

# PORT EXTENSION IN MARTINIQUE, IN THE FRENCH CARIBBEAN: USE OF THE OBSERVATIONAL METHOD IN A HIGHLY SEISMIC AREA

by

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## Paper abstract

Grand Port Maritime de La Martinique (GPMLM), the public authority in charge of the port of Martinique, is rolling out an ambitious action plan to develop its container terminal "La pointe des Grives".

GPMLM has appointed Artelia to provide design and construction supervision services for its container's yard and quay extension in 2013. The project proceedings were decided in two stages: the South extension, realised in 2016, object of the present paper, and the North one, construction bid for tender under launching.

The original South terminal extension project consist in a 3 hectares' container yard increasing, and a 130 m extension quay construction, until a water depth of 10 m, the whole on a soft soil. Actually, the geotechnical sequence is called "madreporic" loose to very loose sands, with a thickness sometime more than 10 m, covered by a 2-3 meters layer of mud.

Otherwise, the French Island "La Martinique" is located in an important seismic area and combined with a compressive project soil conditions involve, in accordance with French standard Eurocode 8, a significant structural calculation constraint:

- the peakground acceleration parameter is  $a_{gR} = 0.3g$
- the calculation acceleration amplified by the geotechnical condition is  $a_{vg} = 0.45g$

Moreover, during design studies of the project, the French Government precises the environmental policy and decrees that there should be no dredging or substitution due to environmental protection and no using sea sand borrow.

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The particular project challenge was to fulfill the recent French Seismic regulation in a bad geotechnical conditions and a very concerning environmental context.

Taking into account this constraints and due to the environment French regulation, the project have been revised, and the studies start over again.

The extension project has been separate in two parts North and South extensions. The North is still under design, and the South involves a 2.45 ha container yard extension without dredging.

Soil reinforcement was design as alternative solution. The first settlement assessment was carried out to secure the realistic geotechnical assumptions and earthwork design. It gave a one-meter amplitude, and a re engineered design conducted to 30 cm.

The successful of design and construction method was confirmed by monitoring the platform settlements (pore pressure dissipation, settlement, strain) and by using very good (angular and strength) granular filling and rock protection. Finally the measured settlements were about 20 cm, with a complete consolidation.

The owner construction cost management is also described in a French context of public works: the owner and its designer ensure the totality of the design (and the risks). The Owner organised a specific construction management contract, and it conducted to a cost effective approach.

The South stage is now completed and in service since the beginning of 2016.

This paper presents the project constraints and the construction methodology, and sets out the feedback obtained in regard to settlement upon delivery of the reclamation area after 12 months of work.

Originality of the paper:

The paper describe an observational method chosen to design and construct the yard extension of the container terminal at Fort de France in Martinique, which enabled a construction cost decrease and an environmental impact reduction.