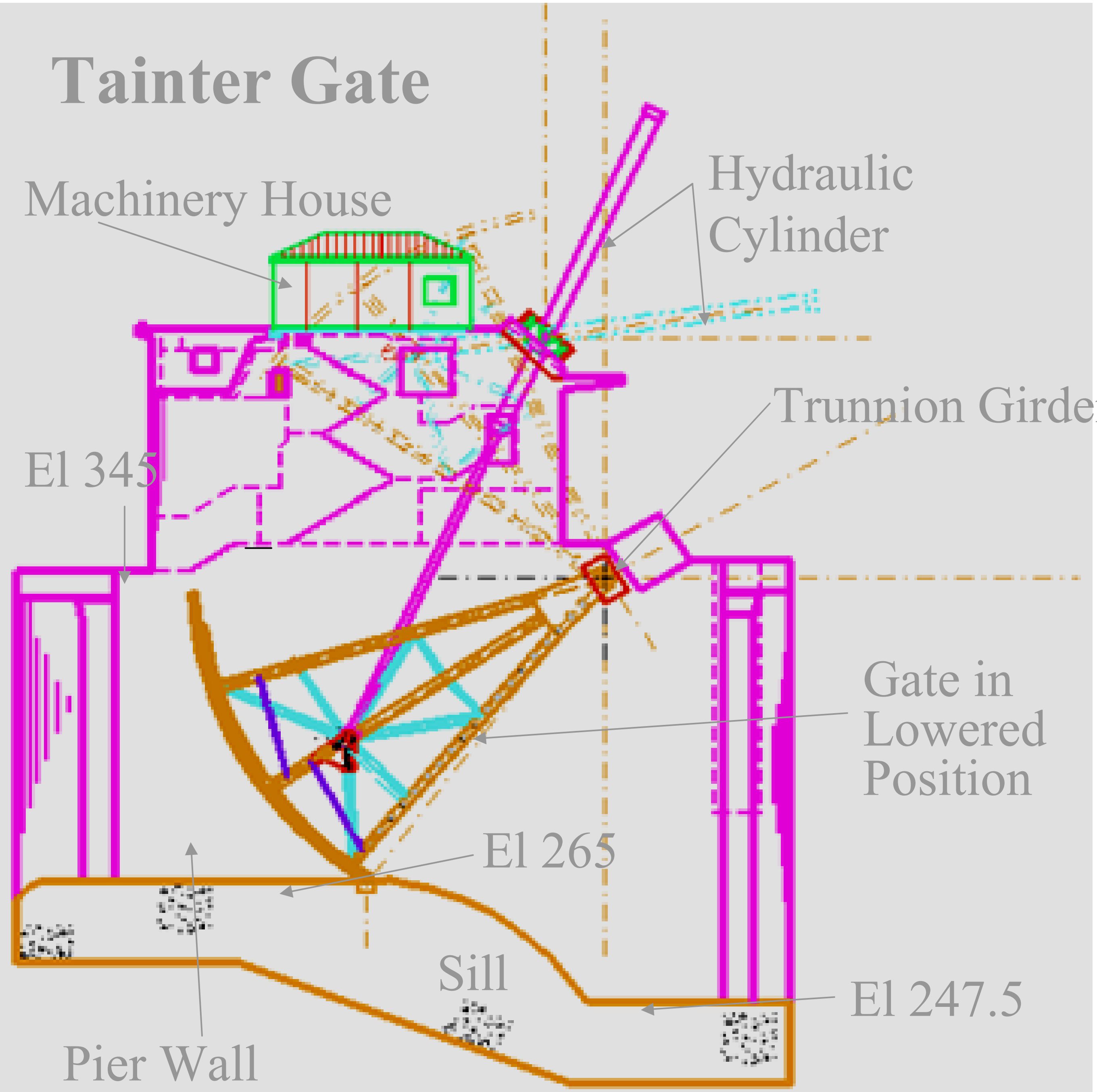
US Army Corps of Engineers
Louisville District

Tremie Concrete Sequence



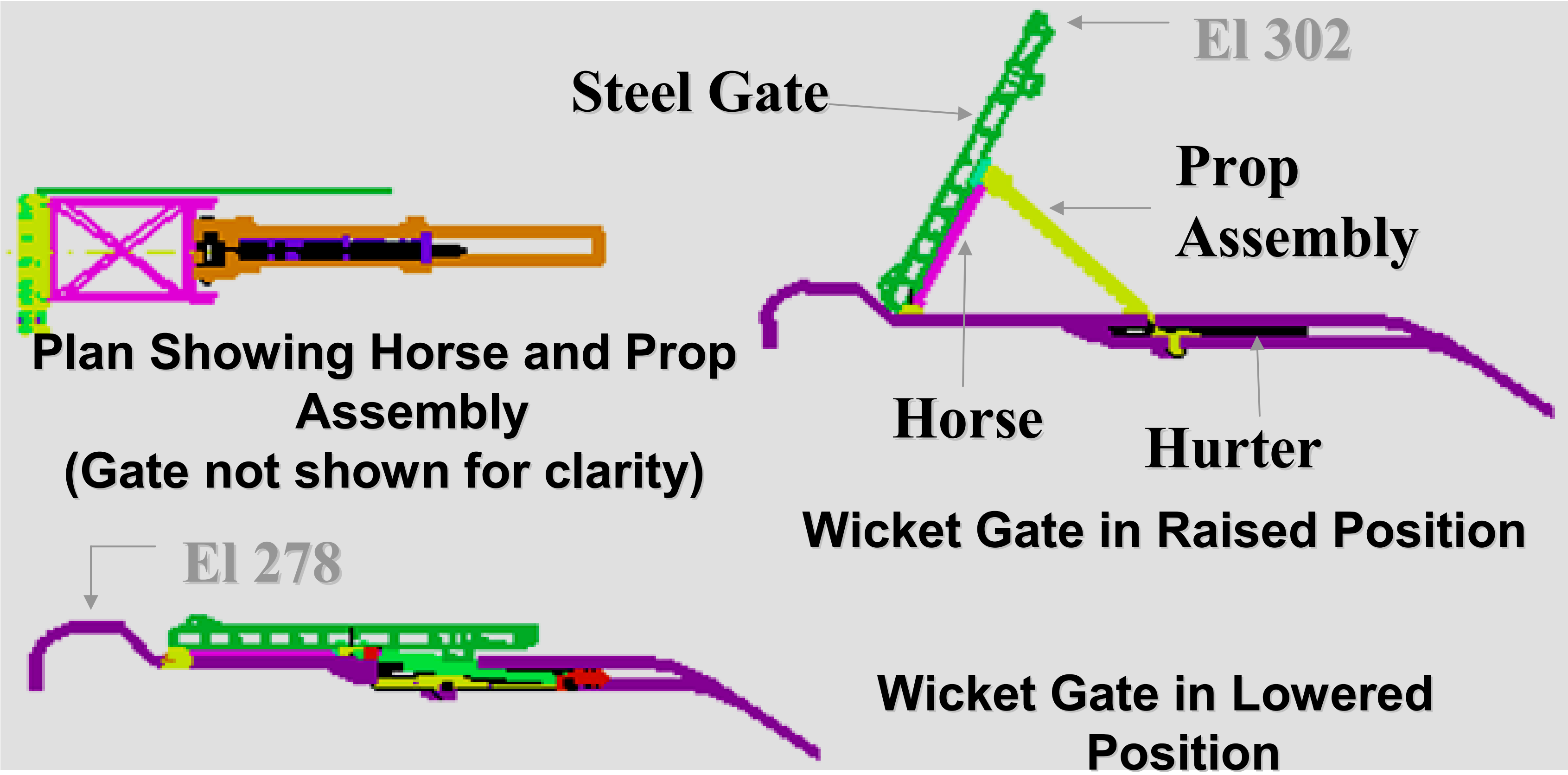
US Army Corps
of Engineers
Louisville District

Tainter Gate



US Army Corps of Engineers
Louisville District

Wicket Assembly



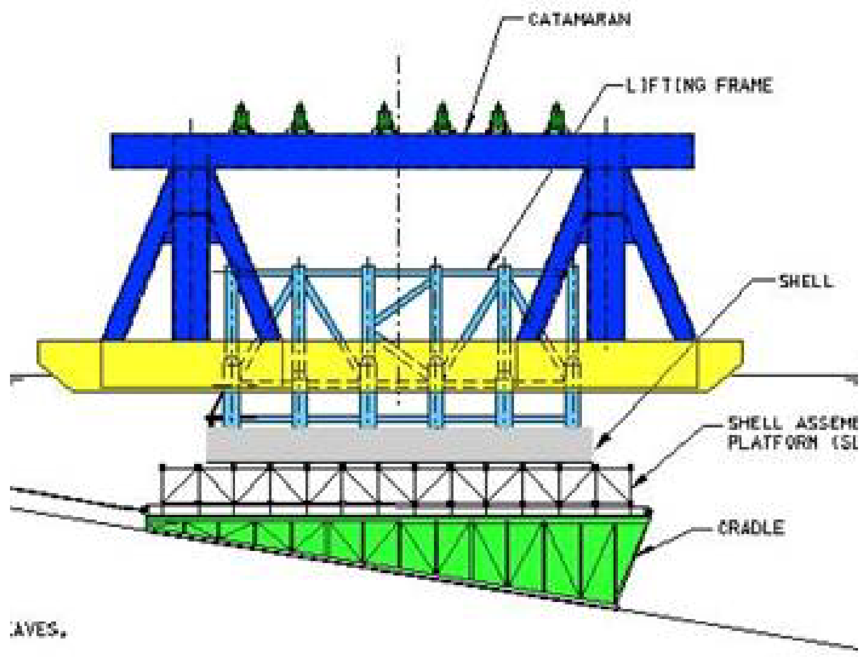
Plan Showing Horse and Prop Assembly
(Gate not shown for clarity)

Wicket Gate in Raised Position

Wicket Gate in Lowered Position

US Army Corps
of Engineers
Louisville District

Relative Scale



US Army Corps
of Engineers
Louisville District

Dam Site May 2005

Original Scope

- + Government only provided conceptual design on means and methods. Gave Contractor considerable latitude to propose changes.
- + Government if requested would provide design engineer to finish conceptual designs (means and methods) or redesign features of work if contractor had a better idea.

US Army Corps
of Engineers
Louisville District

2005 Infrastructure Systems Conference

Design Changes to Tainter Gate Shells
for
Super Gantry Method of Construction
at
The Olmsted Dam Project

Jacobs / Gerwick - A Joint Venture
in Partnership With
The Louisville District, COE

Presented By: Dale Berner, PhD, PE

US Army Corps of Engineers
Louisville District

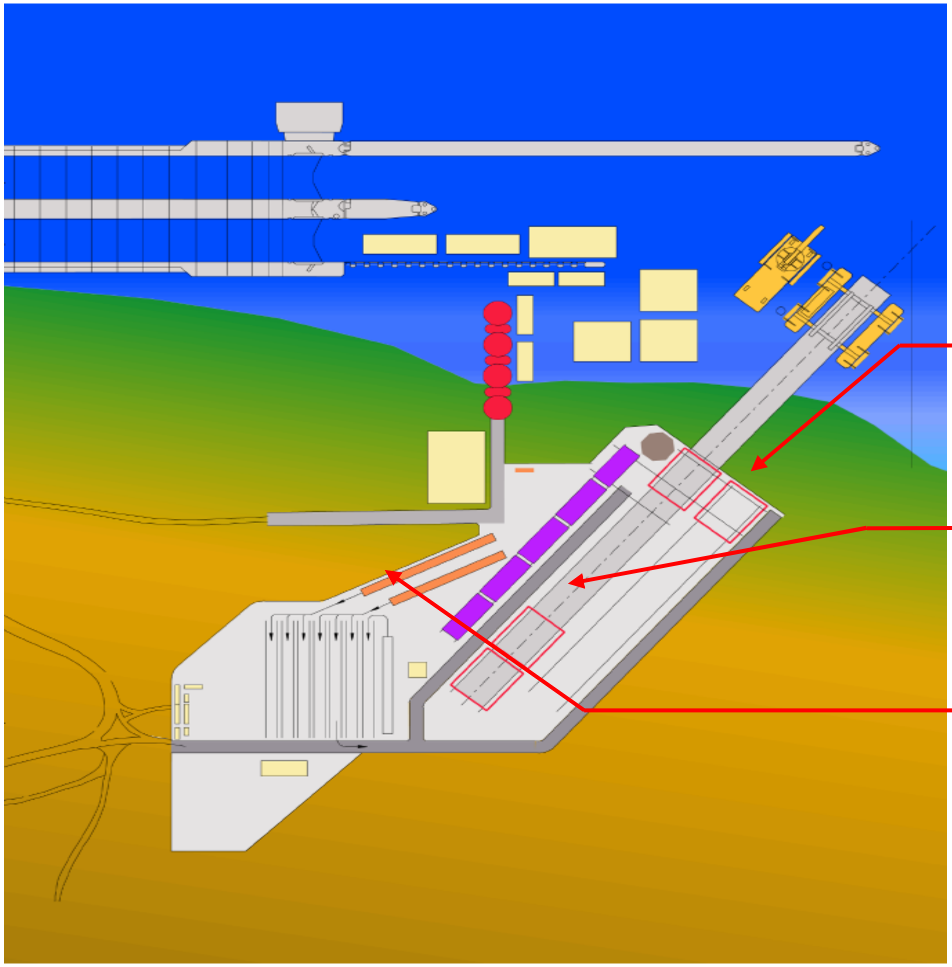
Differences between the Initial and the Super Gantry Construction Methods

- ***INITIAL Plan***
- *Precast Elements for Building the Shells.*
- *Shells Built on Sleds.*
- *Shells Can Only be Lifted Submerged.*
- *Tremie Reinforcing Mats Pre-Installed.*
- *Uses Temporary Scour Articulated Concrete Mats*
- *Tremie from Floating Plant.*

- ***SUPER-GANTRY PLAN***
- *The Shells Are Cast-in-Place.*
- *Shells Built on Slabs.*
- *Shells Can be Lifted In-the-Dry.*
- *Tremie Mats Lifted-in with the Shells.*
- *Uses Permanent Grout Mats for Scour Control.*
- *Tremie from Land Plant.*

