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Study of the Secant Pile Wall technique, its application and Substantial Construction by utilizing the Non-Biodegradable Waste as partial replacement of ingredients of Concrete.

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Abstract: *This paper presents design and construction of Secant Pile wall. Secant pile wall are embedded retaining wall structure utilized to allow deep excavation in water charged ground conditions and soft sub strata. The walls are constructed by installing piles in predetermined sequence. Soft piles are installed first followed by hard piles which overlap, cutting into the two soft piles on either side. This design is also suitable for retaining fine sands and very soft wet ground and may also be used as cut off wall.Keeping in view to the substantial development, an idea of utilizing the non-biodegradable waste in the concrete is also included here. There are many non-biodegradable wastes; this paper presents studies on possible reuse of ceramic waste and glass as the partial replacement in ingredients of concrete. These waste materials are taken in different percentage and replaced based on the refereed papers. Property of concrete containing respective waste material is studied.*

I. Introduction

India, a country having a wide diversity within, is emerging itself as one of the fastest developing country in the world. With the demand and pace of development in India, infrastructural development can be considered as the backbone of it. Our country have many major cities viz Mumbai, Delhi, Chennai, Kolkata, etc. where there is a demand of high rise infrastructure may fall in some challenging situation. There can be the problems orienting to the challenging condition such as soft soil of low bearing capacity, high water table level, congestion of space for construction, threat to adjacent structure. All this problems can be overcome by constructing secant wall. Secant pile is type of retaining wall which is used for deep excavation in soft soil and water charged area. The purpose of secant wall is to ensure that the ground or composition behind the wall is securely and safely held in place despite its lateral and downward pressure against the retaining structure.

Secant Pile wall

Secant pile walls are formed by constructing intersecting reinforced concrete piles & thus forming a wall like barrier to adjacent media. The secant piles are reinforced with either steel rebar or with steel beams and are constructed by either drilling under mud or auguring. The secant pile wall method provides a cost effective solution for the construction of deep excavations to form basements, cut and cover tunnels, tanks, etc. in urban environment.

II. Methodology

1. **Construction of guide wall:** A guide wall is constructed to set out the position of secant pile wall.
2. **Installation of casing:** The vibro-hammer drives a casing into the ground leaving about 1 meter length of the casing protruding from the ground.
3. **Auguring of primary borehole:** The auger, a drilling tool, cuts and removes the soil within the casing to form a primary borehole. The soil surrounding the borehole is supported by the casing. If the casing is not long enough to reach the required depth in the ground, bentonite slurry is used to support the soil below**.**
4. **Concentering of primary borehole:** concrete is poured into the borehole to form the primary bored pile.
5. **Augering of secondary bore hole: After** the casing of the two primary bored piles are extracted by the vibro-hammer, the auger cuts and removes the soil in between the two primary bored piles to form a secondary borehole. The secondary borehole intersects with the adjacent primary bored piles.
6. **Installation of steel casing:** The crane lifts up the steel cage and places it within the secondary borehole.
7. **Concreting of secondary borehole:** Concrete is poured into the borehole to form the secondary bored pile.
8. **Repetition of process:** Steps 2 -7 are repeated till entire length of the secant pile wall construction is completed.

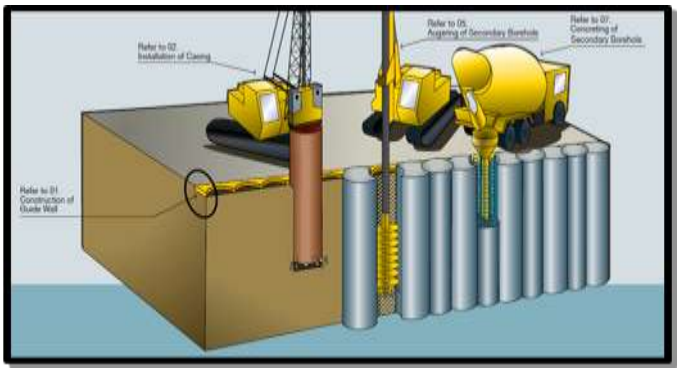

Figure 1: Procedure of Installation

III. Experimental program

There are various non-biodegradable wastes of which the decomposition and disposal is not an economical as well as environmental friendly task, and therefore it should be utilized effectively wherever possible. Based on the referred papers two non-biodegradable waste were selected. First was the ceramic waste which was partially replaced by the 10% of coarse aggregate of size between 10mm to 4.75mm and secondly 10% of uniformly distributed glass wastes of size varying from 4.75mm to 150 micron size as the partial replacement of fine aggregate of concrete.

- **Materials**

1. Cement: The cement used in this study was 43 grade PortlandPozzolana Cement (OPC) confirming to IS 8112-
1989.
2. Fine aggregate: Locally available sand confirming to zone II with specific gravity 2.62 was used. The testing of sand was done as per Indian Standard Specification IS: 383-1970.
3. Coarse aggregate: Coarse aggregate used was 20mm and down size and specific gravity 2.93. Testing was doneas per Indian Standard Specification IS: 383-1970.
4. Ceramic waste: Waste ceramic waste available locally is brought into desired size by crusher between 10mm to 4.75mm for replacement ofCoarse aggregate.
4. Glass: Waste glass available locally was collected. Glass waste is very hard material.
Before adding glass in the concrete it has to be powdered to desired size i.e. to desired size i.e. between 4.75mm to 150 micron for replacement of Fine aggregate.

- **Mix Design**

The concrete mix without glass powder was proportioned as per Indian Standard Specifications IS: 10262-1982. Mix design was done for M30grade of concrete. The mixture was prepared with water to cement ratio of 0.55. The mix proportion of materials is 1:2.05:3.22 as per IS 10262-2009. Then natural fine aggregate was used.
The waste materials are taken in different percentage and replaced based on the refereed papers. The ceramic waste which was partially replaced by the 10% (by weight) of coarse aggregate of size between 10mm to 4.75mm in first batch. Andin second batch 10% (by weight) of uniformly distributed glass wastes of size varying from 4.75mm to 150 micron size as the partial replacement of fine aggregate of concrete.

IV. Analysis and Result

Property of concrete containing respective material and results obtainedare shown in the below.

Table 1: Mix Design (Control Mix)

Material	Partially Replaced material	Replacement percentage	Quantity (kg/m3)
Ceramic Waste	Coarse Agg.	10%	115.327
Glass Waste	Fine Agg.	10%	73.733

Water (liters)	Cement	Fine aggregate	Coarse aggregate
197	358.18 kg/m3	737.33 kg/m3	1153.27 kg/m3
0.55	1	2.05	3.22

Table 2: Partial Replacement Details

S.R	Property	Standard (mm)	Ceramic waste (mm)	Glass (mm)
1	Slump value	150	140	155
2	Flow value	43	45	45

Table 3: Properties of fresh concrete

No. of days	Standard (Mpa)	Ceramic waste (Mpa)	Glass (Mpa)
7^{th}	16.44	13.33	21.66
14^{th}	26	21.24	24.54
28^{th}	29.89	29.56	31.33

Table 4: Compressive strength test

V. Conclusion

Study has proven that appropriate drilling equipment and methods can achieve installation tolerances that allow secant pile wall to be used in geotechnical critical condition and for excavation of depths previously considered to be infeasible. It also increases construction alignment flexibility.

The studies and experimentation on the replacement of fine aggregate by non-biodegradable waste i.e. glass and ceramic waste shown that the strength values were not largely disturbed by the replacements made in the design. Hence it will be economical and environmental friendly to use such replacements in material for the construction of secant pile wall.

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