Design and Construction of Permanent Diaphragm Wall Based on Functional Requirement

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***Abstract*- For my project, the design of Diaphragm wall is based on the soil mechanics and the reinforcement concrete structure to design. Diaphragm wall is a reinforced concrete wall constructed in the ground using under slurry techniques and it is an interest method used to prevent the collapse of excavated surface with slurry that is proportional to the amount of excavated soil. In this project report, I will define what the diaphragm wall is and what the application of diaphragm wall is. Moreover, I will describe the advantages and disadvantages of diaphragm wall. I also will discuss how to design a diaphragm wall used by the Rankine's theory and a simply RC design into my project report and indicate the construction procedure of diaphragm wall.**

***Index terms*- Erection, stability, general requirements, load bearing capacity**

I.INTRODUCTION

Diaphragm walls are used as retaining structures in excavation of soil. Diaphragm walls can be used for underground structures, such as infrastructural foundation. Alternative methods for retaining structures are steel sheet piles and secant piles. During installation the sheet piles are driven down with force, which processes high noise and vibrations. Secant piles are concrete piles cast underground. They are flexible and often without effective reinforcement. Diaphragm walls are considered stiff and watertight structures that can extend great distances both horizontally and vertically. The construction of the walls minimizes noise and vibration compared to construction of sheet pile walls. There are two main type of constructing diaphragm walls. The different lies in their usage as temporary or permanent structures. Temporary diaphragm walls are used only as retaining walls during construction of other permanent structures. The permanent diaphragm wall on the other hand serve both as a retaining wall and as a part of a permanent load bearing structure. Temporary diaphragm walls often require more space on the construction site than the permanent ones. This is because the final structure needs to be built on the inside of the temporary walls, usually few meter from the walls on each sides. It can therefore be more advantages to combine the retaining wall and the final structure with a permanent diaphragm wall, especially in urban areas.

II. CONSTRUCTION PROCDURE

The procedure of constructing diaphragm walls starts with the excavation of a trench, which will act as a form. Supporting fluid is providing in to the trench during excavation to ensure stability of the trench. After the excavation a reinforcement cage is lifted in and concrete is cast from bottom up as an underwater casting. This type of structure is widely used around the world both for temporary and permanent structures. There is a growing experience of constructing diaphragm walls in Surat. The experience is still scarce and somewhat limited to one project like the most recent project includes a permanent diaphragm walls in residential building project. The project used diaphragm walls in foundations, Heritage Construction

When constructing a diaphragm wall the technique used is called the slurry trench technique. The technique mainly consists of:

1. Excavation of trench
2. Supporting fluid provided for stability
3. Reinforcement cage lifted in
4. Concrete cast from bottom up

First a guiding wall is constructed to establish the outline of the diaphragm wall is refereed to as guide wall. The guide walls lie parallel to the trench and provide guidance for the excavating equipment. These walls can be made out of precast units or cast in situ and the guide walls also prevent collapse of the trench close to surface.

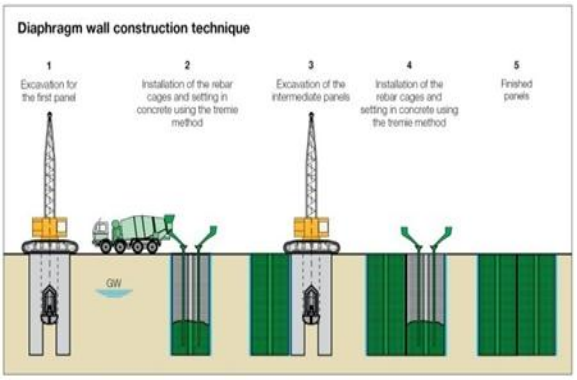

Fig 2.2 Erection sequence of diaphragm wall from Webster

Then the excavation of the trench starts. Special equipment is used, which can vary both in size and type. The type of equipment used is determined from the conditions and characteristics of the soil. The surrounding soil is used as form and therefore the size of the equipment decides the thickness of the wall. For example different equipment is needed when excavating through soils with a lot of boulders.

