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Study of Partial Repalcement of Cement by Fly Ash in a Ferro Cement Water Tanks

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Abstract:- The current study shows the results of testing level cement planks that have been strengthened with varied numbers of wiring works layers. The earliest type of reinforced concrete is ferrocement, which dates back 200 years. It is made of wire mesh made of galvanised steel and mortar. It has a wide range of uses, including the building of boats, water tanks, slabs, and tunnel lining. In this study, fly ash, a waste product, is also used to partially replace cement. RCC water tanks are employed globally. RCC water tanks may be replaced with ferro cement water tanks as a more contemporary alternative. As for the price of RCC water tanks have a high economic cost, but Ferro cement, It may be used in their place and is very available and reasonably priced. It can be suggested that the ferrocement water storage building be used given the cost and building technique in comparison to certain other conventional water storage structures of same capacity. Simple methods may be used to create a water tank for a lower cost.

Keywords:- *Ferrocement , wire mesh , fly ash, fine aggregate etc.*

I. INTRODUCTION

Ferro cement may be produced to serve this role and persist for many years, but this depends on a variety of elements, including the composition of the mortar, the corrosion of the reinforcement, the permeability, the methods used during construction, and the environment. A mortar-embedded wire mesh reinforcement is known as ferrocement. This substance is strong and effective. "Ferrocement is a form of thin wall reinforced concrete that is typically made of hydraulic cement mortar reinforced with layers of continuous, relatively small-diameter wire mesh placed closely together." In the Ferro cement water tanks, the rich mortar constructed of Portland cement—without the coarse aggregates—is employed. The need for formwork with Ferro cement is disregarded because the material may be shaped into a variety of shapes.

"Ferrocement is a form of thin-walled reinforced concrete that is typically built of hydraulic cement mortar reinforced with layers of continuous wire mesh that are relatively tiny in size and spaced closely apart. The mesh may be made of metallic or other appropriate materials" .Ferrocement tanks can store water in sanitary conditions at a lower cost and with greater durability..

Ferrocement uses so little cement because it is so thin, and it prevents breaking very well. The tank is cured for 28 days. The projected result is that RCC tanks with high strength and endurance will be 10% to 25% more expensive than those made of ferrocement. Considering their duty to store water without any losses, water tanks are thought of as highly vital structures. There are several configurations for these structures. They tanks that are raised, ground-supported, or underground. The vessel is made up of ground-supported tanks. The container is available in a range of geometric shapes, including rectangles, cylinder, hemispheres, cones, and combinations of any of these.

Ferrocement is a very adaptable type of reinforced concrete that is typically made of hydraulically cement mortar reinforced by woven, welded, expanded, and fiber- and metal-free wire meshes. Ferrocement construction requires the least amount of specialised labour and makes use of resources that are easily accessible. In several nations, it has a variety of applications.

Industries for it include aqueducts, boats, structures, and buses. retaining walls, food and water storing boxes, bridge decks, shelters, and irrigation systems sculptures, roofing, maintenance, and warning signs for traffic. From earlier research, it may be ferrocement has a significantly larger bonding area or specific surface than the smaller the conventional reinforcement and ferrocement beam, the better it is in controlling cracks. than reinforced concrete, crack width.

For such storage and collection of water for drinking, washing, animal usage, and irrigation, ferrocement tanks are widely utilised. Ferrocement tanks can be hand-built and range in size, form, and capacity. Due to the high manufacturing costs of the other materials, such as steel tanks or fibre reinforced plastic, they are often more affordable. Additionally, ferrocement tanks cost less to maintain than steel tanks and have higher corrosion resistance.

II. MATERIAL USED

- **Cement:** The mix contained regular Portland cement (43 Grade). According to IS: 269-1989, the physical characteristics of cement were evaluated in a lab setting. The cement has a fineness of 1.8%, a specific gravity of 3.12, a standard constancy of 36%, and an initial time for setting of 32%.

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Fig. 1: Cement

Table 1: Properties of cement

S.NO	PROPERTIES	VALUE OBTAINED
1.	Specific gravity	3.12
2.	Fineness modules	2.38

- **Fine aggregate:** For this experiment, locally accessible sand that adhered to the grading zone was employed. To get rid of all the stones, a 4.75 mm sieve is used to filter the sand. Sand and fine aggregate both have a specific gravity of 2.5 and 2.68, respectively.

