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Technical Session #6 PT Solutions



Hebron Gravity Based Structure

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Presentation Goals

- Present a unique and complicated posttensioned 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







HEBRON GBS PLANFORM

NSTITUTE ™

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







> 800 horizontal circular tendons – 19C15

> 50 horizontal circular tendons – 31C15

> 200 vertical U-loop tendons – 19C15

> 200 vertical U-loop tendons – 22C15



FREYSSINET involved in all construction phases (3 years)





END OF DRY DOCK PHASE



DEEP WATER SITE

CONTINUOUS INSTALLATION OF PT DUCT AND TRUMPLATES DURING SLIPFORMING





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



ST-TENSIONING

PROJECT SPECIFIC PTI TRAINING WORKSHOP HELD ONSITE MAY 2014

TRAINING AND CERTIFICATION OF FIELD PERSONNEL FOR BONDED POST-TENSIONING











Main Technical Features

THREADING

- Standard pushing method for horizontal tendons
- Prefabricated tendons for vertical tendons, use of turn table and winch to uncoil and thread into ducts

TENSIONING

Up to 15 jacks, each able to stress 12C15 to 31C15 tendons via simple nose adaptations required to increase versatility to suit the structure

GROUTING

Site-mix designs: high fluidity/workability grout formula to suit both horizontal and vertical duct injection



Main Technical Features

Post-Tensioning – Freyssinet system (anchorage)



Main Technical Features





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



Ducts

- Due to large quantities, production of corrugated galvanized steel duct was performed <u>on site</u>
- All horizontal, vertical and loop tendon duct is galvanized steel



Horizontal Tendons



Horizontal Tendons









Prefabricated Vertical Tendons



Prefabricated Vertical Tendons









Vertical Tendons



150m loop tendons



250m loop tendons





HEBRON Gravity Based Structure Grout Mix Designs



ST-TENSIONING

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



Grout Mock-ups



150m horizontal mock-up



70m vertical mock-up



Vertical Tendons

Mock-up sectioned after grouting



Underneath anchor block

Within trumplate



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 ?