US Army Corps of Engineers
Louisville District

Initial Precast Yard Concept



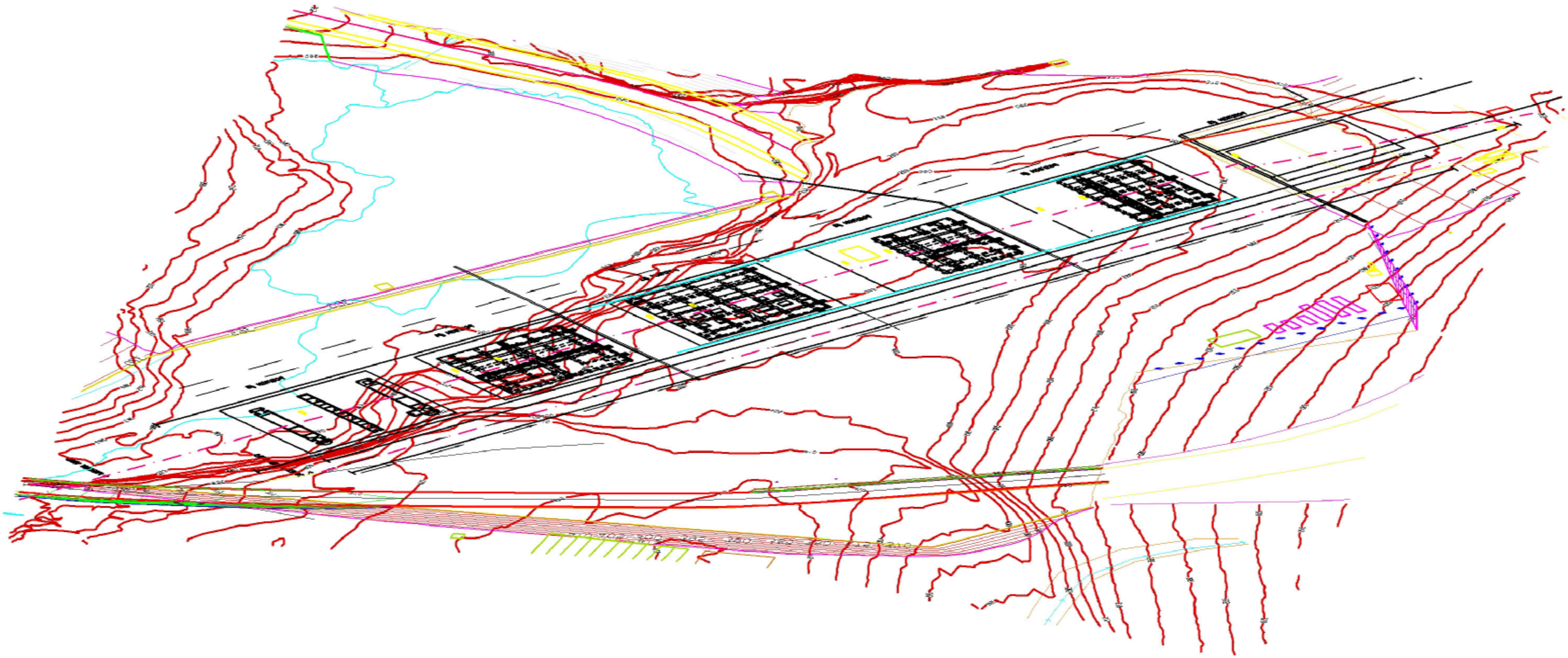
MARINE SKIDWAY

LANDBASE SKIDWAY

PRECAST BEDS

US Army Corps
of Engineers
Louisville District

Super Gantry Casting Bed Alignment



US Army Corps
of Engineers
Louisville District

Preparation for Marine Skidway

US Army Corps
of Engineers
Louisville District

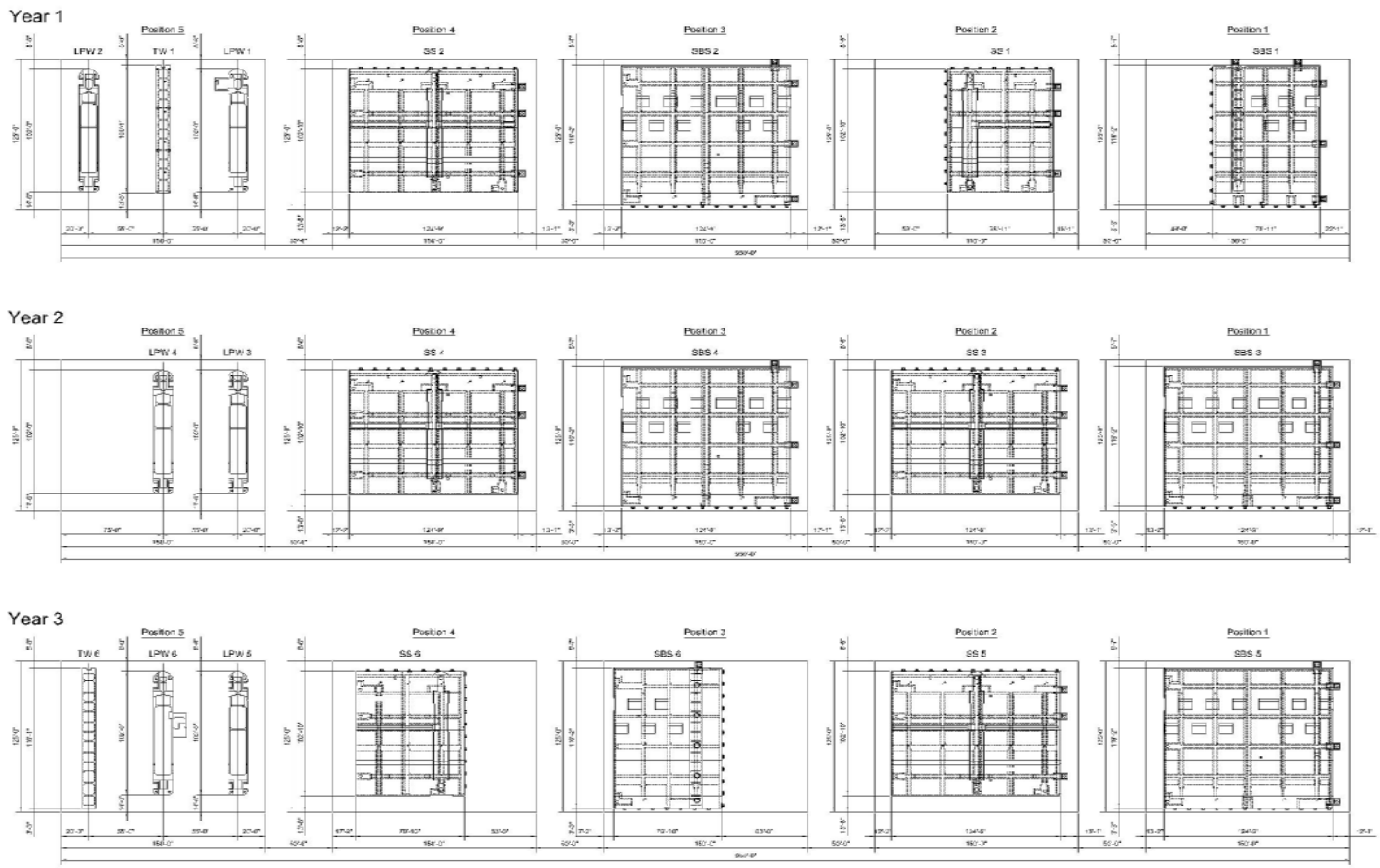
Typical Casting Slab on Grade

Preparation for Pile Supported Casting Slab

US Army Corps of Engineers
Louisville District

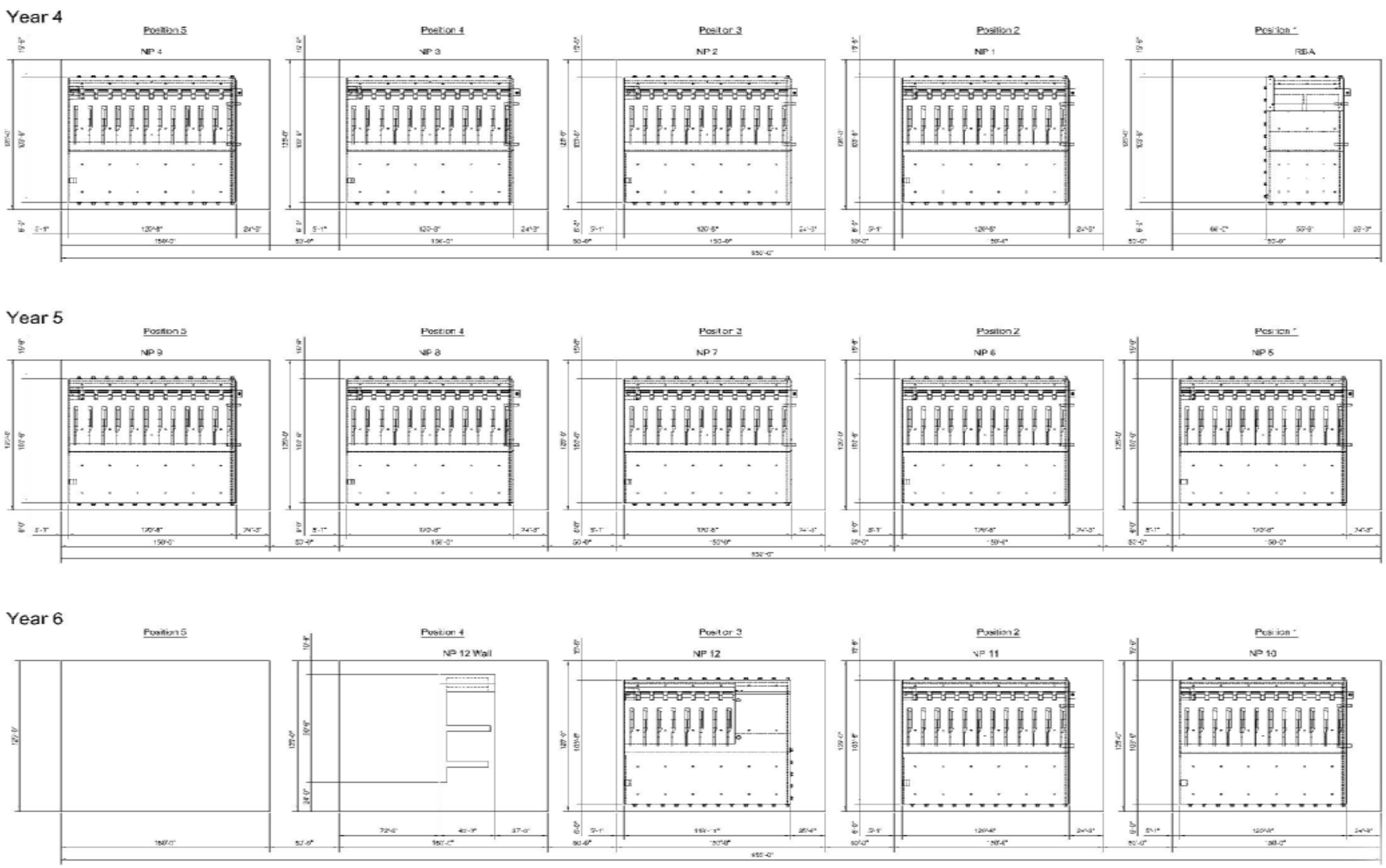
US Army Corps of Engineers
Louisville District

Casting Sequence for Tainter Gate Shells



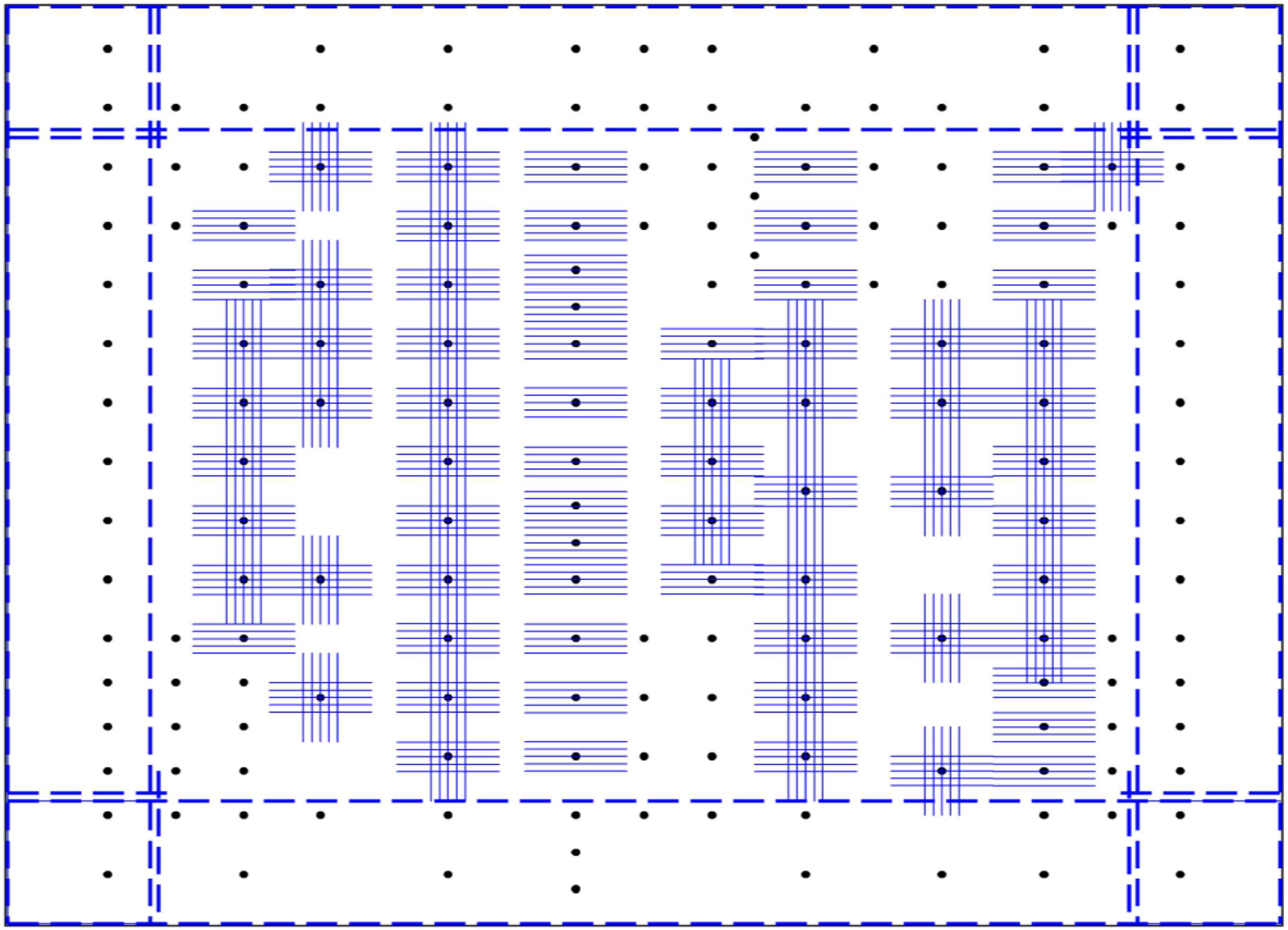
US Army Corps
of Engineers
Louisville District

