Design and Construction of Circular and Vertical Prestressed Concrete Digester Tanks, Atotonilco (México)

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Design and Construction Circular & Vertical Prestressed Concrete Digester Tanks

Waste Water Treatment Plant Atotonilco. General Layout

Capacity 42 m³/s
12 million people
Irrigation 80 000 Ha
Waste Water Treatment Plant Atotonilco. General Layout

Area = 160 Ha; 9 times Real Madrid Stadium
DIGESTERS. GENERAL DESCRIPTION

- 30 Digesters x 15,000 m$^3$ = 450,000 m$^3$ total capacity
- Cylindrical shape; Foundation & dome conical shape
- 26 m diameter, 35 m total height
ANALYSIS AND DESIGN
3D integral model. Main Loads:
- Fluid & Internal Gas pressure
- Earth pressure $k_o$
- Gradient & Uniform Thermal variation
- Seismic & hidrodynamics effects
ANALYSIS AND DESIGN

- Seismic & hidrodynamics effects
- ACI 350.3: Seismic Design of Liquid-Containing Concrete Structures
- Maximum Acceleration = 0.45g

- Impulsive: impact of the fluid
- Convective: oscillations of the fluid
Wall alternatives evaluated:

**Initial solution:**
- Only circumferential prestressing
- Variable thickness wall

**Final solution:**
- Circumferential & Vertical prestressing
- Uniform thickness wall

**Objectives:**
- Reduce construction times using sliding formwork
- Improve seismic global behaviour
DOUBLE POST-TENSIONING SYSTEM:

**Circunferential:** concrete wall compressed.
- 2 families tendons, 2 tendons/family. 180º path.
- Cable: 12 strands 0,6”; ducts 82 mm ext.

**Vertical:** control cracking
- 4 strads 0,6” @ 0,6 m
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**CONSTRUCTION: Foundation Slab**

- Divided in 5 parts: central + 4 sectors
- Water stops bands at planned construction joints
- Curing of concrete using wet blankets
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CONSTRUCTION: Wall. Sliding formwork

- 48 jacking tubes, spaced 1.7 m, eccentrically in the wall
- Working platforms on both sides of the wall
- Average lifting speed= 4m/day
- Continuous working, monolithic construction, high dimensional accuracy
CONSTRUCTION: Wall Cables

Circumferential

Vertical
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**CONSTRUCTION: Wall Cables**

**Vertical Posttensioning:**
VSL 4 monostrand 0.6”

**Horizontal anchorages:**
VSL type EC

**Buttresses & Horizontal anchorages**
**CONSTRUCTION: Dome**

- High load capacity tower
- Supports into the foundation slab
- Beams distributed radially
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CONSTRUCTION: Dome

- Outer dome formwork avoided
- Concrete tested for slope 100%
CONSTRUCTION: STRESSING OF TENDONS

1st Vertical cables
- Symmetrical pattern
- 100 % capacity

2nd Circunferential tendons
- Top to bottom, 100 % capacity
- Alternately opposing buttress
CONSTRUCTION: Protections

Interior Liner: protective sheet HDPPE
Exterior Insulating material
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CONSTRUCTION: October 2011
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CONSTRUCTION: June 2012
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CONSTRUCTION: January 2013
Conclusions:

• Key benefit of the post-tensioning: guaranteeing leak-free construction.

• Post-tensioning systems allows much more economical wall thicknesses and reinforcement quantities, so that costs and construction times are significantly reduced.
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Owner:
ATVM

Contractors:
ICA - Carso
VSL - Macinter

30 Digesters:
Concrete (m³): 50,000
Steel (t): 7,700
Prestressing steel (t): 1,700

Construction Date:
May 2011 - March 2013
Thanks for your attention!