Navigation Lock Foundation Design in Complex Karst Geology At Chickamauga Dam

Mark S. Elson, P.G. USACE
Juan Payne, P.G. USACE
Dewayne Ponds, P.G. Arcadis
Acknowledgements

- Arcadis
- Ben C. Gerwick, Inc.
- Bergmann Assoc.
- Black & Veatch
- Inca Engineers, Inc.
- MWH
Cofferdam construction for the new Chickamauga Lock.
Chickamauga Dam lies within the Valley and Ridge Physiographic Province.
Site Stratigraphy

Compressive Strength

- Cannon, upper – 10,000 psi
- Cannon, lower – 18,000 psi
- Hermitage – 11,000 psi
- Tyrone – 10,000 psi
- Carters – 14,400 psi
Carter's Fm
Tyrone Fm
T-4 Bentonite in Tyrone Fm
Hermitage Fm

Chickamauga Lock
DC-17
Sur EL 621.7
Box 3 of 8
Depth 27.2-41.5
Geologic Map

Rocks strike 020 dipping to the southeast at 2-5 degrees at the surface, 40 degrees to vertical in some locations.
L-12 through L-14 geologic profile.
Sites of further field investigations upstream of Chickamauga Lock
Sites 1-5 bentonite, folding and faulting
Site 3 off of Lake Resort Drive upstream of the existing lock.
Site 4 upstream of existing lock.
Original lock excavation cross cutting bentonite bed exposing fault and slickensided surface
Highly weathered joints and solutioned cavities, looking east.
Joint spacing as close as 2 feet is indicated by arrows
Two joint sets: 258-353 and 018-050
Vertical to near vertical dips with spacing from 2 to 9 feet
Design Solutions

- Design of Lock Monolith Foundations include:
  - Exploratory Drilling for Construction
  - Drilled Shaft Installation
  - Secant Wall Installation
  - Blasting, and Excavation
  - Foundation Drilling and Grouting
  - Excavation Stabilization
Integrated lock monolith, landside.

Riverside lock monolith.
Exploratory Drilling for Drilled Shaft Construction

- One boring in center of structure to verify founding elevation conditions
- One boring at center of each drilled shaft to a depth of 10 feet below tip elevation
- HQ diameter vertical borings
Floating plant for cofferdam drilled shaft installation.
Structural steel for cofferdam drilled shafts.
L-12 through L-14 geologic profile.
L-13 Secant wall, plan view.
Secant wall construction at L-13.
Blasting

• Blasting extremely important at this project
• Most major rock excavation will be accomplished by drilling and blasting
• Types of blasting; Pre-splitting, Pre-splitting at monolith joints, line drilling, production blasting
• Preblast survey conducted end of September of 2007
• Structures examined; TVA Power Management Facility, Chickamauga Lock, Dam and Powerhouse, the other facilities
Lock Foundation Excavation, Looking Southwest

- Outlet structure
- Bentonite beds
- Crossover trench
- Chamber floor
- Downstream miter sill
- Downstream
Lock Foundation Excavation, Looking Southeast
Foundation Drilling and Grouting

- Grouting needed to minimize leakage
  - Operational condition
  - Maintenance condition
- Seepage analysis performed to evaluate grout curtain effectiveness
- Single line grout curtain placed with holes drilled on 10 foot centers, 30 degrees from vertical.
- Contingency in quantities for split spacing to be applied as needed.
Foundation Grouting Plan
Excavation Stabilization

Rock Bolts And Shotcrete

- Closely spaced joints, bedding planes dipping into excavation and bentonite beds make slope failures possible.

- Rock bolts, shotcrete, drains and limits on excavation employed to maintain excavation stability.

- Rock bolts consist of 15’, 20’ 25’ and 30’ vertical and angled mechanical bolts for the excavation.

- Large stranded anchors are to be installed at the toe of the cellular coffercells to maintain stability of cofferdam during excavation.
Shotcrete Application and Drain installation
Rock Bolts at D/S Miter Sill, Plan
Rock Bolts at D/S Miter Sill, Section

Sill Foundation

BUILDING STRONG®
Questions?