

Benefits of Multi-columns Type Bridge Pier Foundations Constructed in Water

Kajima Corporation Sunao Fujinami, Member

1. Introduction

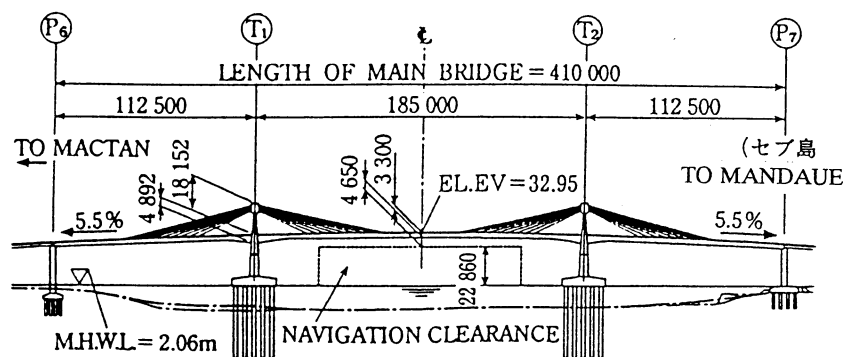
Foreign aid recipient countries often plan to build a large bridge with their foundations in a river, channel or sea. These underwater foundations require sophistication in design and construction, while the technical readiness of the project country tends to limit choice of foundation types in many cases. The Second Mandaue-Mactan Bridge in Philippines completed in 1999 adopted the Multi-columns Type Foundations (large diameter cast-in-place concrete pile foundations), which was successfully completed with high level of quality without accident.

2. Bridge Foundation Type

The following foundation types were considered at the time of planning.

- (1) Large diameter steel pipe piles
- (2) Large diameter well with steel pipe piles
- (3) Open caisson
- (4) Pneumatic caisson
- (5) Multi-columns

The last type was selected for the project in order to meet a short construction schedule and to achieve high level of quality and safety as well as to respond to the Philippine Government's recommendation to maximize use of locally produced materials.



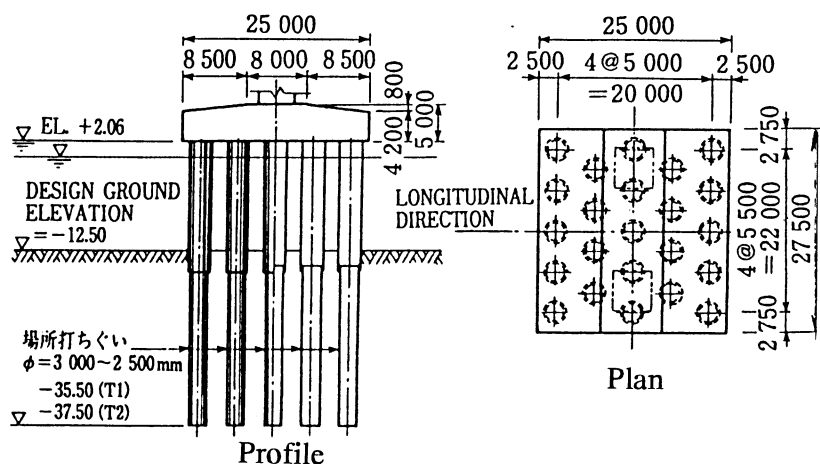
Dimensions of the Second Mandaue-Mactan Bridge

3. Construction of Multi-columns

The size and number of the cast-in-place concrete piles placed were as follows.

- Diameter : 2,500~2,980mm
- Length : 37.7~39.6m
- Number : 23/Foundation

Double casing pipes were utilized. The outer casing was protecting the construction from tide and wave, while the thicker inner casing equipped with bits at the bottom



Dimensions of the Pier Foundation

Multi-column Type Bridge Pier Foundation, Large Diameter cast-in-place concrete piles, Bridge foundation

Shinjuku Park Tower 28th Floor, 3-7-1 Nishi-shinjuku, Shinjuku-ku, Tokyo, 163-1028 Japan
 Phone: 81-3-5324-5936 Fax: 81-3-5324-5937

rim was rotated to cut through the soil layer. The soil inside the inner casing was removed by a grab bucket. Slime was removed and a rebar cage was placed. Concrete was then placed with a tremie pipe as the inner casing pipe was raised and finally removed, while the outer casing left in place as part of the permanent structure.

4. Benefits of Multi-columns Type

The adoption of the Multi-columns Type Foundations was accepted and approved by the Philippines Government and the consultant in charge as an alternative. It was well suited the local conditions and proved to be advantageous over other foundation types in this case. The reasons were as follows.

(1) The foundations were made primarily with concrete, which was of local materials. Some steel materials were imported, however, a good portion of fabrication was done locally, thus achieving high local participation.

(2) The piling was done with double casing pipes. This system minimized collapse of the pile walls during pile driving and excavation, which often happen with cast-in-place concrete pile construction. The speed of the pile construction increased as the workers became familiar with the work procedures, resulting in substantial time saving.

(3) Highly fluid concrete with an AE water reducing agent was utilized. Pre-cooling by ice and keeping uniform fluidity by controlling slump flow values achieved consistent concrete quality in spite of tropical climate, high concentration of re-bars and workers with uneven skill levels.

(4) A temporary jetty from the nearest shore and a large platform surrounding the pier were built for construction of each foundation, which made the access easy and minimized risk of accidents. 2,500-ton pile loading tests were safely and smoothly conducted.

(5) Appropriate selection of large equipment relieved workers from more accident-prone manual works of many different types. The project suffered from no fatal accident partly because of this arrangement combined with use of the temporary jetty and the platform as access to the construction as mentioned above

5. Closure

The Multi-columns Type Foundations in water areas have many advantages in terms of quality, safety and construction speed specially when applied in developing countries.



Multi-Columns with Temporary Platform



Completed Bridge