Casting Sequence for Navigable Pass Shells



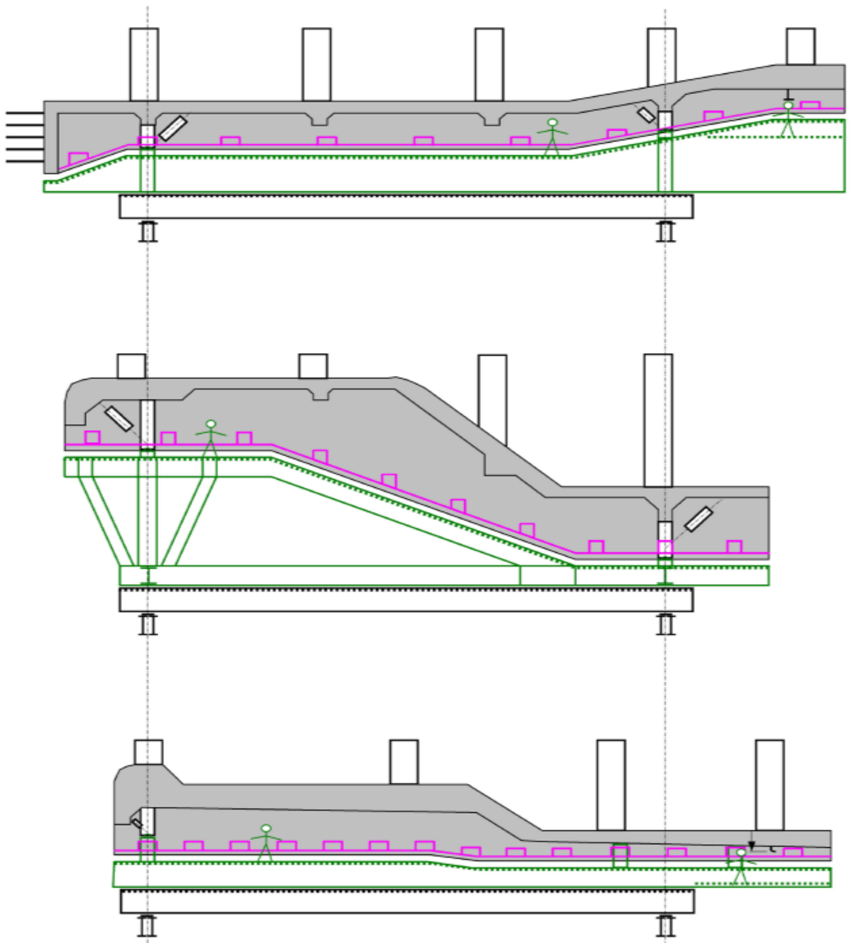
Localized Supplemental Reinforcing in a Typical Slab

US Army Corps of Engineers
Louisville District



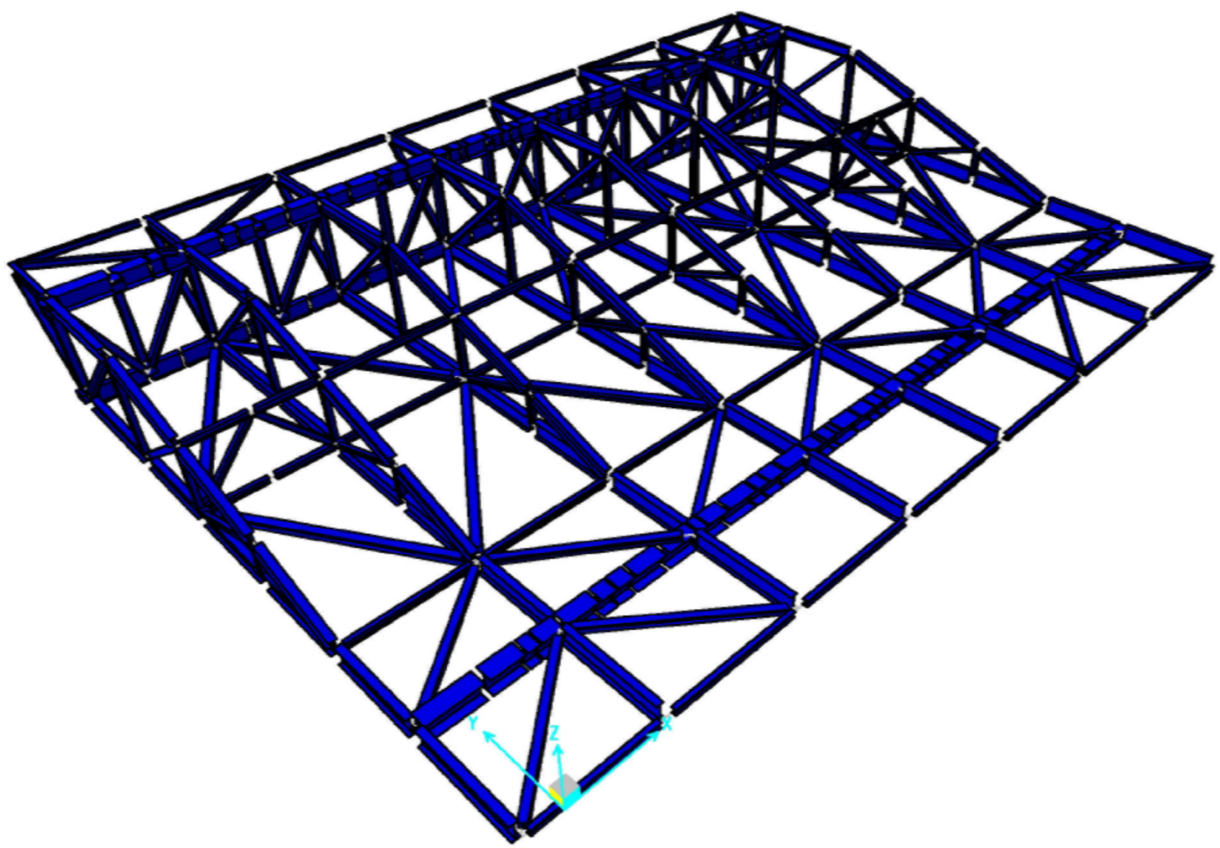
US Army Corps
of Engineers
Louisville District

Common Types of Shells and Tremie Mat Templates



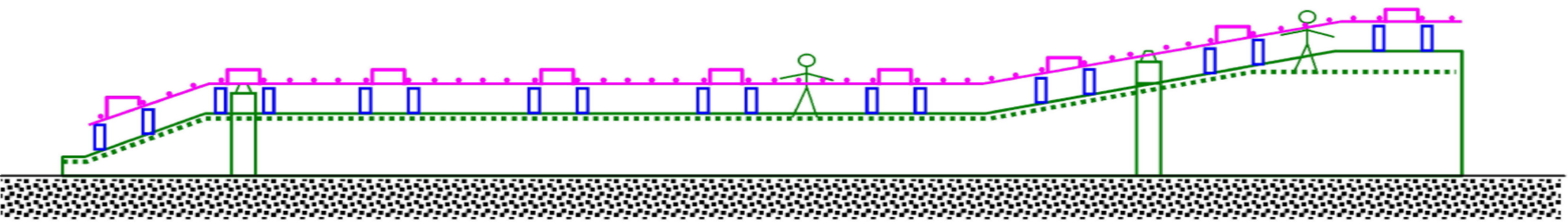
US Army Corps
of Engineers
Louisville District

Typical Template for Tremie Concrete Reinforcing Mat



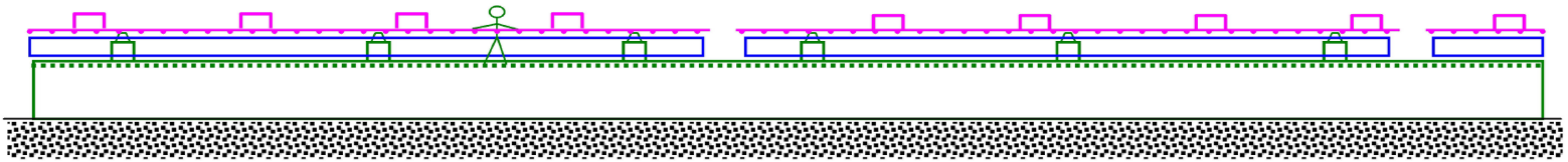
US Army Corps of Engineers
Louisville District

Typical Tremie Rebar Mat on Template



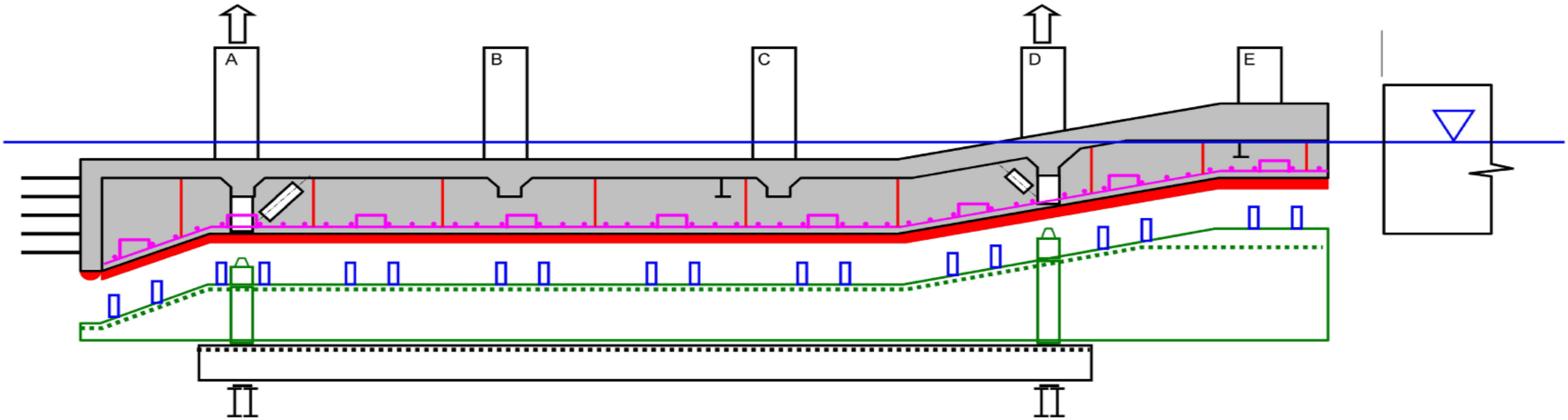
US Army Corps
of Engineers
Louisville District

Typical Cross-Section of Tremie Rebar Mat on Template



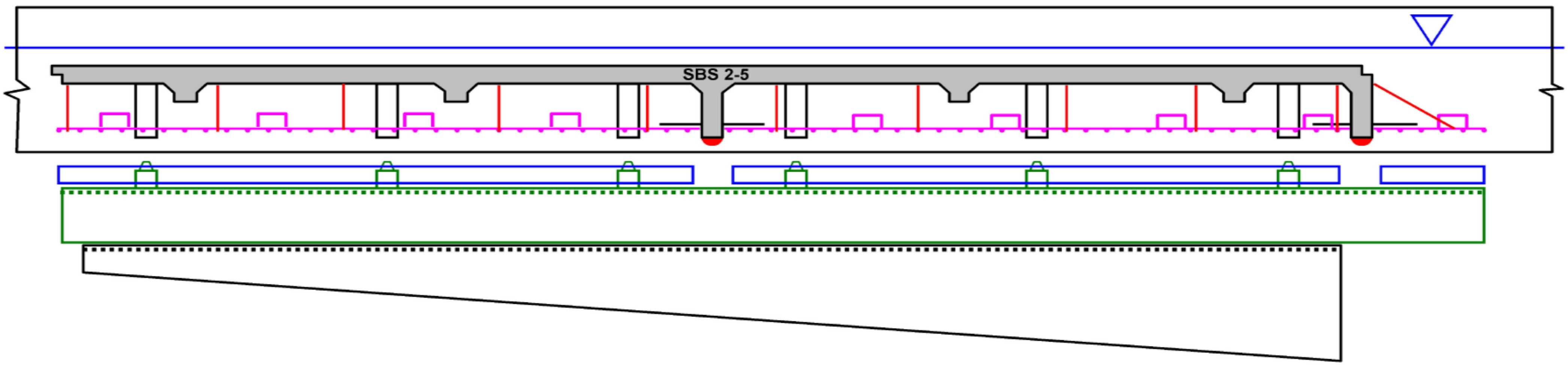
US Army Corps
of Engineers
Louisville District

