PIANC Workshop
13-14th September 2011

Construction Methods

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PIANC
Setting the course

Lock Construction Methods

- "Conventional"
  - Bypass
  - Cofferdam
- "Innovative"
  - Float-in
  - Lift-in
  - Trestle Construction
  - Local Cofferbox
  - Pneumatic Caisson

Bypass Construction – Panama Canal

Conventional Cofferdam Construction

Conventional Construction Advantages

- Utilize Conventional Construction Means & Methods
- Visual Observation and Measurement of performance and progress
- Visual Observation and Measurement for Quality Control

Conventional Construction Disadvantages

- Additional Costs and Schedule for:
  - Real Estate for Bypass, cofferdam, larger laydown and work areas
  - Impacts to navigation during construction
  - Site Access may be more restricted for material deliveries and construction access
  - Additional environmental impacts because of:
    - Larger construction footprint
    - More construction operations on-site

In-The Wet Construction

www.pianc.org *New-Orleans 2011*

PIANC
Setting the course

Float-In Construction – Braddock ½ Dam

Lift-In Construction – Olmsted Lower Pier

In-the-Wet Advantages

- Impacts to Navigation reduced
- Fabrication of components can optimize fabrication site to take advantage of:
  - Availability of material
  - Skilled work force
  - Use of common sites – such as commercial graving docks and dry docks
- Reduced time on site minimizing environmental and real estate impacts

In-the-Wet Disadvantages

- Construction tolerances more stringent
- Quality control more difficult without direct visual observation
- Survey and measurement more difficult
- Underwater operations require specialized equipment, skills and experience.
- Specialized equipment may be required and expensive.

Construction Material Improvements

- In-the-Wet construction facilitated by improvements in materials and construction methods:
  - Improved mix designs with Anti-Wash agents, low heat mixes, self consolidating and leveling agents
  - Improvements in precast connections and alignment devices
  - Light-weight fill and aggregates

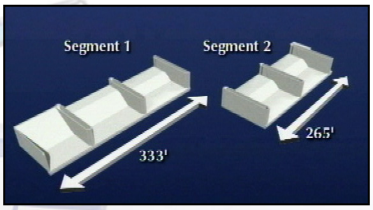
Construction Case Histories

- Braddock Dam – Float-in Construction
- Olmsted Dam – Heavy Lift Construction
- Lith and Almere – Pneumatic Caisson
- Charleroi Lock – Cofferbox Construction
- IHNC FloodWall – In-the-Wet Trestle Construction

Braddock Dam – Pittsburgh, PA USA

- Monongahela River
- The lock is 183m by 33.5 m, lift of 13.7 m.
- The fixed crest dam built in 1906 was replaced in 2002 with a new 600-ft float-in flow-control structure with 5 bays for 4 tainter gates and one fixed overflow weir.
- Thanks to Bill Karaffa and USACE – LRP and Sam Yao with Ben C. Gerwick.

WG29 - LOCK INNOVATIONS
Innovations in the Braddock Dam Design



- Two 11,000 tons precast concrete float-in segments
- A unique two-stage cast & launch system for two segments
- Tow the segments 27 miles to the site through two locks
- A unique positioning system to install the float-in segments on site to a tolerance of 50 mm
- A high performance underwater grouting and tremie concrete

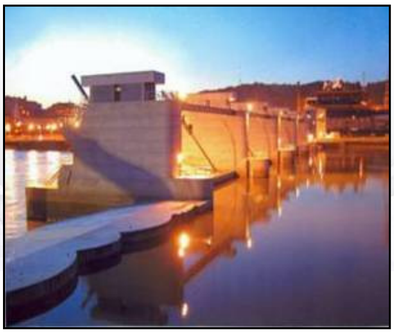
Leetsdale Casting Facility

June 2001

SEGMENT TRANSPORT

BRADDOCK DAM

- 100-year old fixed crest Dam 2 demolished
- New dam fully operational
- Dedication ceremony – May 27, 2004
- Project complete – July 2004



Olmsted Dam, Olmsted, Illinois, USA

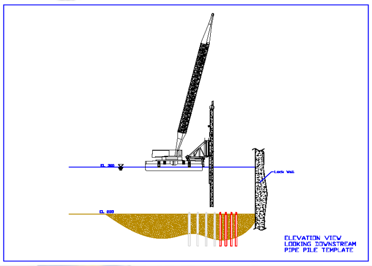
- First built in 1929 on the Ohio River
- Two 110-foot by 1200-foot locks
- The dam will consist of five tainter gates, a 1,400-foot navigable pass wicket gate dam, and a fixed weir.
- New construction should be completed in 2014.
- Thank you to Bill Gilmour, USACE-LRL