During excavation the trench is kept full of a supporting fluid and more fluid is added continuously as the trench gets deeper. The fluid condition has to be monitored to ensure that the characteristics are within specified limits. The role of the supporting fluid is to establish stability of the trench. As the surrounding soil varies the mixture of the supporting fluid has to be mixed accordingly. The supporting fluid should also form a layer on each side of the trench to prevent leakage of water from the surrounding soil and vice versa. The supporting fluid is usually a bentonite suspension, a polymer solution or hardening slurry.

III.GENERAL REQUIREMENT

1. Load Bearing Capacity

Load bearing capacity is a necessary for every man made structure. Load bearing capacity can be defined as the ability of structures and structural systems to safely resist loads. The design should take into account the different environmental conditions during the life cycle of structure. Load bearing capacity is a fundamental requirement that can be found in codes.

2. Serviceability

All aspect of serviceability of a structure should be fulfilled. Even though the load bearing capacity is ensured, the structure has to remain fit for required service function. A verification of serviceability should be established early in projects. Serviceability is a fundamental requirement that can be found in codes, laws and regulations around the world and is covered in basis for structural design.

3. Durability

In order for a structure to be durable it should not lose its load bearing capacity and serviceability during its lifetime. In order to achieve durability, effects of the degradation mechanism must be under control and there for service life design is needed. Structures should therefore be designed and executed for resistance to environmental actions. These requirements can be related to quality control during execution and verification of design. Durability is a fundamental requirement that can be found in codes, laws and regulation around the world and is covered in structural design.

4. Sustainability

Urbanization where individual are moving from rural to urban area, is an ever growing trend in the world we live in. The majority of the worlds populations lives in cities today. The growing cities require large amount of energy for construction, operation, maintenance and decommission of buildings and infrastructure. Sustainable construction can be said to aim at minimizing the environmental impacts, securing economic stability and overall quality during the whole life cycle of the building.

5. Buildability

Buildability governs the ease of construction and is highly related to the project cost. Buildability is of importance for the client builder aspect. As the tern indicates the process is measured on how efficient a building can be constructed. Even so it includes not only that process but also the planning and design of the construction

IV.DIMENSION ANALYISS

Thickness of Diaphragm Wall	600--1500
Proportion	M-25 (1:1:2)
Still Requirement Per Square Foot	4.5 kg
Cement Requirement per Square foot.	12.36kg
Sand Requirement per Square Foot	12.36kg
Aggregate Requirement per Square Foot	24.72kg
Size of the Main Steel (Vertical Bar)	16mm
Size of the Distribution Steel (Horizontal)	12mm
Size of Stirrup	5mm
Depth of Diaphragm Wall	10m

V. LIMITATION

It can be hard to establish the right set of requirements to cover all aspects of the desired performance of the structure. It can take several attempts and number of iterations and when it is finalized, it is a possibility that it only suits one type of structures. This causes further development to be more expensive and time consuming than if it was more open.

It is a possibility that only larger contractors are able to participate in functional based bidding, since large amount of work has to put in the process of developing this type of work ethics.

From the present study it was clear that it is next to impossible to categories important factors without a proper structure and description for different levels of requirements Otherwise they become hard to fulfill and miss the attention needed to secure the required performance of the structure

VI .CONCLUSION

Diaphragm walls have been accepted as permanent structures. Part of this research was this thesis work. In this study the desired performance of permanent diaphragm walls was identified and they were expressed in the form of functional requirements. The conclusion of this work includes.

- For the designed performance to be represented in the best way a complete structure of requirements needs to be established beforehand.
- The structure of requirements has to be established in levels from wide requirements to specific detailed ones.
- Verifying methods are needed to show that the desired performance is fulfilled.
- The representation of different levels of requirements is proposed as:
  - General requirements: Overall performance of the structure.
  - Functional requirements: Detailed performance of the structure.
  - Functional criteria: Specific performance of the structure that is verifiable.

- Proposal of requirements at different levels:
  - General requirements were proposed, which should be applicable to various types of structure.
  - Functional requirements were identified under each general requirement. The functional requirements should be applicable various types of structures.

Functional criteria were identified under each functional requirement. The functional criteria were identified specifically for diaphragm walls

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