Table 2: Properties of fine aggregate

S.NO.	PROPERTIES	VALUE OBTAINED
1.	Specific gravity	2.68
2.	Fineness modules	2.5

Fig. 2: Fine aggregate

- The National Thermal Power Corporation (NTPC) in Tanda, Uttar Pradesh, collected fly ash (Class F).

Table 3: Properties of fly ash

S.NO.	PROPERTIES	VALUE OBTAINED
1.	Specific gravity	2.3
2.	Colour	Light grey

Fig. 3: Fly ash

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- Steel mesh : Wire mesh reinforcing is generally employed as the main and distinctive reinforcing for industrial slabs of concrete . Additionally, it is assessed for structural reasons while reinforcing a water tank.

Used is welded wire mesh.

Table 4: Properties of wire mesh

S.NO	PROPERTIES	VALUE OBTAINED
1.	Mass density	8100 kg/m^3
2.	Poisson's ratio	0.23

Fig. 4: Wire mesh

A. FERRO CEMENT PARAMETERS

- Depth of cover: Depending on the size of the structure, the depth of the covering for water retention structures should be between 2 and 20 mm.
- Average spacing: The needed distance between two wire meshes is between 3 and 8 mm.
- Specific surface: In accordance with the IS, the surface area must be at least 0.09 mm-1 and double that if the structure is a water-retaining structure.
- Volume Fraction: It is typical to supply a volume fraction of at least 4.1 to 5.3%, or around 300 to 400 kg/m3.
- Reinforcement: The wire meshes offered should be of high quality, galvanised, and employ cement with a high composition.
- Meshes: The holes or openings in the wire mesh should be tiny yet large enough for the mortar to fill.

B. Terminology & Measurement Methods

- Aperture width: the distance, measured in the projected plane at the mid position, among two neighboring warp or weft wires.
- Warp: All wires running lengthwise of the cloth as woven.
- Weft: All wires running across the cloth as woven.
- Wire diameter: The width of the wires in the woven cloth. (The wire diameter may be altered slightly during the weaving process.)
- Pitch: The distance between the midpoints of two adjacent wires. Represents the sum of the aperture width (w) and wire diameter (d).

III. APPLICATION OF FERROCEMENT

- Liquid retaining structures: Septic tank, sludge-drying beds, and water tanks that are rectangular, round, tiny, and huge in size.
- Soil retaining structures : Soil retaining walls, counter fort wall etc.
- Building components: Pile, double walling for compound walls on expanding soils, and coulmns in case of ferrocement are some examples.
- Precast materials such as ferrocement are employed in all sorts of small units.
- Ferrocement has unique characteristics, such as railroad sleepers, an underground canal, and a trench lining.

IV. METHODOLOGY & TESTING

A. Volume calculation :

- Tank height = 0.8 m
- Tank diameter – Inner: 0.16m
  - Outer : 0.20 m
- Tank wall thickness : 0.2m
- Reinforcement bars : 6 mm
- Mesh used : Welded Square
- Mesh size 6*20*2
- Grade of cement : 43 Grade
- Grade of concrete : M20

B. Water capacity :

- Volume = $\pi r^2 h$
  = 3.14 x 0.08 x 0.08 x .8
  = 0.0160 m^3

So, the capacity of the tank = 0.016 m^3

Testing:

There are three popular units for measuring water pressure: bar, psi, and head (m).

1 bar is 10 metres of head at 100 psi.

The distance from the bottom of the water tank and the tap outlet is about one metre, or one bar (100).

Therefore, using this approach, 0.8 metres of water can withstand 80 psi of pressure.

V. CONCLUSION

It is extremely easier interms of construction since it does not The current study's objective is to examine if ferrocement water tanks may be used in the planning and building of constructions. When made of 6mm bars and densely knit, welded square mesh, tanks made of ferrocement are more stronger than when made of other materials. This is because the evenly distributed steel mesh makes the entire structural skeleton frame more durable than before.

This study has shown that using ferrocement to build water storage tanks is incredibly cost-effective while never sacrificing strength, durability, workability, or stiffness. Theoretically, a standard RRC tank may be 10% to 25% more inexpensive, and building work would require less labour than RRC works. Since there is absolutely no need for shuttering or formwork, it is much simpler to construct. The ferrocement water tank requires more steel and mortar than conventional RRC water tank, but the cost of using reinforcement is less, hence the cost of ferrocement is lower.

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