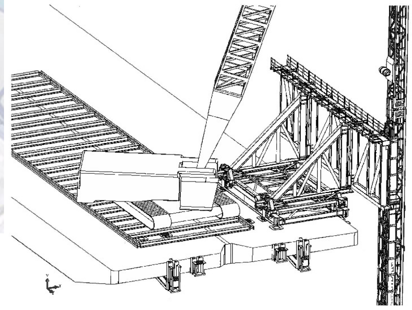
Olmsted Locks & Dam Project

Rendering of completed project

Olmsted Dam Project May 4 2011 Aerial

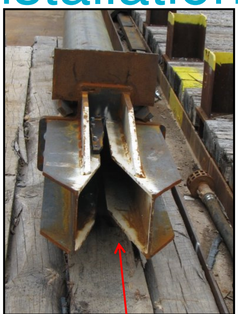
Pile Driving Equipment

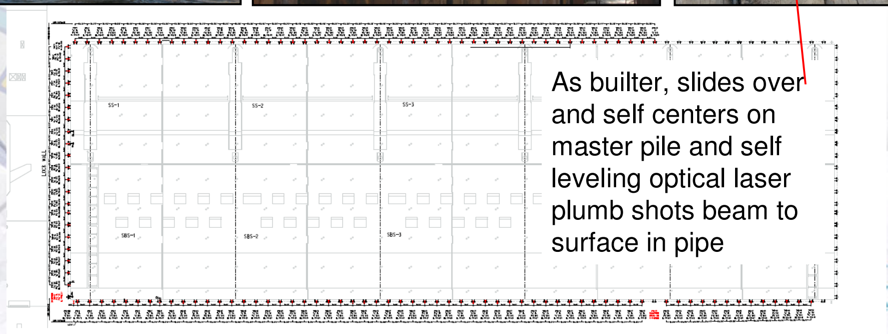




Features:
Template has multiple cylinders to allow it to be moved in nearly any direction to fit the requirements

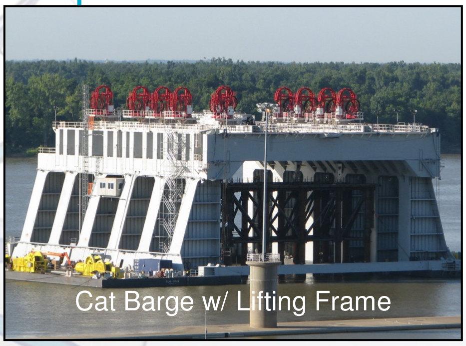
2009 Master / Sheet Pile Installation





As builter, slides over and self centers on master pile and self leveling optical laser plumb shots beam to surface in pipe

