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1. Introduction

A pier for unloading coal in thermal power plant is presently being constructed at the southern part of Peru. This pier consists of an Unloading Platform 1240 m off the coast, a 1270 m long Jetty linking the pier to the on shore, and two Seawater Intake Pipelines measuring 760 m in total (Fig 1). The following three points characterizes the construction condition of Jetty :

- (1) The structure is to be built across a 400-m wide surf zone.
- (2) The ground is so hard that conventional pile driving method would fail to efficiently serve the purpose.
- (3) Allowed construction term is only 14 months, which means that construction of 20 m per week is required.

This report describes the construction method and the type of structure chosen to meet these requirements to properly construct the Jetty.

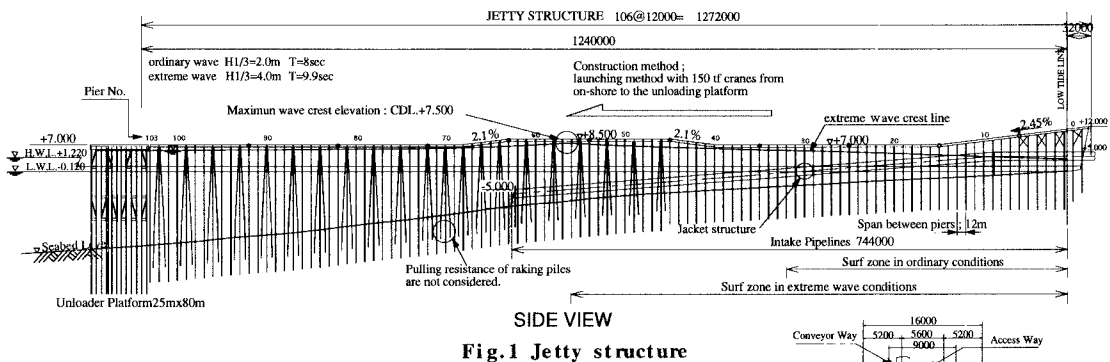


Fig.1 Jetty structure

2. Construction Restrictions

● Marine meteorological conditions

The construction site faces the open sea. The site always receives 2-m high waves at 8-sec. cycles. The sea is shallow for a long distance from the shoreline. Waves break for as long as 400 m off from the beach.

● Ground conditions

The ground is characterized by alternation of strata consisting of a layer of Cemented Sand and a layer of Sand Stone of N value of 50 or more (Fig.2).

● Term of construction

Contract term is 14 months. Building a 1270 m Jetty can only be realized by a fast working pace of more than 20 m a week.

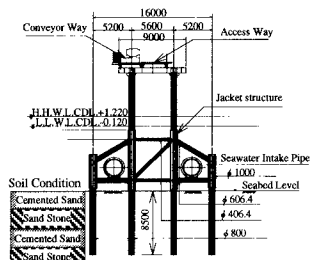


Fig.2 Section of jetty

3. Construction Method and Type of Structure Adopted

Considering local natural conditions, construction term, and Peruvian domestic situation, the following construction plan was developed:

● Construction by launching method

Construction with work ship on surf zone was not feasible. Therefore, one of the typical construction methods in Peru, the launching method, was adopted. The launching method is a technique to construct the Jetty by extending the work point toward offshore. Specifically, crane is placed on the crane girder set on the top of the existing piles and then piles are driven off the deck by using the extension girder to extend the Jetty. (Fig. 3)

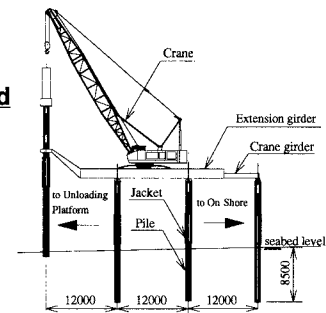


Fig.3 Launching method

Keywords : Jetty, launching method, Pile driving, jet vibro

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● Selection of type of structure

