THE FIRST PHASE OF EXPANSION OF THE KINGSTON CONTAINER TERMINAL

Eric Fernagu[1], Cédric Garnier[2] , Philippe Delhomme[3]

Kingston Freeport Terminal Limited (KFTL) owned by CMA CGM got awarded in April 2015 the 30 years concession for the Kingston Container Terminal (KCT). This Container terminal, with current capacity of 2.8 MTEU, is conveniently situated on a direct line between the U.S. and the Panama Canal, and between Europe and the Panama Canal, would ensure a leadership position for the Port as a regional transhipment hub.

The concession contemplates improvement works that will be implemented in a two-phased development:

- Phase 1 aims at accommodating the existing terminal (Quays and nautical access) to the Neopanamax container vessels, through deepening and realignment of the nautical accesses and refurbishment of 1 200 lm of existing quays. This has allowed partial access as from earlier in 2018 to Neopanamax vessels with 14.7 m draft. Full access to the refurbished 1 200 lm is planned early 2019 ;
- Phase 2 will consist of the deepening of the nautical accesses to allow access to 15.5m draft vessels and of the expansion of the terminal capacity to 3.6 million TEU.

The presentation is proposed to focus on the first phase being implemented currently and more particularly the following challenges of the project:

The conception of the nautical accesses:

It consists in realignment and deepening for Neopanamax 14,000 TEU vessels, considering the technical and environmental constraints of the site.

The 15km long channel passes through very sensitive environmental areas including but not limited to the Palisadoes-Port Royal Protected Area with reefs, heritage historical sites such as the Port Royal Sunken City and sea grass.

Figure 1: Realigned nautical access layout

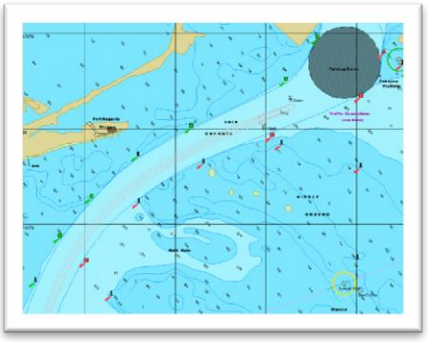

Figure 2: Ship maneuvering simulation exemple

The so-called inner channel is bended passing through very shallow areas with sustained regular transversal wind. This specific layout required the navigation of ships at sustained speed to keep sufficient manoeuvrability. The optimization of the realignment and deepening has been performed on basis of:

- Vertical detailed design supported by bottom factors assessment and ship factors detailed calculations: squat, dynamic heel and wave response allowance. For this last parameter, the ROM semi-probabilistic method has been used.

[1] Project Manager – Employer's Representative, Egis Ports, eric.fernagu@egis.fr
[2] Chief Operating Officer, CMA Terminals Holding, HO.CGARNIER@terminal-link.com
[3] Nautical Studies Manager, CMA Ships, MRS.PDELHOMME@cmaships.com

- Horizontal detailed design supported by real-time ship manoeuvring simulations in the CMA CGM Fleet Center Full Bridge Simulator. They have been performed jointly between CMA navigation experts and pilots from the Port Authority of Jamaica. They have allowed refining the layout of the access channel with a widened first bend and a straightening of the last section of the channel.

The planning of the works:

In order to ensure continuous operations of the Terminal, as well as its increase of throughput during the works started in 2016 and due to be completed by early 2019, the sequencing of the works has been established on basis of detailed modelling of the capacity of the terminal, during the expansion phase. For that purpose, various scenarios have been considered, ranging from 2 stages scenario (800m / 400m or 600m / 600m) to 3 stages scenario (600m / 300m / 300m or 400m / 400m / 400m).

For each scenario, the three main following criteria have been analysed: reaching the targeted capacity during construction, vessel productivity and waiting time.

The best and therefore selected scenario was consisting in phasing in 3 upgrade stages as follows: 600m / 300m / 300m. The overall project, including quay upgrade, yard pavement rehabilitation and new gantry cranes delivery has been optimized in light of this best operational path.

The design of the quay wall upgrade:

As from the start of the Project, CMA-CGM has always looked at taking benefits of the existing structures (2 400 lm of berth with allowed draft of 13m) instead of building extension to the existing berths. This has required an innovative and state-of-the-art approach in order to ensure the feasibility of the project to go over the following obstacles:

- The seismic context with 475 year return period event seismic acceleration reaching 0.29g coupled with a complex geotechnical context (more than 12m thick liquefiable soils on top of stiff to hard clays without presence of substratum). The adopted approach -to confirm and optimize the seismic design criteria- has coupled seismotectonic analysis, PSHA to define site-specific response spectra and specific geotechnical investigation (cross-holes).
- The nature of the existing quay structure, being a combi-wall structure designed for 13m draft vessels. Innovative solutions have been investigated and finally adopted to:
  - Allow the loads of the STS post-panamax cranes
  - Cope with the above defined seismic acceleration
  - Mitigate the increase of the dredged depth and the associated reduction of the embedded length of piles and steel sheet in order to cope with the loss of mobilized passive pressure in front of the quay no longer sufficient to resist to the active pressure due to earth pressure and loads.

The finally adopted quay reinforced structure consists in 4 main components:

- a subseawall made of subsequent piles
- 2 rows of piles connected to an extended front beam
- Inclined piles connected to an extended rear beam
- Soil reinforcement with use of stone columns.

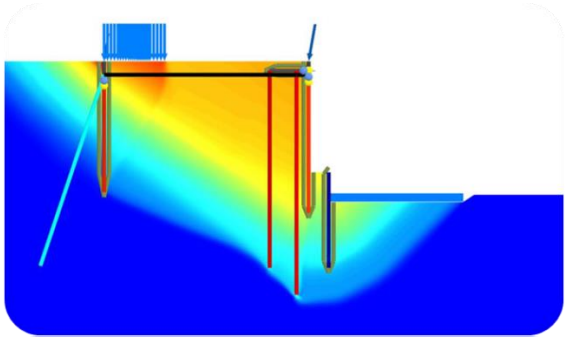

Figure 3: Typical cross-section of the refurbished quay wall (copyright: VCGP)