Typical Shell Lifted By Super Gantry Crane onto Tremie Mat



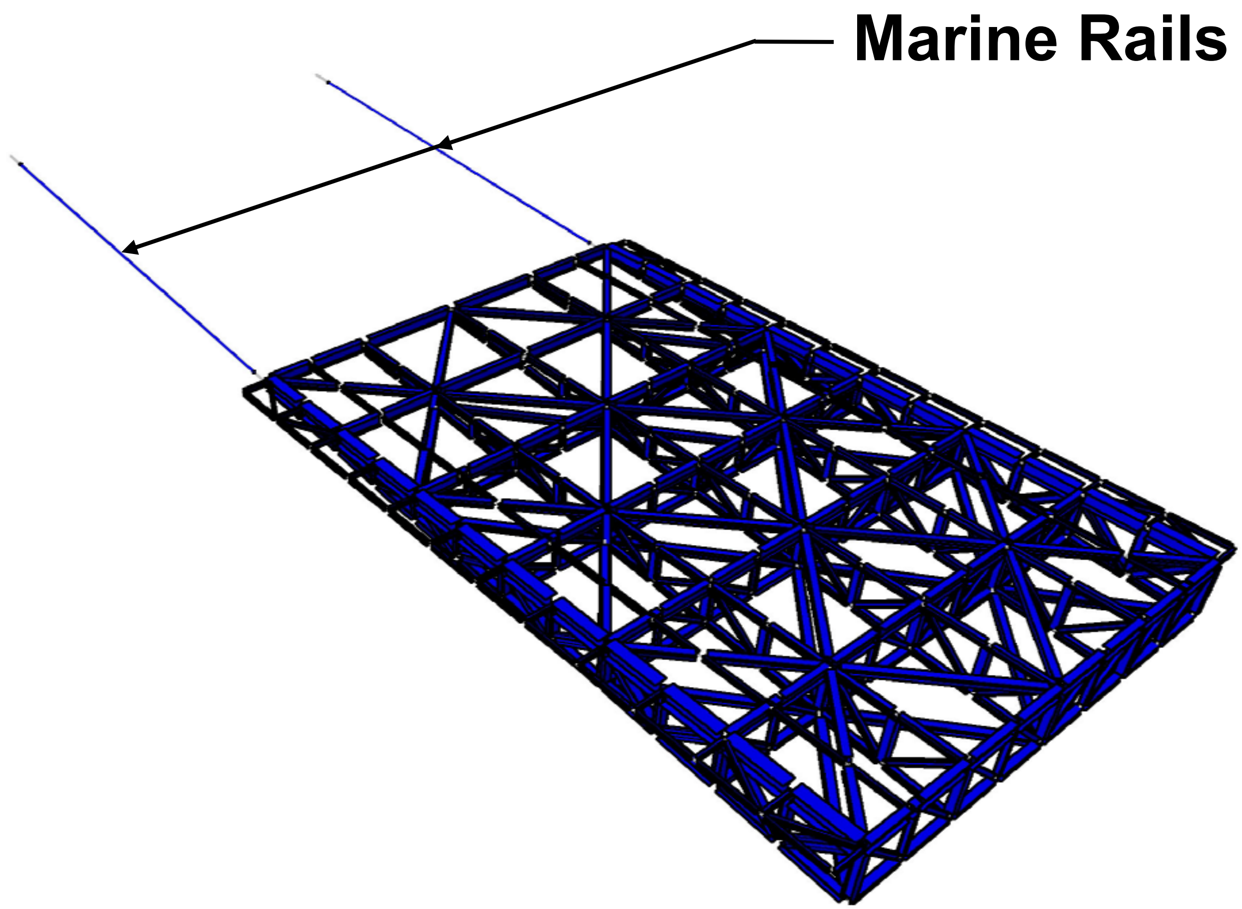
US Army Corps of Engineers
Louisville District

Typical Shell / Rebar Mat / Template on Marine Skidway Cradle



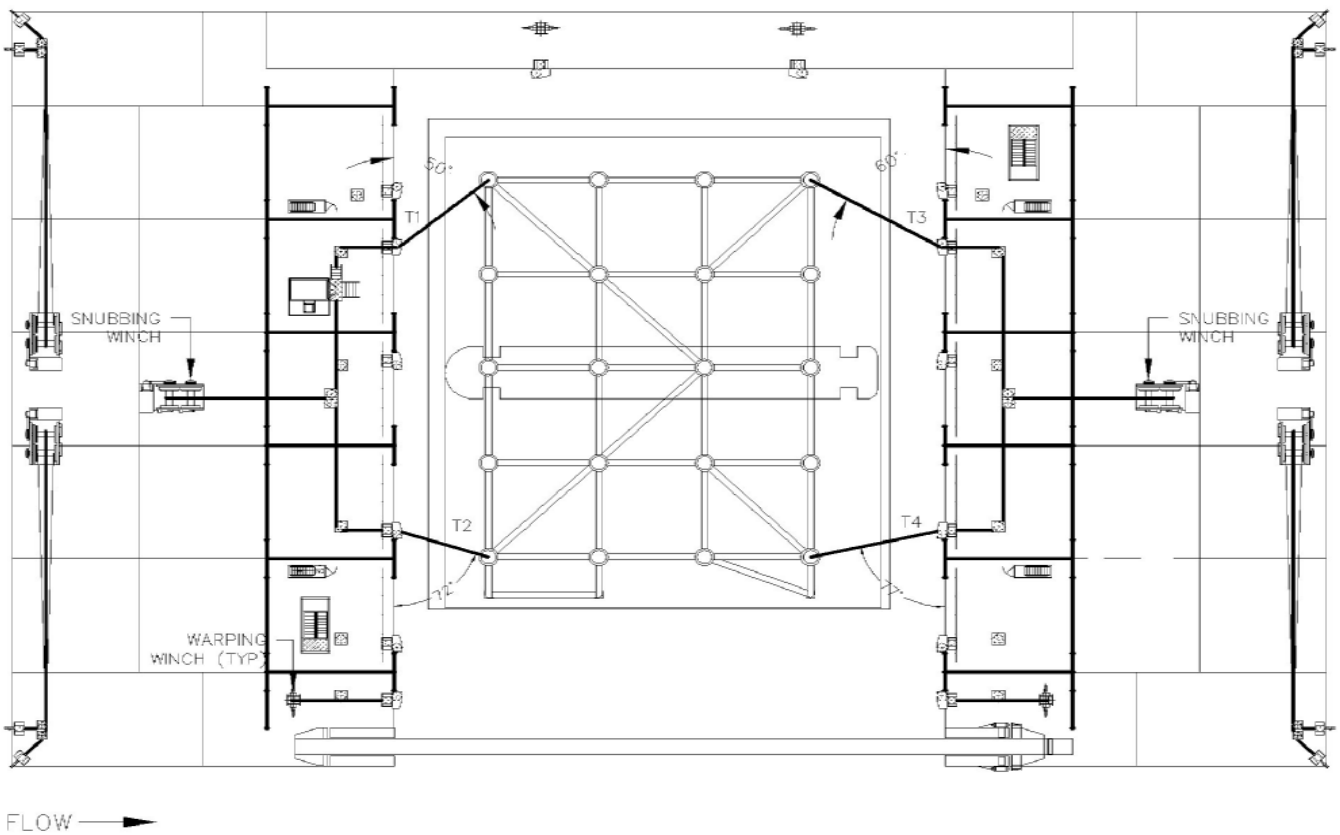
US Army Corps
of Engineers
Louisville District

Cradle for Marine Skidway



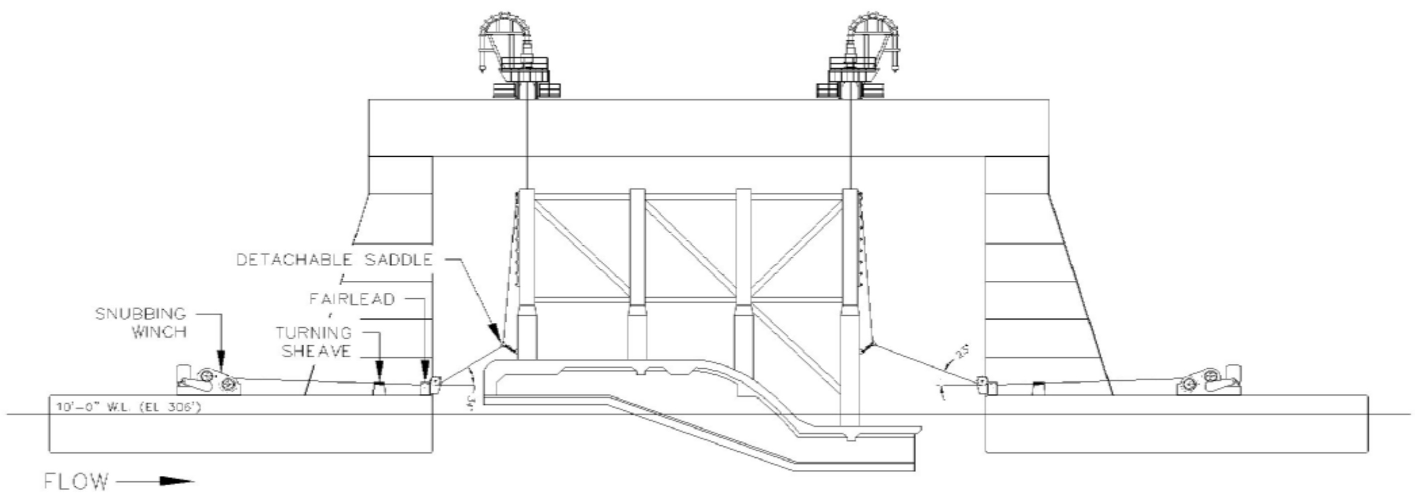
US Army Corps
of Engineers
Louisville District

Plan View of Catamaran Crane Barge & Snubbing System



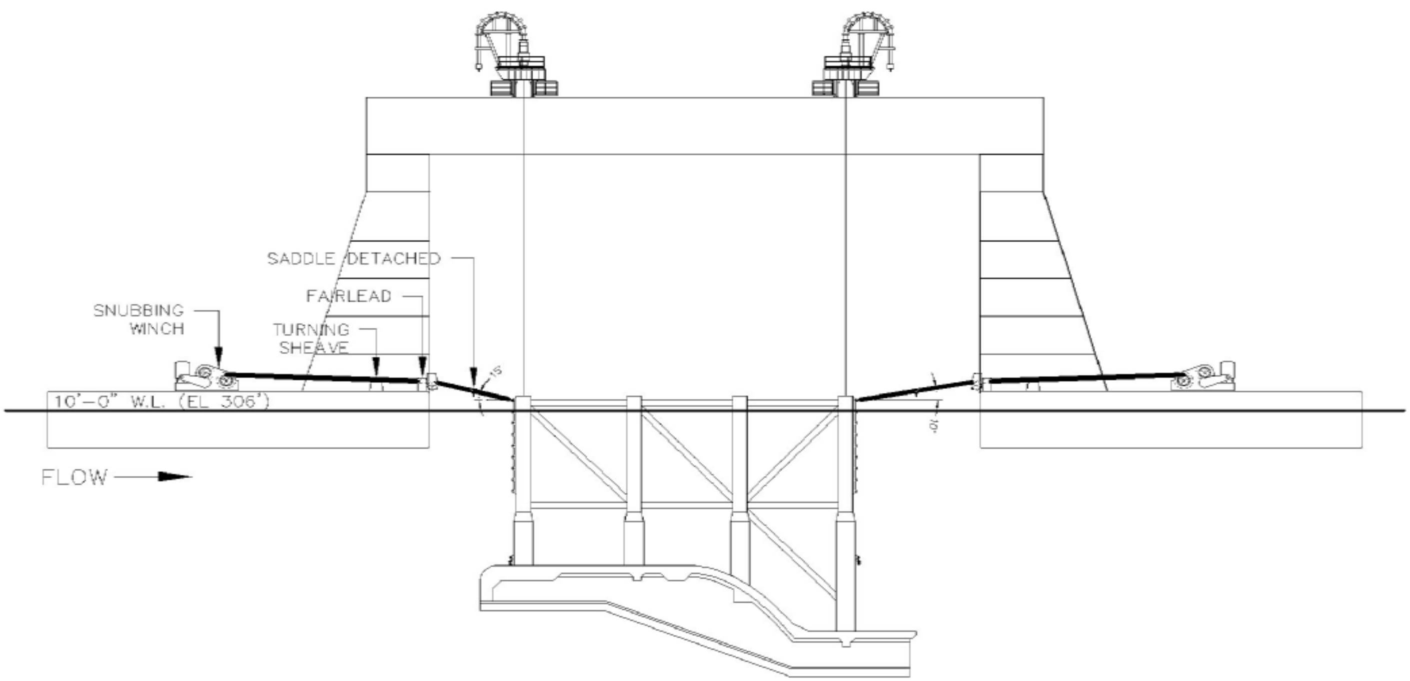
US Army Corps of Engineers
Louisville District

Profile View of 5,000 tons Catamaran Crane Barge & Snubbing System



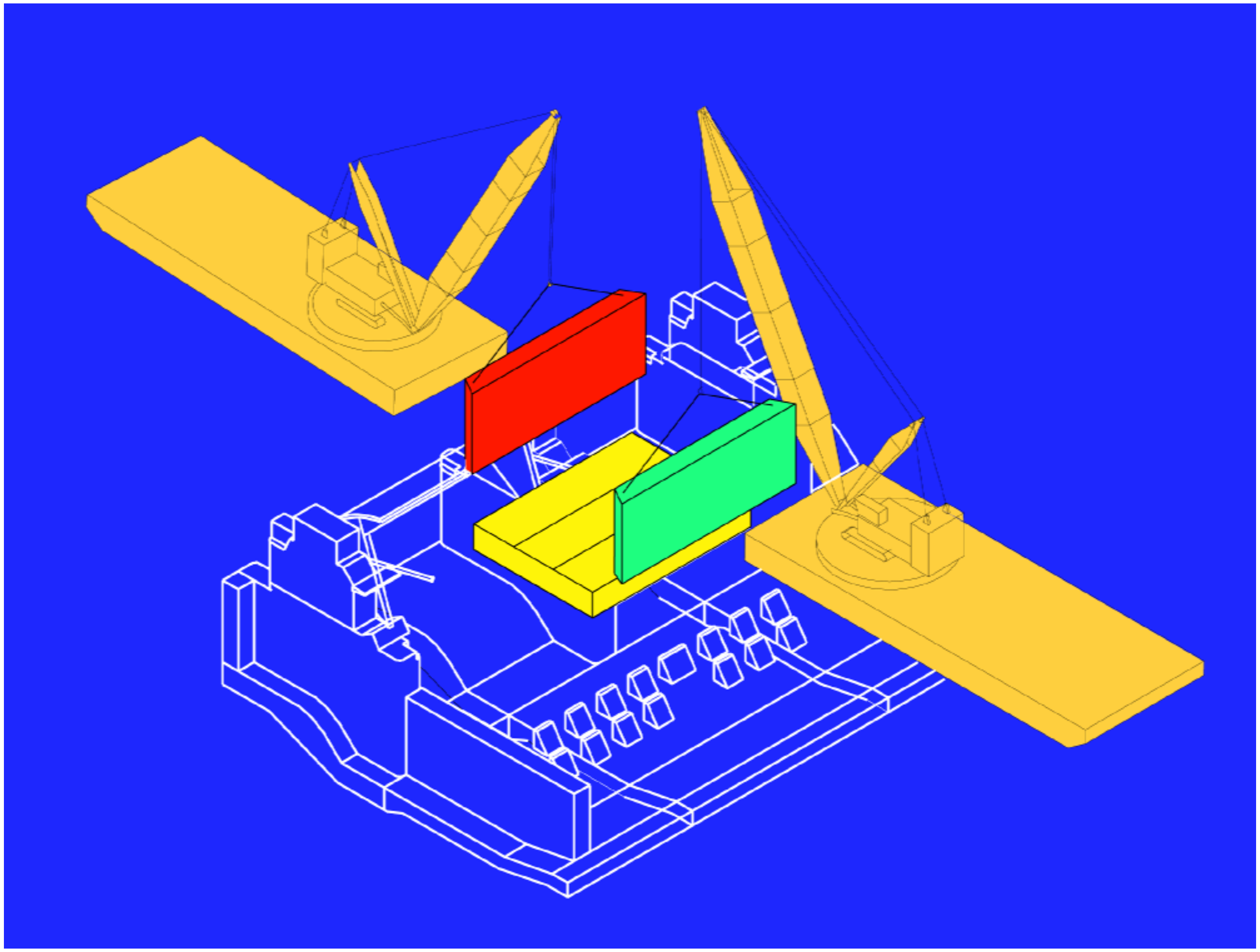
US Army Corps of Engineers
Louisville District

