Intermountain Section
AWWA Conference

2.0MG Layton Water Tank

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Presentation Outline

- Layton City’s decision process
- Tank Design/Construction
- Tendon Tanks - don’t shed the good stuff
Layton City’s Decision

- Schedule
- Quality
- Cost
**Competition vs. Tendon Tanks (D115)**

**Schedule**
- Multiple slab pours
- Shotcrete is weather dependent
- Specialized equipment

**Quality**
- Min. cover on primary reinforcement
- Mildly reinforced slab
- Joints in slabs

**Cost**
- Competitive
- Internal resources

**Construction Space Req’s**
- 15’ – 20’ for wrapping and shotcrete equip.

**Tendon Tanks (D115)**
- Single slab pours
- Not dependent on weather
- Standardized equipment

**Quality**
- Triple protection on primary reinforcement
- Prestressed flexible slab
- Monolithic slabs
- Seismic conditions

**Cost**
- Competitive
- Use local resources

**Construction Space Req’s**
- 3’ outside of wall
- Adjacent to structures
Design/Construction of a Tendon Prestressed Tank
Effect of Applied Loads
Effect of Prestressing
Combined Effect During Service
Prestressed Concrete Tank Wall

Cross Section

Horizontal Bonded Post-Tensioning

Vertical Post-Tensioning

Bi-Axial Compression
Types of Post-Tensioning
Unbonded System

- Coated and sheathed strand
- Sleeve
- Bearing plate
- Permanent cap
- Wedges
Bonded Wall System

- Grout injection port w/ shut-off valve
- Anchor head
- Transition trumpet
- Duct and coupler
- Strand and wedges
- Galvanized bearing plate
- Permanent grout cap w/ stainless steel bolts
Benefits of Post-Tensioning

- Reduction in reinforcement: P-T is 4.5x capacity of rebar, 270 ksi / 60 ksi
- Thinner members (economy in materials, labor, and schedule)
- Reduced congestion: simpler consolidation of concrete, particularly wall placements
- Concrete stress control: specified minimum pre-compressions, and tension limits
- Durability resulting from crack control
- Watertight structures
- Superior corrosion protection on primary reinforcement (post-tensioning tendons)
National Building Codes

- American Concrete Institute  ACI 350-06
  Code Requirements for Environmental Engineering Concrete Structures and Commentary

- American Water Works Association
  ANSI / AWWA D115-06
  Tendon - Prestressed Concrete Water Tanks

- American Concrete Institute  ACI 373R-97
  Design and Construction of Circular Prestressed Concrete Structures with Circumferential Tendons
  (Report Recommendations)
Base Slab
Construction Sequence

- Base slab
  1) Prepare subgrade
  2) Install underslab piping
  3) Set edge formwork
  4) Place P-T and rebar
  5) Place concrete
  6) Cure properly
  7) Strip edge form
  8) Stage stress P-T
Walls
Walls
Construction Sequence

- **Wall Segments**
  1. Set inner form
  2. Install P-T and rebar
  3. Set outer form
  4. Place concrete
Construction Sequence
Construction Sequence

- Footings and Columns
  - Concurrent with wall construction
Construction Sequence

◆ Wall Post-Tensioning
1) Insert horizontal strands
2) Stress verticals
3) Stress horizontals
4) Injection grout tendons
Roof Slab
Construction Sequence

- **Roof Slab**
  1) Set shoring and deck
  2) Install P-T and rebar
  3) Place concrete
  4) Strip edge form
  5) Stage stress P-T
Tendon Tank Advantages

1. Durability
   - Solid concrete sections
   - No joints in slab or roof
   - Controlled concrete stresses
   - Bi-axial compression on all concrete members
   - Superior corrosion protection on primary reinforcement
Tendon Tank Advantages

2. Versatility
3. Watertightness
Watertightness

◆ AWWA D115 Criteria
  ● Walls and wall-floor joints
    ◆ 100% watertight
  ● Floors, piping and valves
    ◆ Less than 0.0125% loss in 24 hours

◆ “Many tanks have been constructed and found to have no measurable leakage when tested for watertightness”
Tendon Tank Advantages

4. Economical
Tendon Tank Advantages

- **Reduce excavation costs**
  - No need for 10’-15’ access for wrapping and shotcrete equipment

- **Larger capacity tanks on small sites**

- **Adjacent structures**
Tendon Tank Advantages

- No structural maintenance
  - Coatings and liners not required
  - No unplanned down time
  - No joint maintenance
Tendon Tank Advantages

- Includes local resources
  - Subcontractors
  - Multiple skilled trades
  - Labor services
  - Material suppliers
  - Equipment rentals
  - Testing agencies
  - Consultants
  - Non-proprietary construction methods
Tendon Tank Advantages

◆ Structural modifications
  • Pre-construction (planned)
  • Post-construction (unplanned)
  • Avoid tendons or apply exterior reinforcement (P-T or CFRP)
    ♦ Vertical wall tendon spacings 3x – 5x wall thickness depending on base fixity
    ♦ Horizontal tendon normally spacings 1.5’ – 5.0’ depending on location up wall
Questions?