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COMPARATIVE STUDY OF FERRO CEMENT WATER TANK AND RCC WATER TANK

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Abstract: *Ferro cement can moreover be called as Ferro concrete. As RCC water tanks are used as worldwide Ferro cement water tanks can be the modernized technique to replace the RCC water tanks. As the cost of the RCC water tanks leads to very high in economic factor where as the Ferro cement can be used instead which is very cheap as well as easily available. In this research paper the objective is to compare the cost of the RCC water tank and Ferro cement water tank. As many components such as aggregate, formwork, equipments are required in very less number as compare to RCC which reduces the cost of the Ferro cement water tank*

Keywords: **Ferro cement, wire mesh, formwork, mortar mix, serviceability, durability**

1. INTRODUCTION

Ferro cement is a new material which was used first for rowing the boat in 19th centaury in France. Ferro cement water tanks are more prominently as similar to the that of the RCC water tanks but the difference between them are that the thickness of Ferro cement water tanks can be rarely more than 25 mm whereas the thickness of the RCC water tanks can lead up to more than 100 mm. the rich mortar made of Portland cement is used in the Ferro cement water tanks not including the coarse aggregates within it. The Ferro cement water tanks compared to the RCC water tanks covers more area as small diameter of the wire mesh and wires are covered along the whole surface. The Ferro cements tensile to weight strength is more as compared to that of the RCC water tank. As the Ferro cement can be molded into different shape the requirement of the formwork in Ferro cement is neglected.

Fig-1: Ferro cement water tank

2. REVIEW OF LITERATURE

Y.B.I. Shaheen and A.A. Elsayed resulted that Ferro cement is an upcoming construction material of the future. The interaction between ferrous (iron) mesh and cement (cement mortar) producing a new kind of material which is strong, versatile, durable and easy to maintain. Ferro cement is not used in all the structures but it can be used in some structures where it was recommended. The highest strength is observed on 15% replacement of cement content by silica fume. There is a need to encourage more use of Ferro cement as low cost construction material. Piyush Sharma has concluded us that this method is innovative and versatile and advanced technique. Ferro cement can be used in repairing as well as reshaping any structures any defective in RCC structural elements. Maintenance cost considering its unique structure is very less. It has a great potential that can be used in future for developing and developed countries. M.B.Verma concluded from the past reviewed the results were carried out for the analytical and experimental studies for the members of Ferro cement. The review brings out the importance of the Ferro cement as an advanced technology and by using proper reinforcement can be used in many different structures. This brings out that the availability and maintenance and the cost of the Ferro cement is less and can be used further it is found to

be the good material to repair the defective RCC structures. The reinforcement mesh which is to be used shows the performance of the Ferro cement structure. The optimum range property of mesh is not required to show. Randhir J. Phalke, Darshan G. GaidhankarUsing the steel fibers 0.5% of total volume and the aspect ratio of l/d=57 some panels were constructed and then tested in the UTM machine after 28 days and 7 days. The number of layer meshes used in the panel is the main objective of the flexural load at first crack and ultimate load. By increasing the numbers of meshes increases the ductility and its capability to absorb the energy. The flexural strength, ductility and reduction in central deflection tendency also increase by the presence of steel fibers.

3. FERRO CEMENT METHODS

Basically there are three types of methods in which the Ferro cement construction can be carried out:

1. Armature system
2. Closed mould system
3. Integrated mould system

Armature system: In this system the skeleton steel can be welded into any desired shape surrounded with the numbers of wire mesh and then the mortar is pushed through these meshes towards inside and supporting temporarily from other side. As the skeletal steel is inside they add the dead weight without proving any strength.

Closed mould system: numbers of wire meshes are tied towards the mould and then the mortar is filled inside the mould. After the work is done the mould can be removed and can be reused afterwards.

Integrated mould system: I this method the numbers of wire meshes are placed inside the mold and filled with mortar and then the plastering is done on the mould. In this method the mould becomes the permanent structure

4. FERRO CEMENT PARAMETERS

- **Volume Fraction:** At least 5.1 - 6.3% value is given typically for volume fraction which is almost 400 -500 kg/m3.

- **Average spacing:** 5-10 mm of the spacing between two wire mesh is required.

- **Specific surface:** The surface area according to the IS should be minimum 0.08 mm-1, and twice if the structure is water retaining structures.