5,000 TONS Catamaran
Lowering Tainter Gate Sill Shell



US Army Corps of Engineers
Louisville District

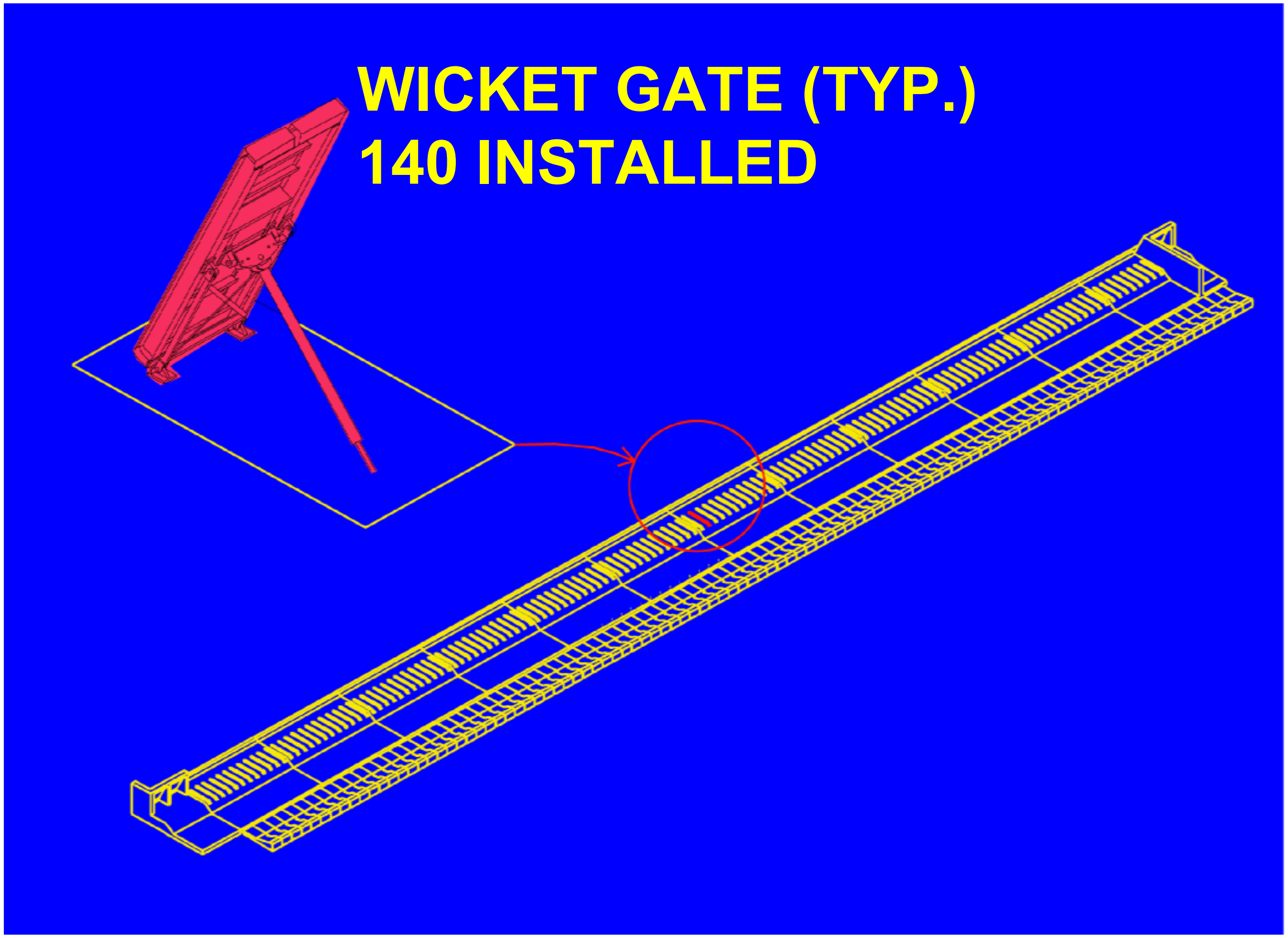
Erection of Pre-Fabricated Tainter Gate



LOUISVILLE DISTRICT
ESSAYONS
ENGINEER

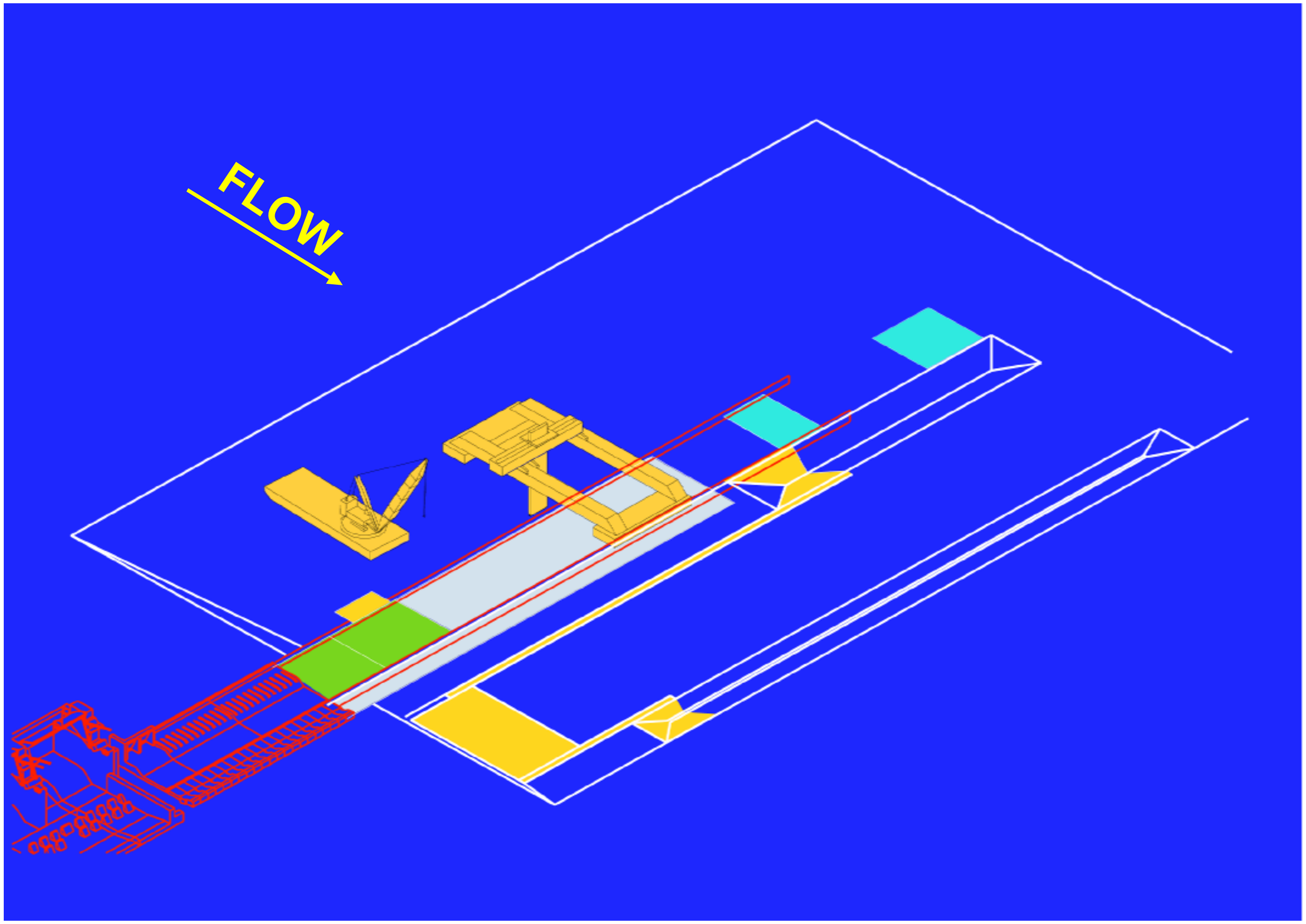
US Army Corps of Engineers
Louisville District

Navigable Pass Section of Olmsted Dam



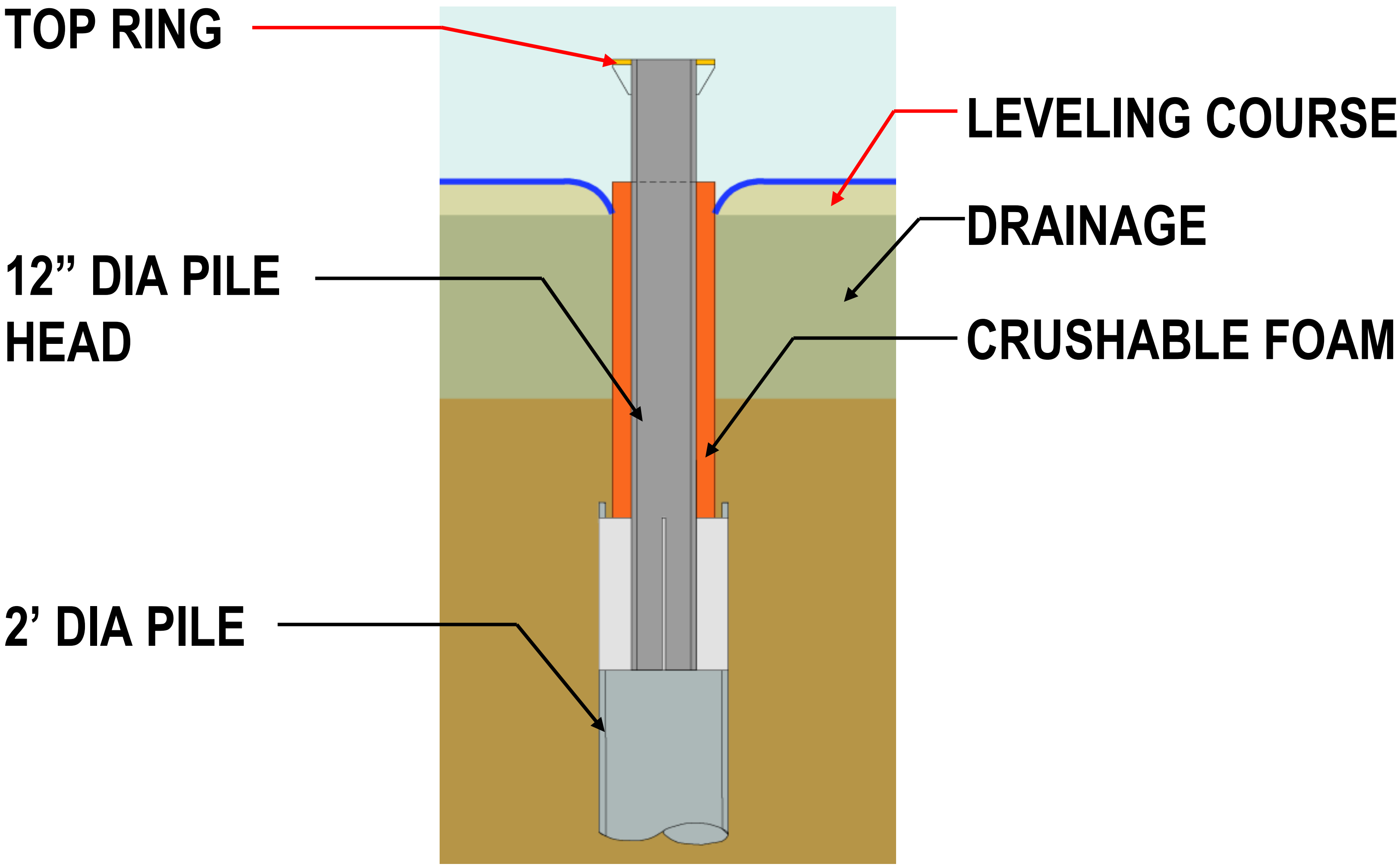
Sequence of Construction for Navigable Pass

US Army Corps of Engineers
Louisville District



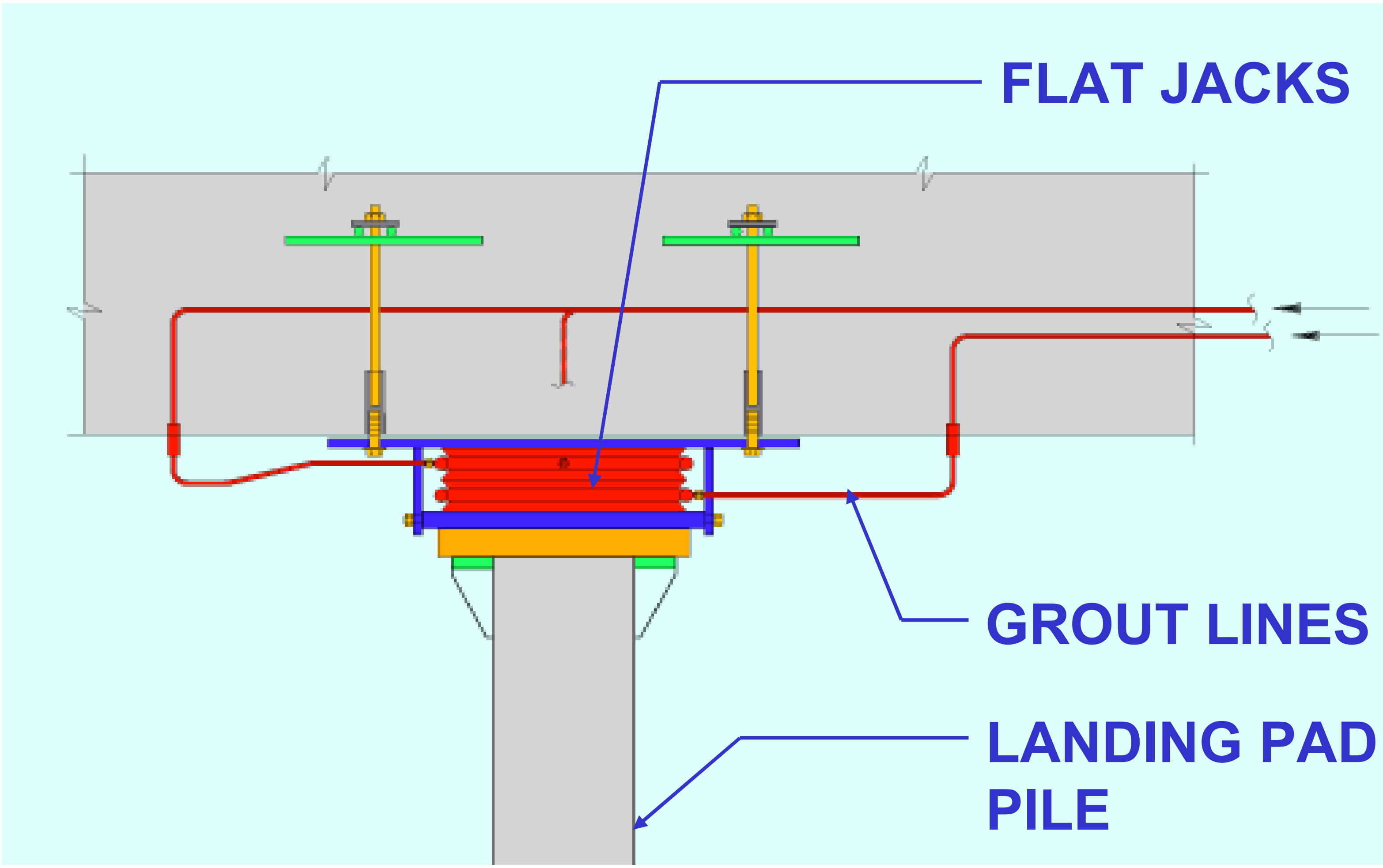
US Army Corps
of Engineers
Louisville District