Specialized Tools to Build Olmsted Dam



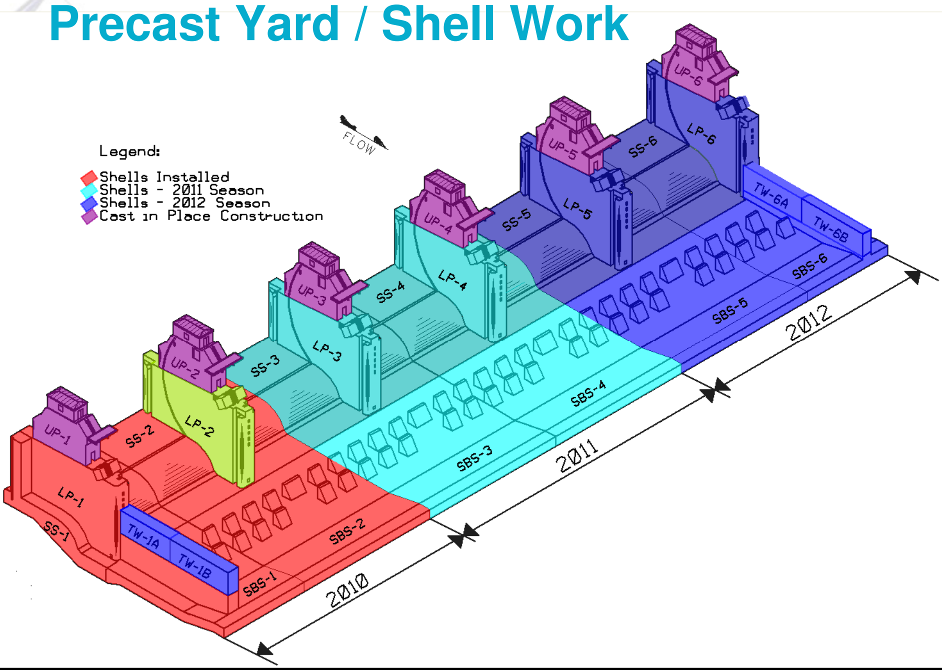
Cat Barge w/ Lifting Frame

Lifting Frame

Tremie Rebar Template on Cradle being moved by CTE

Gantry w/ Lifting Frame.

Precast Yard / Shell Work



Late May 2010 Versus Aug 2010

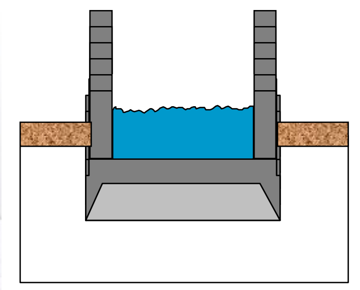
Shell Outfitting Work
Vertical Lower Pier Shells

Hookup and Move of SBS1 Dam Station

Lith and Almere Locks
The Netherlands

- Lith Lock on The Maas River in The Netherlands
- Constructed in 2001
- 200 m x 18.5 m with depth of 4.7 m
- Thank you to Erwin Pechtold with Rijkswaterstaat for use of the slides

Caisson method – Lock Lith



- Construction of sand tarp
- Construction of lock head with cutting edge
- Excavation below lock floor
- Pneumatic submersion of lock head
- Fill-up basement with concrete
- Finish construction

Alternatives

Fig 4.3 : Whole lock structure to be immersed - Almere Haven (NL)

Fig 4.4 : Upper lock head structure to be immersed – Lith (NL)

Lock Lith

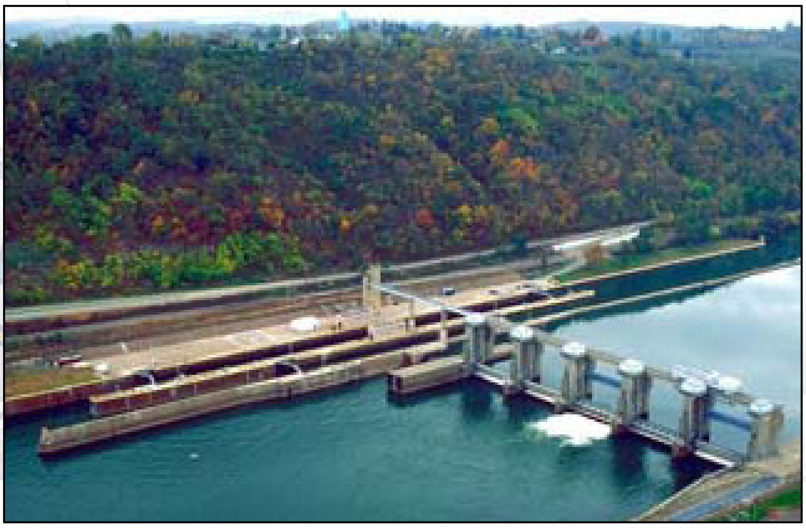
Photo; Testing the filling system of the new lock

Air view; Construction (almost) completed.

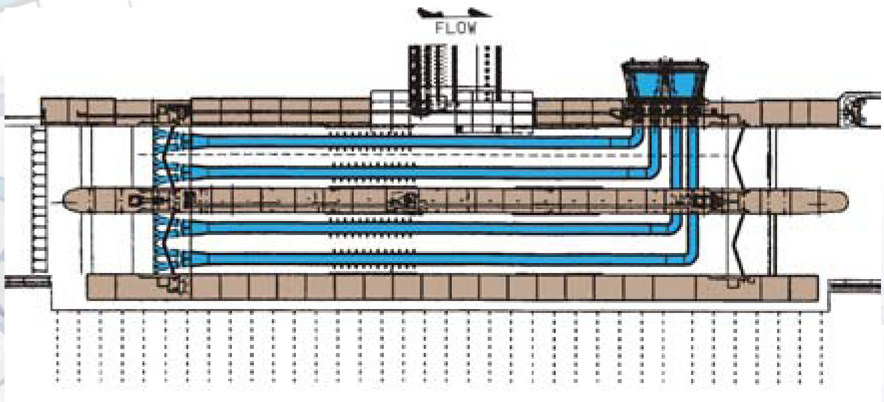
Charleroi Locks – Cofferbox Charleroi, Pennsylvania, USA

