A REVIEW PAPER ON EVALUATE DESIGN PARAMETER OF DIAPHRAGM WALL FOR COHESION AND COHESIONLESS SOIL

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Abstract -*Diaphragm walls are constructed in reinforced cement concrete to achieve the required structural strength, but they may also be designed as the unreinforced plastic cut-off. The construction of the walls optimizes noise and vibration compared to the execution of sheet pile walls. D-walls are generally 20m to 50m deep, but they can be extended to considerably more depth. There are two types of diaphragm walls. Temporary and permanent D- walls based on their usage. Typical wall thickness ranges between 600 mm to1100mm. The wall is constructed panel by panel for full length and depth. Panel width varies from 2500mm to about 6000mm.*

***Key Words*: DIAPHRAGM WALL, ANCHOR LENGTH, DEEP EXCAVATION, ANCHOR DIAMETER, SOIL CONDITION**

1. INTRODUCTION

Diaphragm walls are constructed in reinforced cement concrete to achieve the required structural strength, but they can also be designed as unreinforced plastic cut-off walls. These are waterproof structures it can be expanded to great length and height. The construction of the D-walls reduces noise and vibration compared to the construction of sheet pile walls. D-walls are typically 20m to 50m in-depth, but they can be extended to a considerably greater depth. There are two types of D-walls. Temporary and permanent diaphragm walls based on their functions. Temporary diaphragm walls are used only as retaining structures during the construction of other permanent diaphragm wall structures. The permanent diaphragm retaining walls on the other side serves both as a retaining structural wall and as a part of a permanent load-bearing structure. Temporary diaphragm walls generally require more area on the construction site than the permanent wall does. This is because the final structure needs to be constructed on the inner part of the temporary walls, usually few meters from the walls on all sides. So, the combination of retaining structural wall structure and the final structural wall with permanent diaphragm walls become more efficient in urban regions.

D-wall provides structural support and waterproofness. These reinforced concrete D-walls are also called Slurry trench retaining walls. This is because the excavation trench is made by filling and keeping the wall cavity full with the bentonite-water mixture to protect against the collapse of the vertical excavated surface area. These are also used as a permanent basement soil retaining wall. Typical wall thickness ranges between 600 mm to 1100mm. The wall is constructed panel by panel in full-designed depth. Panel width ranges from 2500mm to about 6000m. The structural stability is provided through an embedment of the retaining wall on the ground working as a pure cantilever structure and eventually a system of post-tensioning anchors, so the wall is subject to shear forces and bending moments. It is generally a reinforced concrete wall that can be used to transfer horizontal loads like earthquake loads, hydrostatic pressure, earth pressure.

1.1 OBJECTIVE OF STUDY

The main objectives of undertaking the present study are as follows:

- To evaluate design parameters for the Diaphragm wall which are not mentioned in IS code 9556:1980 and IS code 14344:1996.
- Prepare design charts for a various variable like,
  - Thickness and reinforcement of diaphragm wall based on height and soil condition.
  - Anchor length, angle, and diameter.

2. Literature Review

[1] James, A., & Kurian, B. (2020). Design Specifications for Diaphragm Wall: State of the Art. Indian Geotechnical Journal, 50(5), 838–847.

In this research, different structural design standards are evaluated for their application-specific for D-walls. The codal provison for the analysis and design of D-walls include IS 456, AS 4678, EN 1997-1, BS 8004, Canadian foundation engineering manual, IS 9556, EN 1992-1-1, CSA A23.3, BS 8002, ACI 318, BS 8110, BS EN 1538.

Since both structural and geotechnical design criteria are needed to be considered, complexity arises regarding the application of load and safety factors. The foundation and structural codes of each combination and safety factors for horizontal pressure, dead loads, and live loads. It is preferable to accommodate a unique design provision to standardize the design and detailing of reinforced cement concrete D-wall.

[2] Mini, M.., Kurian, D. B., & James, A. (2008). A Theoretical Study on the Analysis of Diaphragm Wall. International Research Journal of Engineering and Technology, 9001(May), 4089.

