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5. Foundation Structures of Large Scale

Foundation of steel pipe-pile-wall

General

The foundations of steel pipe wall was invented in 1966 for foundations of blast furnaces and since then this type of foundation has been increasingly applied to foundations of harbour structures, highway bridges and so on. It is, however, only recently that the Japanese National Railways, after theoretical and experimental investigation and field measurements of foundations which were tentatively constructed by this method, decided to adopt it for the first time for railway structures.

Sequence for construction of the foundations

The foundation of steel pipe wall is constructed generally in the following sequence; firstly, piles of steel pipes with longitudinal joints are driven into ground ordinarily in a circular, elliptical or rectangular pattern. Photo 1 shows a circular arrangement of piles, and Photo 2 shows the guiding ring beams which are usually installed to secure a necessary accuracy in driving the piles.

Then concrete is placed into the top portion of each pile.

Soft cement mortar is generally grouted into the longitudinal junctions between adjoining piles. Finally, the top reinforced concrete slab is placed in position and is supported by the brackets attached near the top of each pile (see Photo 3).

Structural characteristics

The main structural characteristics of the foundation, which are generally recognized are as follows;

As the foundation can serve as a water cut-off wall, too, it is preferably used particularly in cases where the water level is high. Even on extremely weak ground, it has considerable lateral rigidity which varies mainly according to the ground condition at its bottom and to the degree of solidification of the junctions of piles. Open-end steel pipes being driven into ground, the ground is less disturbed than with other types of foundation.

This type of foundation is, therefore, advantageous for construction in the vicinity of existing railways.

It has a great variety in its sectional dimensions and shapes, and requires no work under a high pneumatic pressure, a great advantage from the view-point of the recent tendency towards shortage of experienced workers for such construction.

Example of application I

Foundations of a railway viaduct, which consist of piles of 800 mm in diameter and 17 m in length as shown in Fig. 1, are under construction in marshy land. One of them was tested under a horizontal loading at its top. The result of the measurements is under analysis at present.

Example of application II

This is an example where the method is applied to reconstruction of an existing deteriorated bridge and its foundations in a river with relatively high water level, and where the minimum distance between the new foundations and the existing ones is as short as 3 m. As shown in Fig. 2, 27 m and 45 m long piles are alternately driven into the ground. The upper part of the piles serves as a water cut-off wall and the lower part thereof, as the foundation to bear the load. A loading test on the foundation is planned.

Foundation of closed wall of cast-in-situ reinforced concrete

Foundations of closed wall of cast-in-situ reinforced concrete form another newly developed type of foundation which is applicable to foundations for large structures.

They have been applied to temporary retaining walls over the past 20 years, but after various improvements of the constructional method especially in excavation, they have recently come to be used as permanent elements of structures, such as large retaining walls and foundations.

The wall is usually arranged in a rectangular or octagonal pattern. For construction it is divided into at least four blocks, because without division it is difficult to execute the following constructional sequence for the whole foundation; excavating the trench, inserting preassembled cages of reinforcing bars into it and then filling it with concrete.

Fig. 3 and Fig. 4 show a foundation of this type and the joint part between blocks, respectively.

The stiffness of the completed foundation depends mainly on the quality of the joints between the blocks. After enthusiastic instruction and extensive cooperation of J.N.R., considerably reliable structural details for the joint and also machines which make it possible to excavate accurate trenches in the vertical direction have been developed. Now J.N.R. is trying to construct large foundations of this kind and to make various measurements thereon.