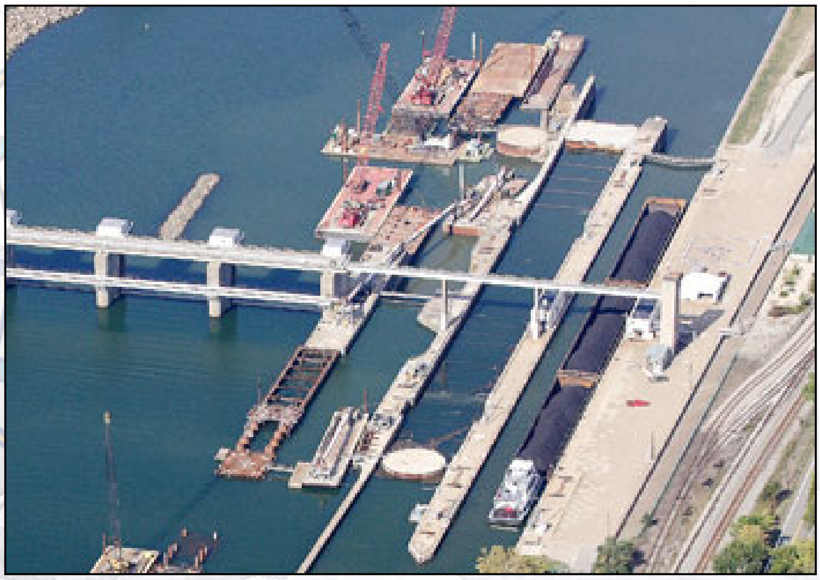
- Monongahela River
- Original locks 17 m x 220 m and 17 m x 110 m constructed in 1930's
- New Locks two–220 m x 26 m with 6 m lift
- Construction started in 2004 and is being completed in phases.
- Thanks to Steve Stoltz with USACE-LRP