D-walls are generally constructed in Reinforced cement concrete to provide the required structural capacity. Generally, wall thickness ranges between 600mm to 1100mm. Panel width ranges from 2500mm to 6000mm. Diaphragm walls are mainly differentiated into three subcategories-strutted diaphragm wall, cantilever diaphragm walls, anchored diaphragm wall.

Earth pressure and water pressure have a major role in diaphragm wall design. From the study of Indian codal provisions, there are some uncertainties in the analysis of the diaphragm wall. Diaphragm wall has a greater effect on the adjacent property. There is a certain amount of settlement when the structure is exposed near the diaphragm wall.

[3] Yajnheswaran, Ranjan, H. S., & Rao, S. (2015). Analysis of the Effect of Anchor Rod on the Behavior of Diaphragm Wall Using Plaxis 3d. Aquatic Procedia, 4(Icwrcoe), 240–247.

Anchor rods are usually provided strength to structure and provide resist the horizontal loads and reduce the deflection. In this, paper the deep draft berth of the new Mangalore port provided with D-wall and anchor rods is analyzed using the finite element method in software PLAXIS 3D. The shear force, displacement, and bending moment are calculated for D-wall for the cases of with and while not an anchor. The comparison was done for depth v/s shear force, depth v/s deflection, and depth v/s bending moment of the D- wall.

The percentage reduction within the displacement of the D-wall due to the effect of anchor rod at 2500 mm is 93.56%, shear force is 18.53% and bending moment is 63.06%. The displacement of the D-wall is often to reduce an excellent extent by providing an anchor rod. The provision of an anchor rod at the precise location can increase the steadiness of the berthing structure

[4] Helidon Kokona, & Enkeleda Kokona. (2016). Design Concept for an Anchored Diaphragm Wall in the Central Part of Budva, Montenegro. Journal of Civil Engineering and Architecture, 10(7), 806–814.

The idea of an anchored D-wall system is to create an internally stable mass of soil that may resist external failure modes at an explicit level of safety. The structure is meant to be used within the construction of 3 basement levels of a residential building. The anchored D-wall can comprise non-gravity cantilevered D-walls with 3 levels of ground anchors.

D-walls with anchors will stand up to lateral pressures without a great increase in wall cross-sectional size. It additionally protection of the excavation base from groundwater table, uplift forces, and bottom swelling of soil. Anchored continuous D-walls offer less noise and vibration levels, that create construction appropriate in the town area.

[5] A.K. Choudhary1, J.N. Jha2, and K. S. G. (2010). Copyright ASCE 2010 GeoShanghai 2010 International Conference GEOTECHNICAL SPECIAL PUBLICATION NO. 205 Copyright ASCE 2010 GeoShanghai 2010 International Conference. ASCE, (204), 34–41.

Shanghai tower includes a cylinder-shaped D-wall with a larger outer diameter of 123.4m, 1200mm thickness, and 50m tall, and excavation depth is 31.1m. The cylinder-shaped D-wall, by absolutely utilizing the result of high compressive strength of the concrete and cylindrical result, by transferring the horizontal load from underground soil and water are going to be transferred into horizontal centripetal forces. Therefore, no horizontal supporting strut is required to be put in throughout the excavation.

Application of larger diameter cylindrical-shaped D-wall without lateral supporting strut isn't solely to attain economy however additional viable and safe in construction. Analysis of the super-columns was based on the inertia calculated from the composite section of steel and reinforced cement concrete. Certain reduction on soil pressure to the cylindrical D-wall may also be achieved due to the arched result of the wall, additionally, an explicit reduction in embedment length of D-wall are often reached, because the stability of soil is improved due to the cylindrical area effect of the D-wall.

3. CONCLUSION

From the above research paper, it's clear that diaphragm wall design needs elaborate clarification and simplification on design parameters and design procedure.

Detail clarification can be evaluated for diaphragm wall thickness, diaphragm wall reinforcement, anchor free length, anchor bond length, anchor diameter, anchor inclination, etc.

REFERENCES

[1] Yajnheswaran, Ranjan, H. S., & Rao, S. (2015). Analysis of the Effect of Anchor Rod on the Behavior of Diaphragm Wall Using Plaxis 3d. Aquatic Procedia, 4(Icwrcoe), 240–247.

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