2016 PTI Convention
Long Beach, California

Technical Session #6
PT Solutions
Hebron
Gravity Based Structure

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Presentation Goals

• Present a unique and complicated post-tensioned concrete structure
• Explain the structure
• Describe the general construction techniques
• Present the post-tensioning systems and practices employed on the project
• Grouting
HEBRON
Gravity Base Structure
Project Summary
Project Summary and Scope of Works

HEBRON GBS PLATFORM
LOCATION : NEWFOUNDLAND, CANADA

PROJECT : POST-TENSIONED CONCRETE GRAVITY BASE STRUCTURE

OWNER : EXXON MOBIL

MAIN CONTRACTOR : KIEWIT-KVAERNER CONTRACTORS

START DATE : SUMMER 2013

END DATE : FALL 2016

PLATFORM COMMISSIONING AND SAIL AWAY : WINTER 2017
OVERALL CONSTRUCTION COST: ~$4 Billion CAD

> 50,000t Reinforcement Steel

> 100,000m³ Cast-in-place concrete

> 2,500t Post-tensioning

Number of craft workers at peak: > 1500

Number of craft workers for PT operations at peak:
- Installation of ducts/embeds: 70
- Threading / Stressing / Grouting: 30
Project Summary and Scope of Works

100 m dia. X 120 m tall prestressed concrete offshore structure

- Topside Support
- Shaft – Horizontal and Vertical PT
- Oil Storage Cells – Horizontal & Vertical PT
- Ice Walls – Vertical PT
Project Summary and Scope of Works

> 800 horizontal circular tendons – 19C15

> 50 horizontal circular tendons – 31C15

> 200 vertical U-loop tendons – 19C15

> 200 vertical U-loop tendons – 22C15
Project Summary and Scope of Works

FREYSSINET involved in all construction phases (3 years)

> 100 km of duct installed
> 2,700 PT anchorages placed
> 2500t of Prestressing steel installed
Project Summary and Scope of Works

DRY DOCK PHASE
Project Summary and Scope of Works

END OF DRY DOCK PHASE
Project Summary and Scope of Works
Project Summary and Scope of Works

DEEP WATER SITE

CONTINUOUS INSTALLATION OF PT DUCT AND TRUMPLATES DURING SLIPFORMING
Project Summary and Scope of Works

DEEP WATER SITE
Project Summary and Scope of Works

DEEP WATER SITE

INSTALLATION OF PT DUCT AND BLOCK-OUTS IN HIGHLY CONGESTED AREAS
HEBRON
Gravity Based Structure
Post-tensioning Details
Project Summary and Scope of Works

PROJECT SPECIFIC PTI TRAINING WORKSHOP HELD ONSITE MAY 2014
### Main Technical Features

<table>
<thead>
<tr>
<th>THREADING</th>
<th>TENSIONING</th>
<th>GROUTING</th>
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<tr>
<td>- Standard pushing method for horizontal tendons</td>
<td>- Up to 15 jacks, each able to stress 12C15 to 31C15 tendons via simple nose adaptations required to increase versatility to suit the structure</td>
<td>- Site-mix designs: high fluidity/workability grout formula to suit both horizontal and vertical duct injection</td>
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Project Summary and Scope of Works

Main Technical Features

Post-Tensioning – Freyssinet system (anchorage)
Project Summary and Scope of Works

Main Technical Features
Project Summary and Scope of Works

Main Technical Features

• 15.2 mm strands mainly used except some sections installed with 15.7 mm strands

• Standard anchor block (12/19/22/31 strands) used for horizontal tendons

• Modified anchor blocks (with inspection holes 19/22 strands) used for vertical tendons. Holes to be filled after inspection of first phase injection under the block

• Strands purchased from Europe (15.2mm) and from US (15.7mm), pre-oiled packaged coils

• Corrugated galvanized steel ducts, fabricated locally
Project Summary and Scope of Works

Ducts

- Due to large quantities, production of corrugated galvanized steel duct was performed on site

- All horizontal, vertical and loop tendon duct is galvanized steel
Project Summary and Scope of Works

Horizontal Tendons
Project Summary and Scope of Works

Horizontal Tendons
Project Summary and Scope of Works

Prefabricated Vertical Tendons
Project Summary and Scope of Works

Prefabricated Vertical Tendons
Project Summary and Scope of Works

Vertical Tendons

150m loop tendons

250m loop tendons
HEBRON
Gravity Based Structure
Grout Mix Designs
Project Summary and Scope of Works

Grout Site-Mix Designs

• Qualified for both horizontal and vertical tendons

• Qualification process through several scale mock-ups

• Mix design to keep high fluidity (below 18 sec) over time (same workability up to 4 hours)

• No bleeding

• Stringent criteria: no voids / no bubbles

• Simple and replicable formula: water + cement + superplasticizer + retarder
Project Summary and Scope of Works

Grout Mock-ups

150m horizontal mock-up

70m vertical mock-up
Project Summary and Scope of Works

Vertical Tendons

Mock-up sectioned after grouting

Underneath anchor block

Within trumplate
Project Summary and Scope of Works

Horizontal Tendons

Temporary Metallic Caps
Grouting Procedure

• Standard pumping procedures for horizontal tendons (no deviation) with venting at the outlet

• Different methods qualified for vertical tendons:
  • One-step Standpipe method (bottom-up) for most vertical tendons

  • Two-step Standpipe method (reinjection after 24h the last 4 ft. of vertical section underneath the anchor block) for vertical tendons with water leaks

  => No grout cap used for the vertical tendons – standard configuration

• Vacuum assisted method for tendons with blocked injection hose (in case) with custom-made top caps (allow reinjection)
Thank You!

Questions?