Typical "Controlled Moment" Pile Connection



US Army Corps
of Engineers
Louisville District

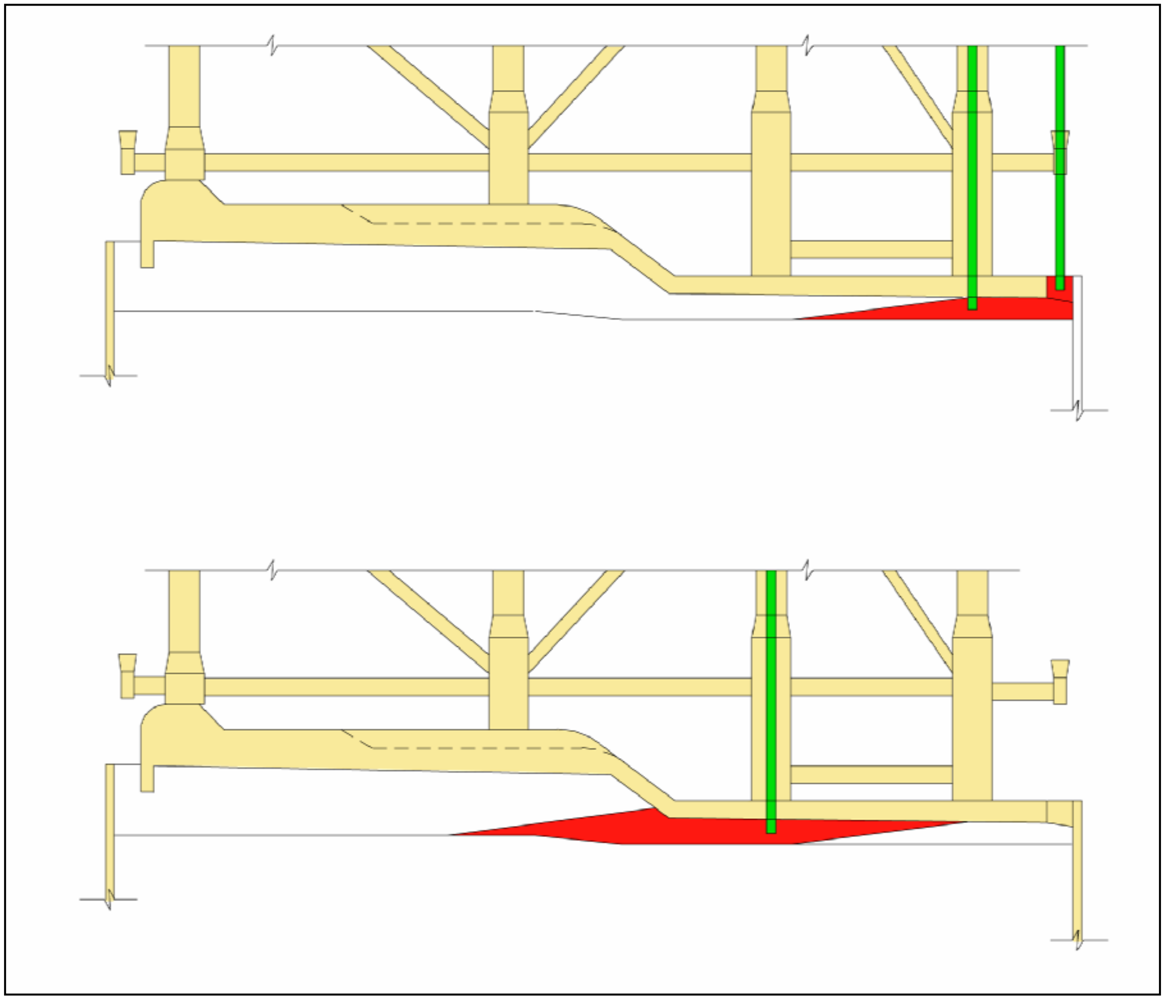
Typical Landing Pile with Flat-Jacks



US Army Corps of Engineers
Louisville District

Sequence for tremie Concrete Placement for Navigable Pass

ESSAYONS
LOUISVILLE DISTRICT ENGINEER

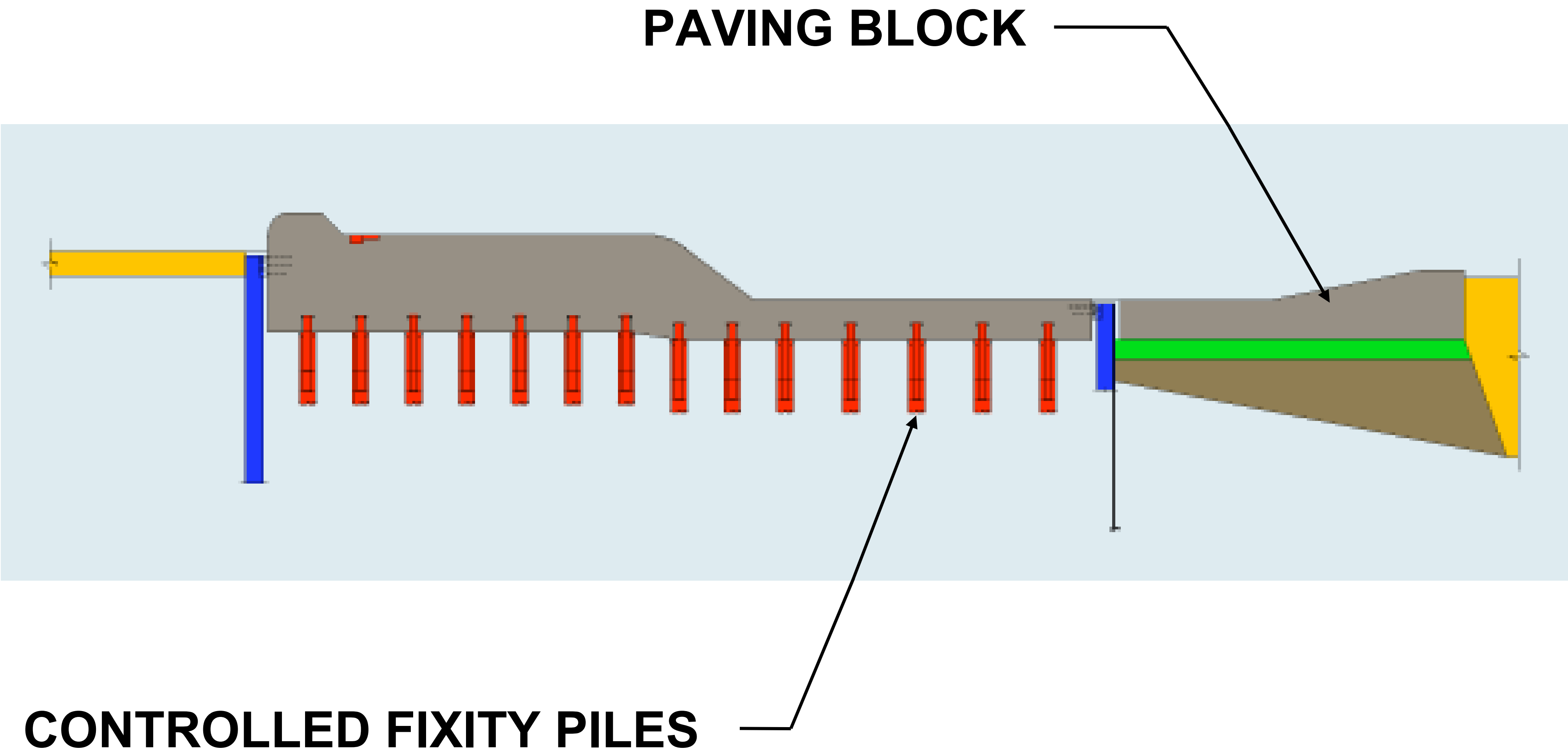


STAGE 1 POUR

STAGE 2 POUR

US Army Corps
of Engineers
Louisville District

Typical Elevation of Navigable Pass



US Army Corps
of Engineers
Louisville District

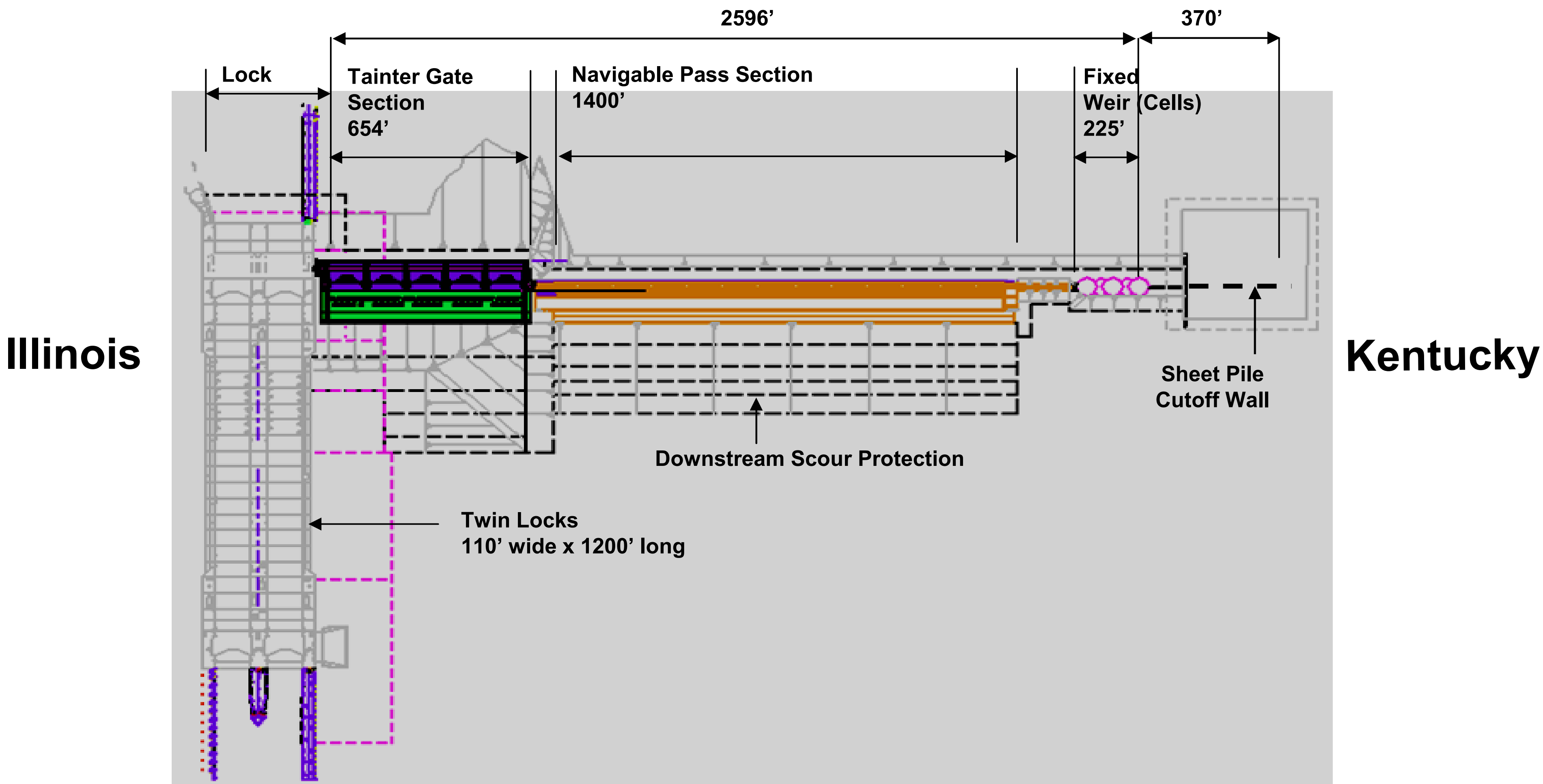
2005 Infrastructure Systems Conference

Design Changes to Tainter Gate Shells
for
Super Gantry Method of Construction
at
The Olmsted Dam Project
Jacobs / Gerwick - A Joint Venture
in Partnership With
The Louisville District, COE