To develop a structure most appropriate to the construction method chosen, the following types were chosen:

- Steel structure, to achieve shortening of construction term by means of integrated construction approach.
- Because of the launching method, the design span of piles was set at 12 m, the longest possible considering crane lifting capacity (lifting load of 30 t) and durability of temporary crane girder(Fig.3).
- Jet vibro method (which will be explained later) cannot be easily applied to raking piles, which means that sufficient embedded length cannot be guaranteed at raking piles. Therefore, construction of raking piles had to be avoided wherever possible. If a situation does not allow avoidance of an raking pile, such raking piles had to be built in such a manner that it does not need to provide pulling resistance.
- Diameter and thickness of a pile have to be uniform for Jetty to provide consistency in diversion of materials and casing pipe for the jet vibro.
- The interval of piles in the cross direction have to be the crane shoe width to directly transfer crane loads to piles during construction. The access way has to be built off the temporary crane girder to allow retreat of crane after completion of the jetty(Fig. 4).
- Selection of the jacket structure and use of standard steel aimed at reduction of field welding.

● Pile driving method in combination with jet vibro

Since it is difficult to construct the jetty using conventional pile driving method due to ground conditions, an approach that reduces rock excavation time was selected. A composite approach of using the jet vibro method for initial excavation and pile driving for finishing excavation was planned. To verify its validity to construction term reduction, the jet vibro technique was experimented on simulated local ground. Simulation ground used in the experiment was mortar mixed with shells ($q_u=50-200\text{kg/cm}^2$). Driving speed, current and amplitude of vibro hammer, pressure and discharge of jet, and the condition of piles and ground after pile driving were measured and evaluated for each vibro hammer capacity. The experiment results demonstrated that the proposed method is capable of fully achieving the goal within the prescribed term. Therefore, it was decided that the pile driving method in combination with jet vibro method will be used in actual construction(Fig.5).

● Selection of Crawler Crane

Large scale civil construction projects are rarely implemented in Peru, which means large crane is not readily available in the country. The large crane was necessary in this project to allow reduction in construction by driving piles farther off from the on shore and considering that integrated construction requires increase of lifting load to as much as 30 t. Therefore, a 150 t crane was transported by sea from Japan to Peru.

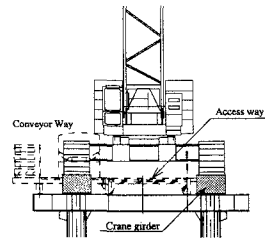


Fig.4 Crane girder

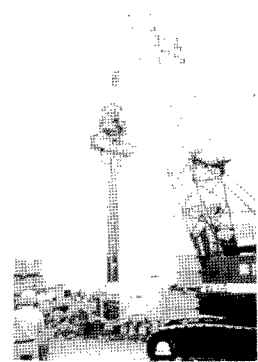


Fig.5 Experiment on jet vibro

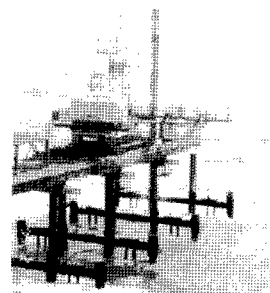


Fig.6 Jetty under construction

4. Work Progress

The Jetty is now under construction. The work is on schedule as projected in the beginning. This confirms that the launching method and pile driving method developed to overcome various restrictions are appropriate. The structural type selected to optimize the construction method is also playing an important role in the smooth implementation of the work(Fig6).

5. Afterword

Although a structural system that simply minimizes quantities from design viewpoint is often considered to be an economical design, we firmly believe that selection of an optimum structure from comprehensive viewpoint considering local conditions, construction method, and many other factors will surely bring success to the project. It is unfortunate that we are still unable to provide a report of successful ending of the project as it is still ongoing. When the project is completed, we strongly believe we can report the project to be a successful case where combined efforts of construction and design surmounted the barrier of various restrictions.