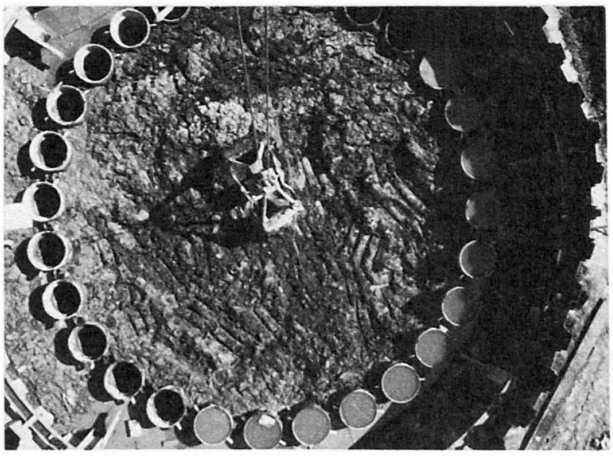

Photo 1 Circular arrangement of pipe-pile-wall

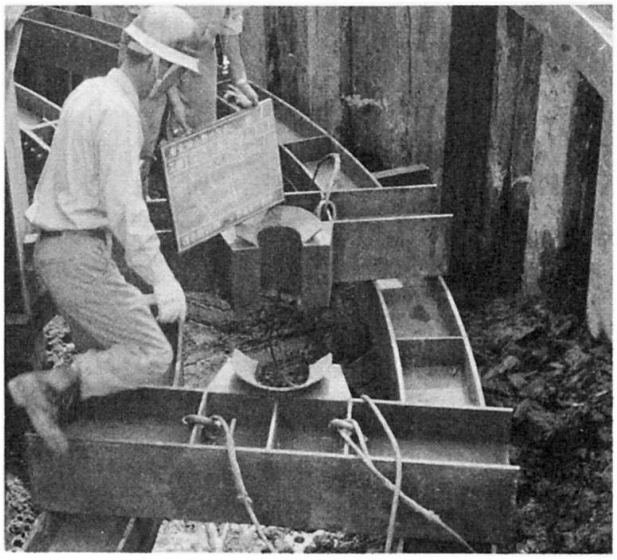

Photo 2 Guiding ring beams for pipe-pile-wall foundation

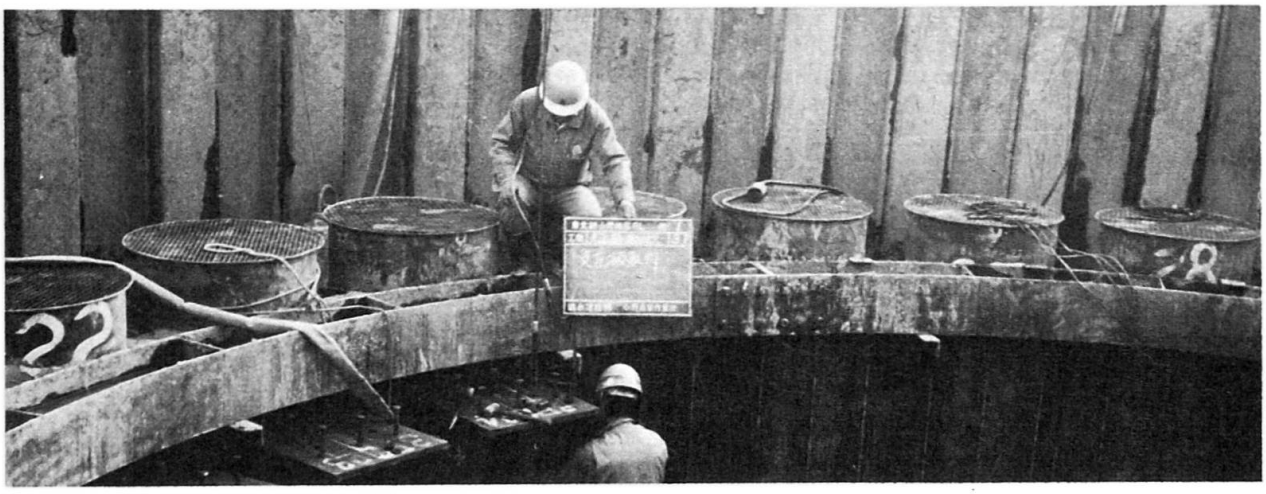

Photo 3 Brackets to support top slab

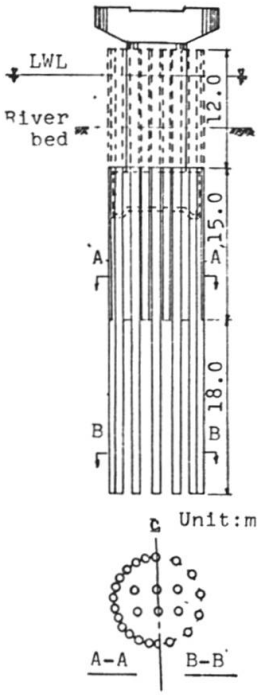

Fig. 2 Foundation of pipe-pile-wall (example 2)

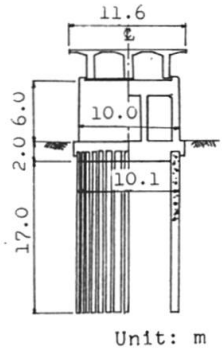

Fig. 1 Foundation of pipe-pile-wall (example 1)

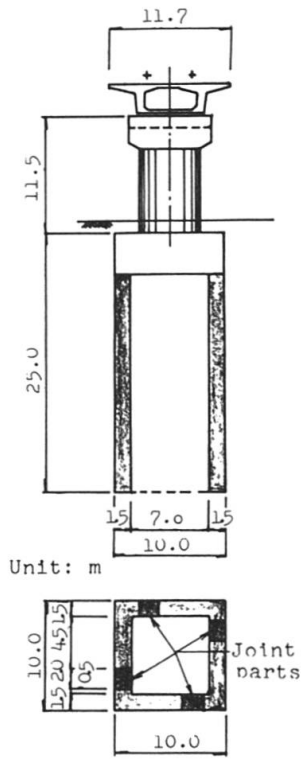

Fig. 3 Foundation of closed wall

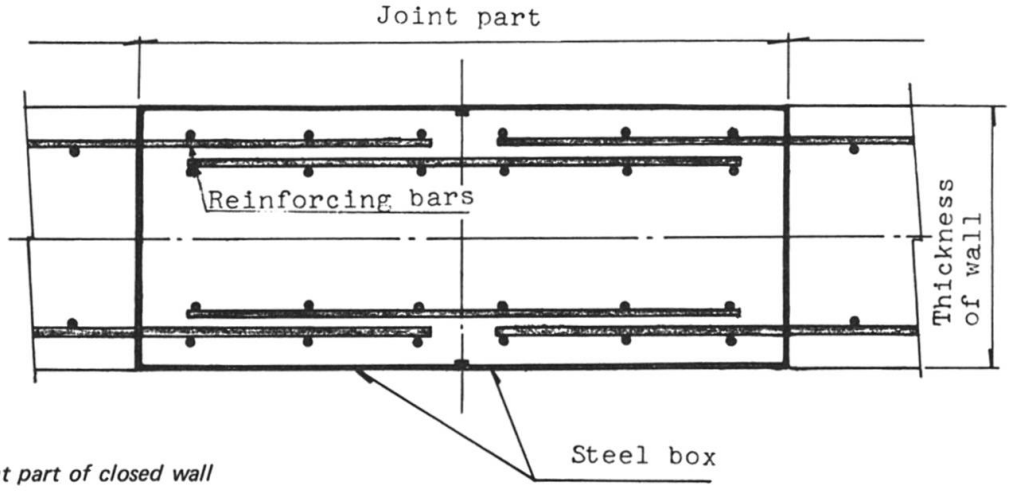

Fig. 4 Joint part of closed wall