Presented By: Ken Burg
Project Manager

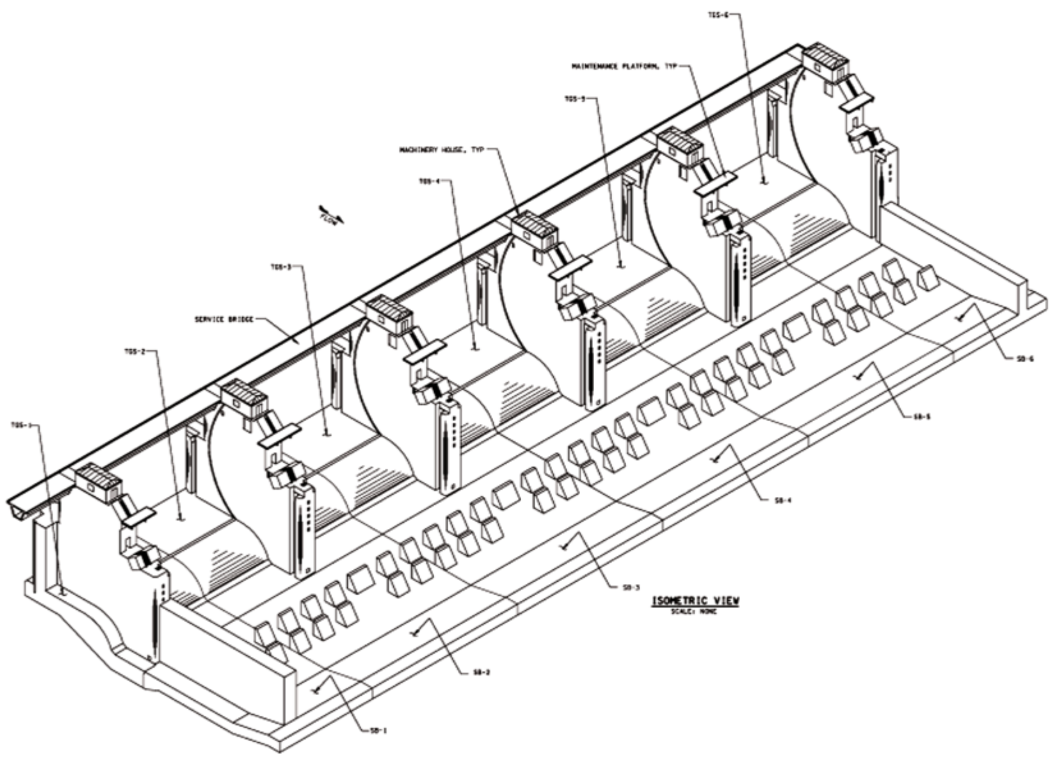
US Army Corps
of Engineers
Louisville District

Major Project Components



US Army Corps of Engineers
Louisville District

Tainter Gate Section



US Army Corps
of Engineers
Louisville District

Precast Shell Statistics

- **Sill Shells**
  - 125' x 102' x 30', 3683 tons dry, 2151 tons wet
- **Stilling Basin Shells**
  - 125' x 116' x 18', 3647 tons dry, 2130 tons wet
- **Lower Pier Shells**
  - 102' x 69' x 14', 2112 tons dry
- **Upper Pier Shells**
  - 57' x 30' x 14', 601 tons dry; will be cast in place with this method

Original Method of Construction

- ***Prepare in-the-river foundation, complete with piles and tremie reinforcing mat***
- ***Cast shells on shore, self weight fully supported***
- ***Move shells into water, self weight fully supported***
- ***Pick up and transport shells submerged***
- ***Set shells in place on prepared foundation and fill with tremie concrete***

US Army Corps
of Engineers
Louisville District

Super Gantry Method of Construction

- *Prepare in-the-river foundation and drive piles*
- *Cast shells on shore, self weight fully supported*
- *Attach lift frame to shells and remove secondary shoring*
- *Lift shells in-the-dry and mate with tremie reinforcing on skidway*
- *Move shells into river and transport partially submerged*
- *Set shell and tremie reinforcing over piles and fill shells with tremie concrete*

US Army Corps
of Engineers
Louisville District

Changes in Design Requirements

- *In-the-dry lift increases load to shells and lift frames by a minimum of 70%*
- *Transport is partially submerged; center of gravity of lift changes during setdown; loads to catamaran barge increase*
- *Connections between shell / lift frame and between lift frame / catamaran are much larger*
- *Shell geometry and reinforcing revised for increased loading*

Revisions to Shells for Super Gantry - 1

US Army Corps
of Engineers
Louisville District

- *Increase dimensions of selected stiffening elements to accept additional reinforcing / maintain existing reinforcing*
- *Increase size / decrease spacing of selected reinforcing*
- *Revise intersection of typical stiffening element for larger connection to lift frame*
- *Increase "gap" between shells for increased clearance at set down*
- *Revise continuity reinforcing to include portions of tremie reinforcing*
- *Revise tremie reinforcing to clear casting supports*

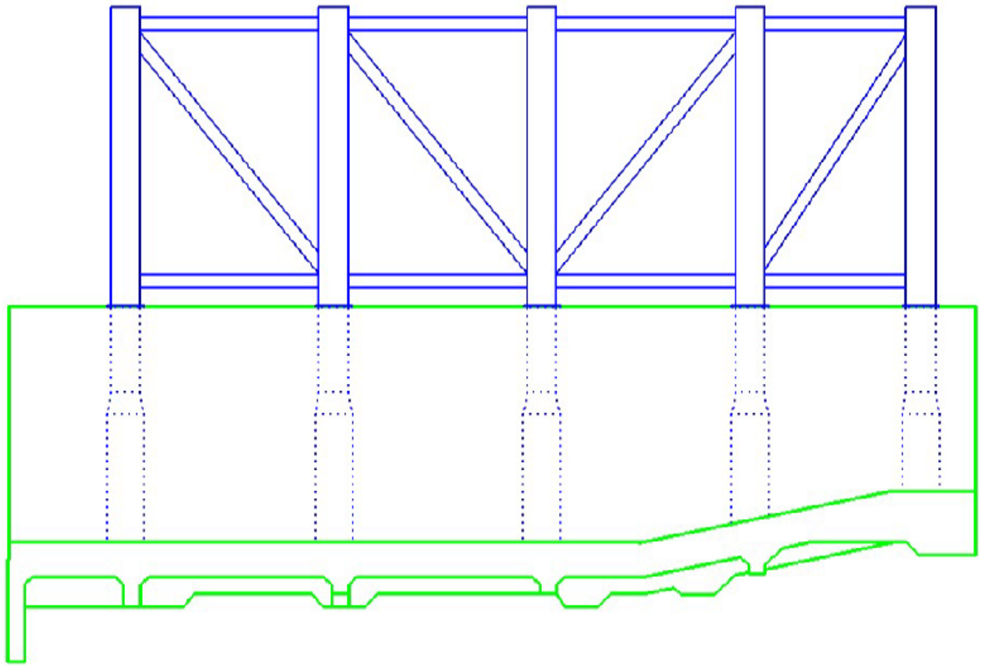
US Army Corps
of Engineers
Louisville District

Revisions to Shells for Super Gantry - 2

- *Revise (shorten) training walls on SBS-6 shell to clear larger catamaran*
- *Revise connection between Sill Shell and Lower Pier Shell for reinforcing assembly in-the-dry after mating and dewatering*
- *Revise underdrain details and location to clear splice location between shell continuity bars and tremie reinforcing mat*

US Army Corps
of Engineers
Louisville District

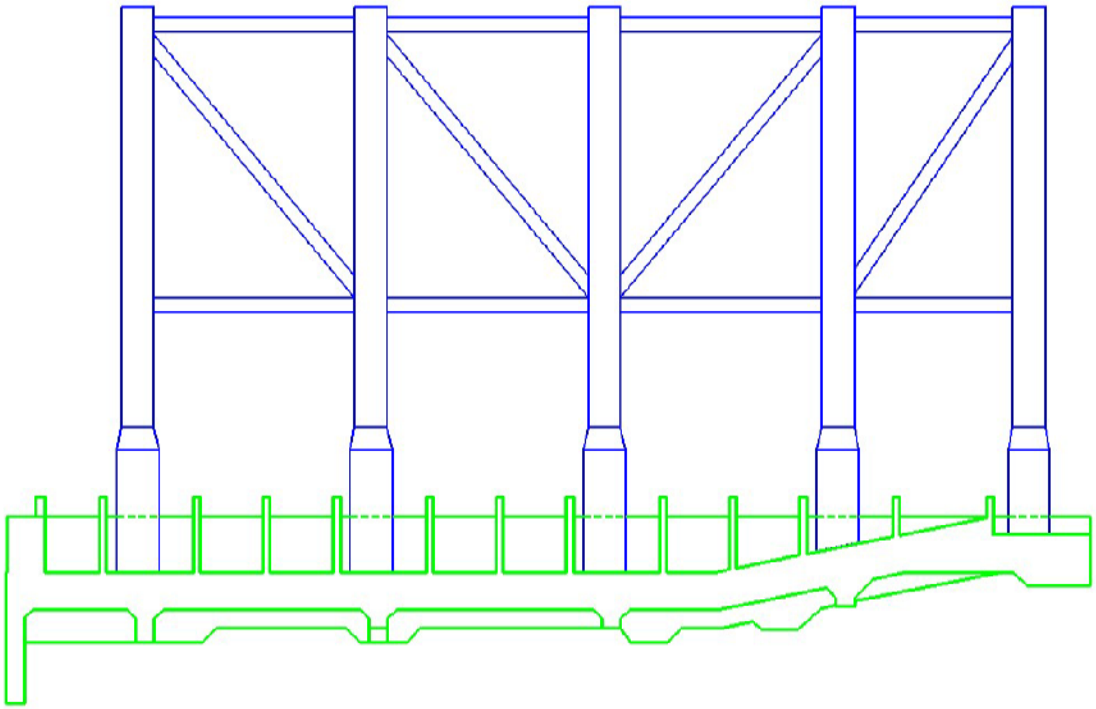
Revise Training Wall on SBS Shell



US Army Corps
of Engineers
Louisville District

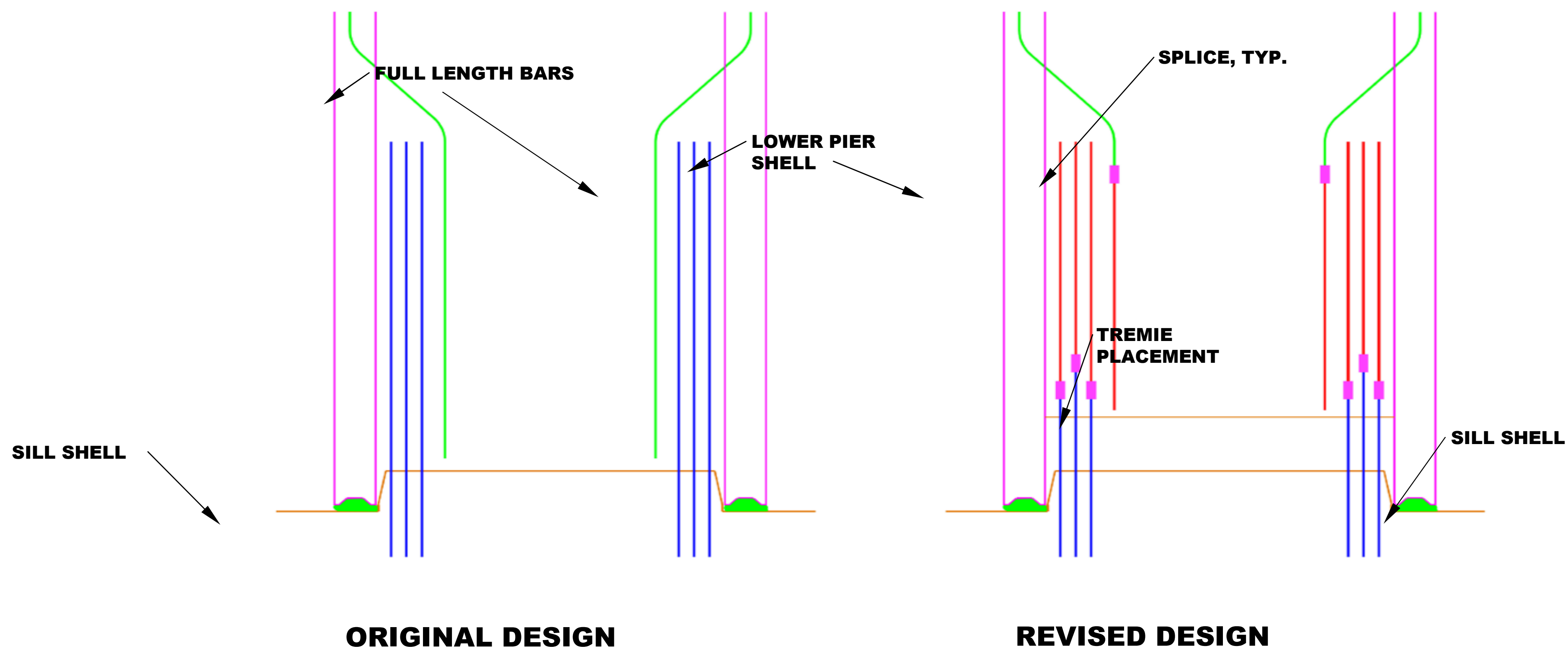
Revise Training Walls on SBS Shell

ESSAYONS
LOUISVILLE DISTRICT
ENGINEER



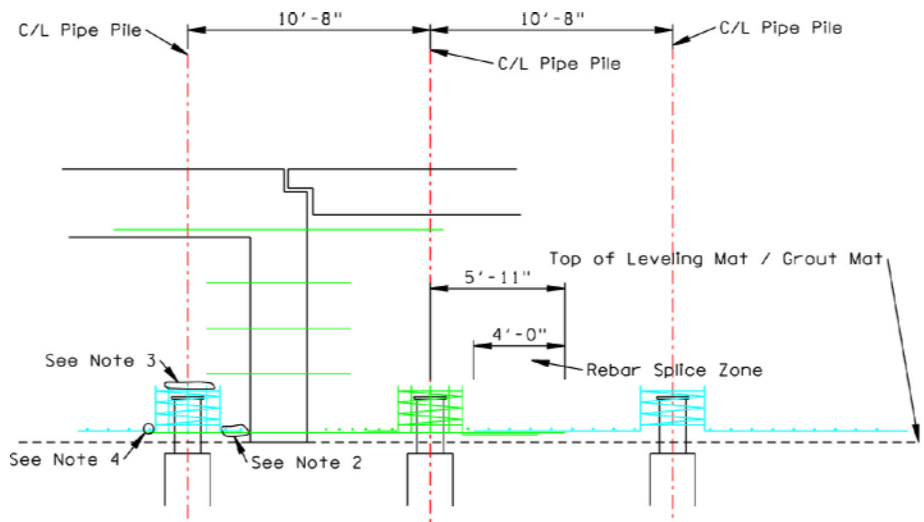
US Army Corps of Engineers
Louisville District

Revised Sill to Lower Pier Connection



US Army Corps of Engineers
Louisville District

Revisions to Shells for Super Gantry



REBAR CODE

1. Green rebar is shell continuity reinforcing
2. Blue rebar is tremie rebar mat reinforcing

SS to SS INTERFACE

Notes:

1. Typical at SS-1 to SS-2, SS-3 to SS-4 and SS-5 to SS-6
2. At Contractor's option, install with shell continuity bars or tie to shear reinforcing and postion after mating shell and rebar mat.
3. Using spliced bars from S-72, rotate bars back and position after shell is mated to rebar mat.
4. At Contractor's option, install with continuity bars or pullback and position after shell mating with rebar mat.

