Cameroon Douala Harbour – Bonabéri – Reconstruction of Quay 52

Pierre MENGEOT
Civil Engineer
BESIX
Brussels, Belgium
pmengeot@besix.com

Pierre Mengeot, born 1982, received his civil engineering degree from the University of Louvain-La-Neuve, Belgium. He has been working for Besix since 2005 and has been lecturer at the university of Louvain-La-Neuve since 2011.

Summary

The project consisted of the construction of a new sheet piled wall (220m long, 1150 tons) with the requirement that there was to be no disturbance to the day to day operations of the port. It included the driving of the steel sheet piles in front of the existing wall, the pouring of a reinforced concrete capping beam (850m³), the drilling of 150 anchors (34m) and the installation of new fenders and mooring bollards.

Keywords: sheet piled wall; concrete capping beam; anchors; fender

1. Introduction

The Port of Douala (PAD) lies on the estuary of the Wouri River, on the Atlantic coast in the southwest region of Cameroon. The site is located on the downstream side of the Wouri Bridge, linking the center of Douala to the Bonabéri neighborhood. Quay 52, operated by the Cameroonian cement manufacturer Cimencam, part of the Lafarge group, required a global reconstruction. It accommodates vessels delivering raw materials such as gypsum and clinker.

This paper demonstrates, by describing the required construction sequence, that the reconstruction works were more challenging than the construction of a new quay wall.

2. Existing structures

The existing structure consists of a front steel sheet piled wall connected to a rear sheet wall that acts as a passive anchor. 25m long tie rods transfer horizontal forces to the rear wall. The existing sheet piles were heavily corroded and there was therefore no guarantee of the structure's stability. Many holes were also present in the main wall leading to settlement of the quay. A new quay wall was thus required to guarantee stability while permitting the use of the crane rail that is situated adjacent to the existing capping beam.

3. Description of the new quay wall

The new retaining wall was designed to follow the same structural principal as the existing wall, with several exceptions: an active anchoring was selected over a passive system in order to reduce the wall deflection, the level and inclination of the anchors was modified and S-shaped piles were selected. There are no expansion joints in the capping beam of the existing quay wall and accordingly, it was decided that no joints would be placed in the new capping beam. Additional reinforcement bars to those required for strength were placed in the new beam to avoid any problems arising due to early thermal cracking. The following paragraphs describe the construction sequence of the works.

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3.1 Temporary Relocation of Berthing Line and check of the residual capacity

Given that the works could not interfere with the day to day operations of the cement factory, there was a contractual obligation to permit the berthing and unloading of vessels on the existing quay wall at all times during the construction of the new wall. To achieve this, a temporary fendering system was constructed, which moved the berthing line by 3.4m beyond the existing berthing line. This ensured sufficient space for the drilling of anchors and driving of piles while still permitting vessel operations.

The residual capacity of the existing quay wall was estimated in various locations along its length in order to determine maximum allowable crane loads.

3.2 Drilling of anchors, filling space between two sheet walls with sand and use of precast element under the capping beam

Prestressed ground anchors with high strength tendon elements (steel grade 1670/1860 N/mm²) have been used. The IRS ("Injection Répétitive Sélective") method was adopted in order to enhance the friction capacity of the anchorage. Injection valves (manchettes) were pressurised individually using a double packer injection tube.

In order to permit installation of the anchors in the limited working space between the temporary berthing line and the existing quay wall, a novel drilling technique was developed. The maximum length of individual anchor elements (temporary casing, manchette tubes etc.) was limited to 2m and could thus be placed within the confined working space. Elements were then connected together to achieve the required 34m anchor length.

Top of sheet piles have been temporary anchored to the existing capping beam. Space between the two walls has been filled with sand and a lean concrete. At the river side, precast with the AU jagged wall shape have been hung to the sheet pile to act as a lost formwork for the capping beam.

3.3 Use of specific reinforcement cages and pouring of the new capping beam

Due to the tide of the Wouri River, the placing of the capping beam reinforcement in the formwork has to be as quick as possible. On the other hand, the use of typical shear reinforcement was not possible due to the specific shape of the sheet pile wall and the presence of the existing capping beam which hinders the placing of U shaped bar through hole in sheet pile.

Specific accurate prefab steel cages have been prepared to limit as much as possible the placing of additional reinforcement in the formwork: lapping bars between steel cages and L shaped bars to be placed in sheet pile's holes.

4. Conclusion

Economical constraints (no disturbance of the day to day activity of the quay), combined with the need to ensure the stability of the existing quay wall during construction, resulted in a project that has been unique and significantly more challenging than the construction of a new quay wall.