Original Charleroi Locks

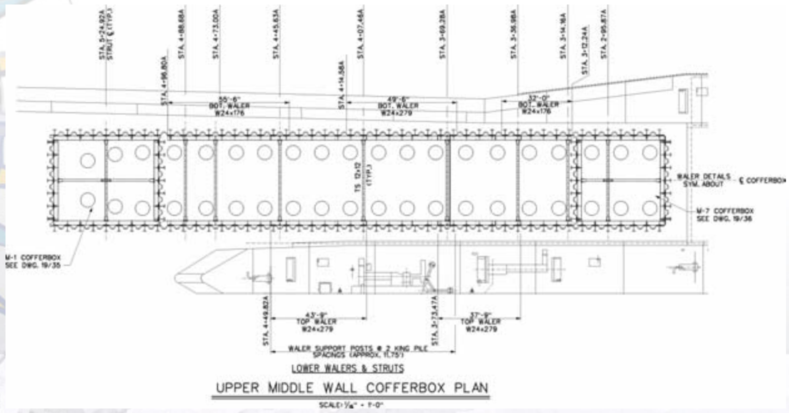


Charleroi Lock Expansion Plan

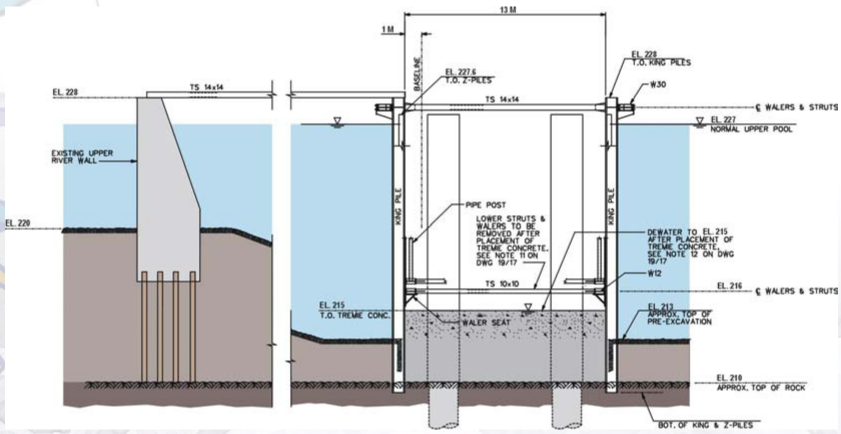




Upper Middle Cofferbox Plan



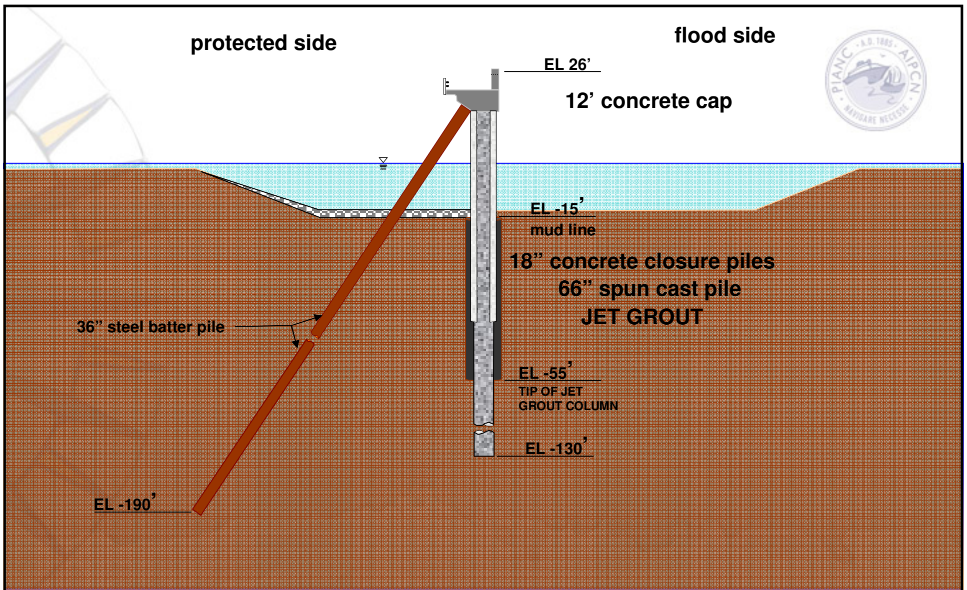
Cofferbox with Drilled Shafts & Tremie



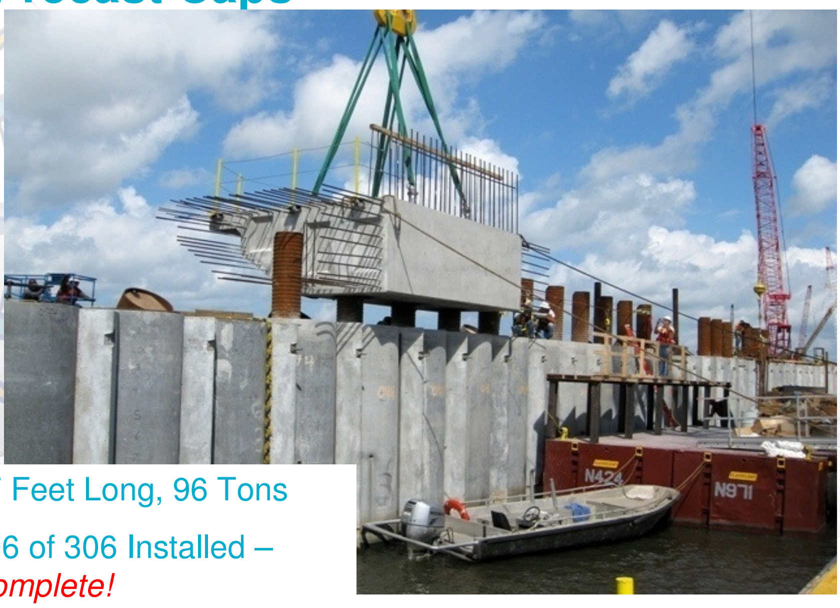
IHNC Storm Surge Barrier, New Orleans, Louisiana, USA

- Storm Surge Risk Reduction at Lake Borgne
- Construction to be completed in 2012
- 1.8 mile barrier
- 26’ above the water line
- 150’ Sector Gate
- 150’ Barge Bypass Gate
- 56’ Vertical Lift Gate

Gulf Intracoastal Waterway (GIWW) and Inner Harbor Navigation Canal (IHNC)



Precast Caps



17 Feet Long, 96 Tons

306 of 306 Installed –
Complete!

Cast in Place Concrete Section

6 Feet Wide, 339 of 339 Cast – *Complete*

Protected Side of Floodwall

Discussion?