ESSAYONS
LOUISVILLE DISTRICT
ENGINEER

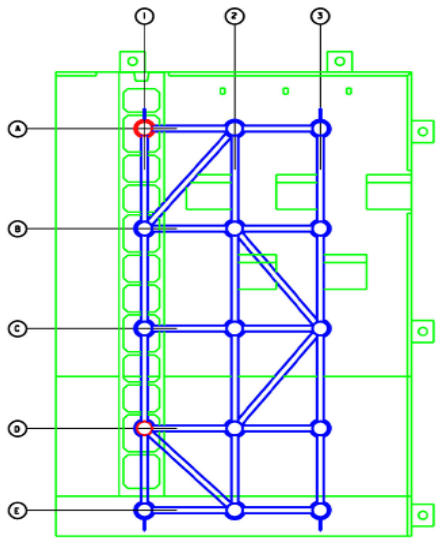
US Army Corps
of Engineers
Louisville District

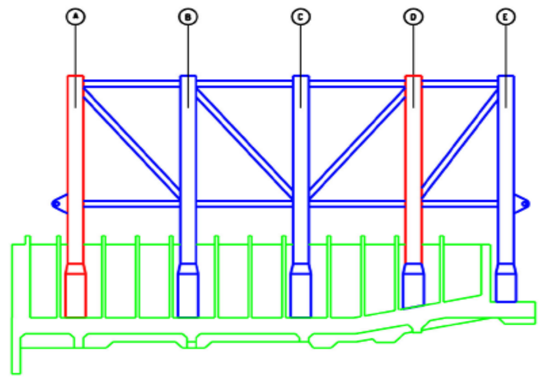
Revisions to Lift Frames for Super Gantry

- *Configure Lift Frames for SBS-1 for reuse with SBS-6 with minimum rework*
- *Revise connection between shell / frame to meet Contractor preferences for location and orientation*
- *Add man door to bottom of leg for personnel access to assemble shell/frame connection; reinforce leg*
- *Add full area access platforms to top of lift frame to meet Contractor work plan*
- *Revise wall thickness and material strength for selected leg members to match demands from increased loadings*

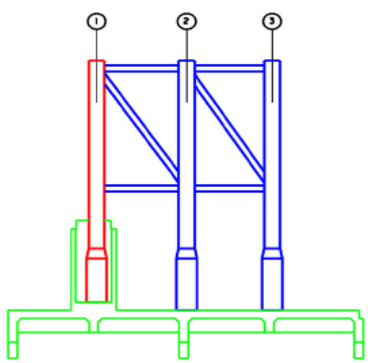
US Army Corps of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry



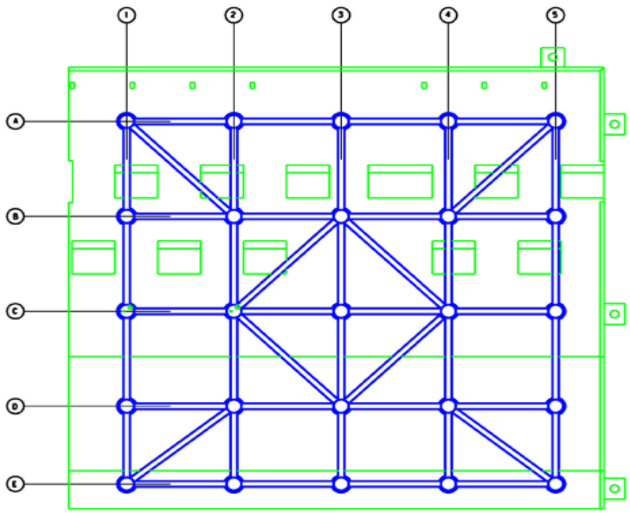


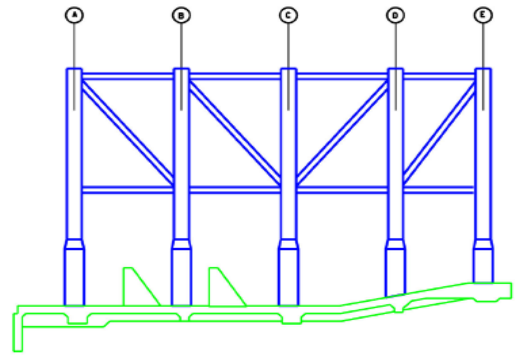
Shell SBS-1

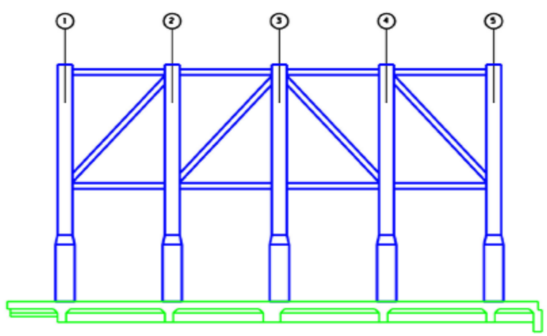


US Army Corps of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry



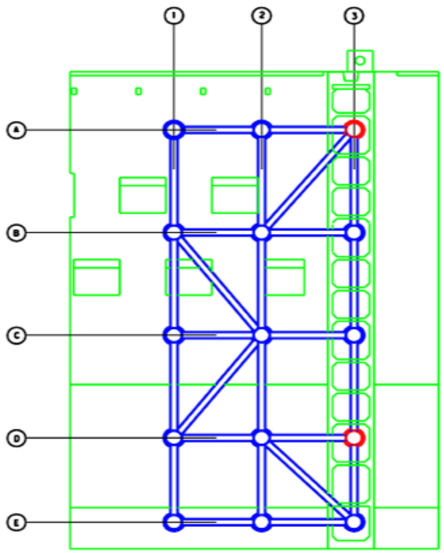


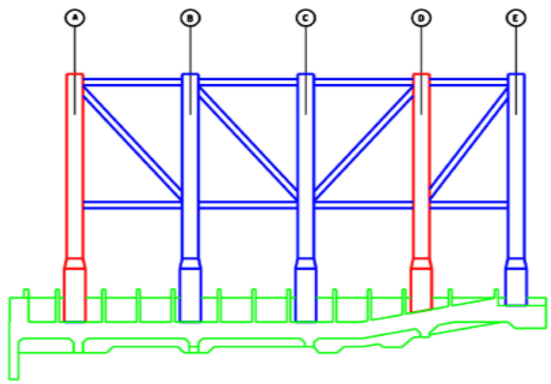


Shells SBS-2 thru SBS-5

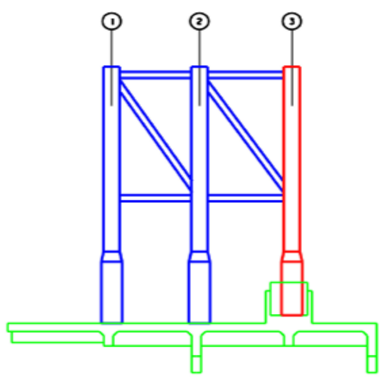
US Army Corps
of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry



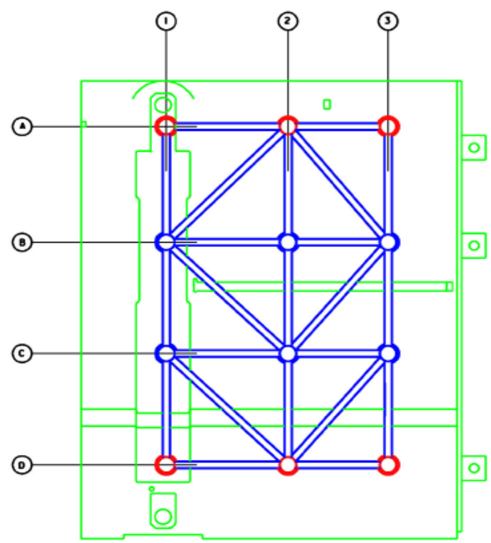


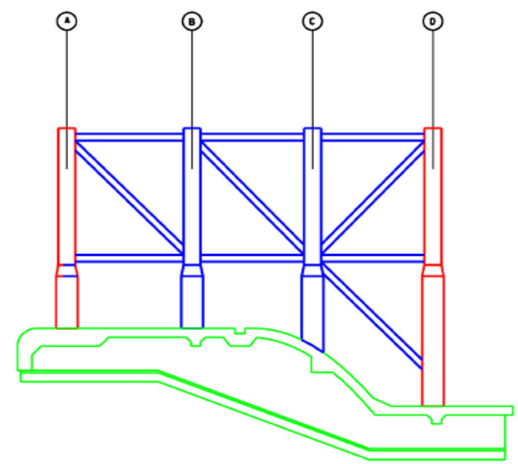
Shell SBS-6

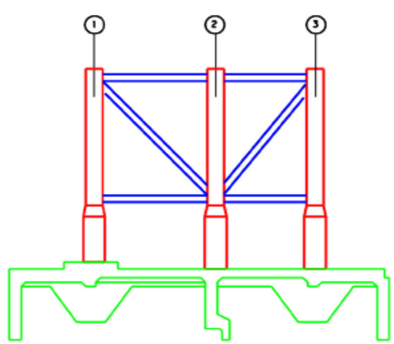


US Army Corps of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry



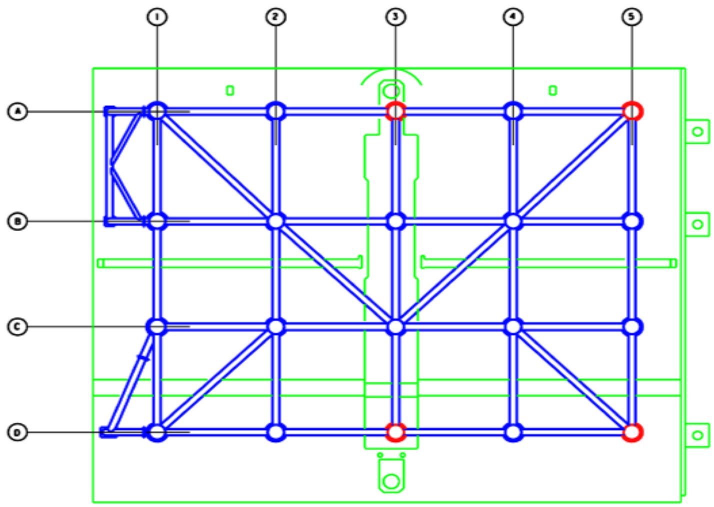


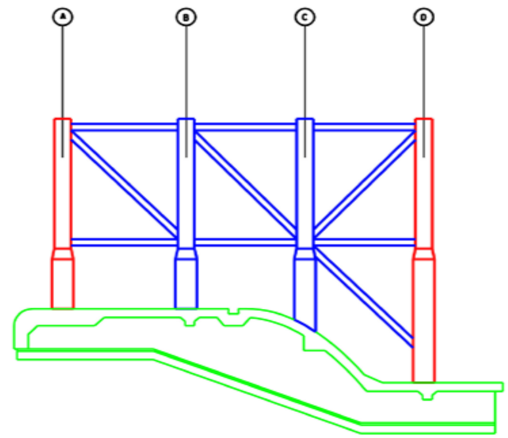


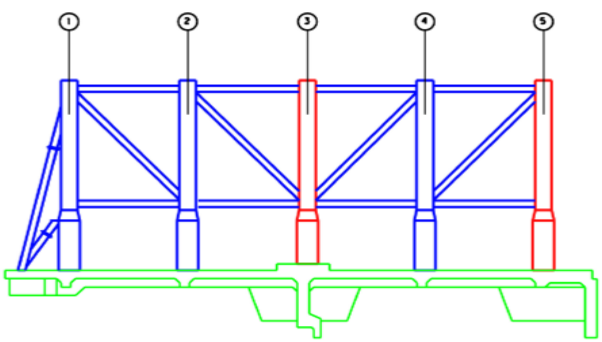
Shell SS-1

US Army Corps
of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry



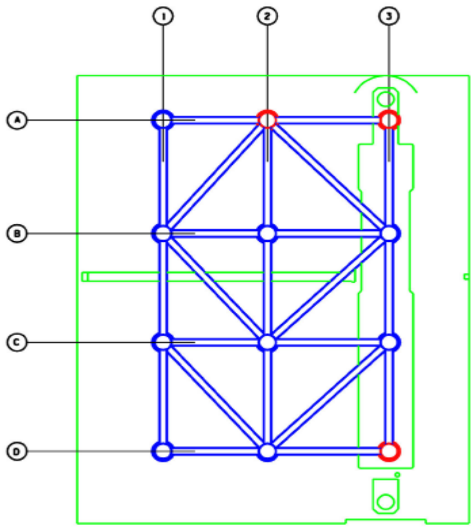


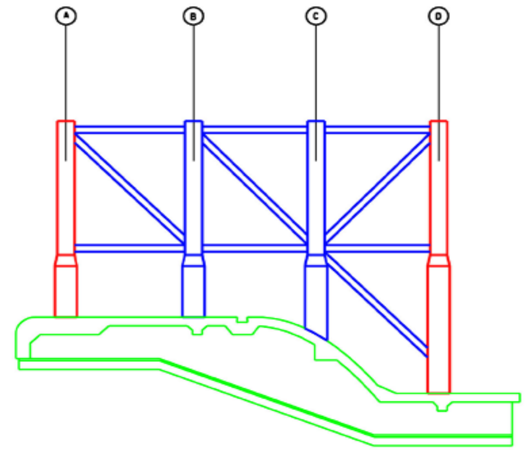


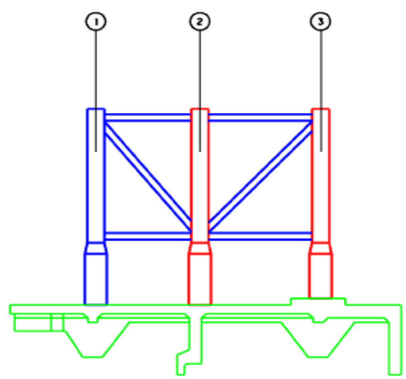
Shells SS-2 thru SS-5

US Army Corps of Engineers
Louisville District

Revisions to Lift Frames for Super Gantry







Shell SS-6

US Army Corps
of Engineers
Louisville District

Summary

- The Super Gantry Method of Construction required re-analyses of the shells and lift frames for loadings approximately 70% greater than the original design
- Modifications to the shells and lift frames have been included almost entirely within the geometric envelope of the original design
- The sequence of work has been modified drastically compared to the visible modifications to the shells and lift frames
- The Super Gantry Method of Construction provided the Contractor with the benefits of reduced operation time in the river with more mating operations completed on shore in-the-dry

US Army Corps
of Engineers
Louisville District

Byron McClellan,

USACE-Louisville District

502-315-6240

Byron.K.McClellan@LRL02.usace.army.mil