- **Depth of cover:** The depth of the cover for water retaining structures should be a about 2mm to 20 mm which depends upon the size of the structure.

- **Reinforcement:** the wire meshes used should be of good quality and should be galvanized and the mortar mix used should of rich content.

- **Meshes:** the wire meshes used should be thin and fine and the holes or apertures should be small but allow the mortar to fill.

5. DESIGN ANALYSIS AND ASSUMPTIONS

RCC was designed by the Ferro cement. Ferro cement is using as a layers in RCC and all the designs are made as RCC in all over the world. The analysis of Ferro cement structure subjected to direct compression, tension, bending and combinations of this, can be done as if it is a reinforced concrete member with layered reinforcement.

1. Working state method
2. Limit state method
3. Serviceability conditions
4. Experimental conditions

Working state method: All the structures using Ferro cement may be analyzed by the linear classical theory of flexure to calculate internal actions produced by the design loads. Classical theory of bending assumes that the composite is homogeneous; bond between steel and concrete is perfect up to failure. Straight line theory of strain distribution on section in flexure can be used for investigations of structure by working state method.

Assumptions of working state method

- Strains in cement mortar And reinforcement are directly proportional to their natural axis distance.
- The stress in wire mesh reinforcement up to its yield strength are proportional to their distance from natural axis
- In calculation of flexural strength of cracked beam, the tensile strength of concrete is neglected in RCC.
- Maximum compressive fiber strain is 0.003

Limit state method: Members should be propositioned for adequate strength in accordance with provisions specified in IS 456-1978, for partial factors for materials strengths and loads in design of
Ferro cement structures. When selection of characteristics strength of mortar on Ferro cement, it should be noted that rich cement mortar will have very higher strengths up to 60 MPa.

Assumptions of limit state method

- The probability of getting the designed strength consistently is much increased. It may be possible to reduce the partial safety factors for the mortar used.
- Global efficiency factors and orientation of mesh will have to be taken in account while calculating the characteristics strengths of mesh reinforcement.
- Due to use of Ferro cement members the reduction in dead loads is noted while calculating the characteristics.
- In Ferro cement when such a data is not available for cement mortar, treating mortar as micro concrete, characteristic value of the same grade can be safely used.

6. APPLICATION OF FERROCEMENT

1. **Liquid retaining structures:** Water tanks: rectangular, circular, spherical, small and large size, open, covered, loft tanks, ground service reservoirs, underground and elevated, hopper and shell bottom. Effluent treatment plants: septic tanks, clarifiers, settling tank, digesters, humus tanks, sludge-drying beds.

2. **Soil retaining structures:** Soil retaining walls, counter fort walls, grain silos, face wall panels and anchor plates for reinforced earth techniques.

3. **Building components:** Foundations-parabolic shaped, multi-build under-reamed piles, RCC columns encased in Ferro concrete, double walling for compound walls on expansive soils.

4. **Large size space structures:** Large size conduits for stream diversion and egg-shaped storm water drains, outfall sewers, precast canal sections in parabolic shapes.
5. **Precast Ferro concrete products:** All types of small size units, in water retaining structures, building components and soil retaining structures**.**

6. **Special Application:** Foldable Ferro concrete elements, lining to tunnels, tanks, basements, canals, Earthquake resisting structures, Precast pre-stressed girders of T, I, U sections, Polymerized ferroconcrete railway sleepers etc.

7. QUANTITY CALCULATION

The quantities of the important materials required for construction of water tank are:

MATERIALS	RCC QUANTITY	UNIT
Concrete	21.04	M^3
Middle & bottom 10 Ø 100 mm c/c	466.66	Kg
Top 10 Ø100 mm c/c	190	Kg
Vertical reinforcement 10 Ø164 mm c/c	2081.2	Kg
Base slab 8 Ø 280 mm c/c	142	kg
Top slab 10 Ø273 mm c/c	215	Kg

Table-1: RCC quantity

MATERIALS	FERRO CEMENT QUANTITY	UNIT
Mortar	24.65	M^3
Middle & bottom1.25 Ø 2 mm c/c	80.34	Kg
Top 1.25Ø 4 mm c/c	70.57	Kg
Vertical reinforcement1.25Ø 2 mm c/c	82.34	Kg
Vertical reinforcemen1.25 Ø 4 mm c/c	70.57	Kg
Base slab1.25 Ø 7 mm c/c	49.58	Kg
Top slab 2 Ø11 mm c/c	41.07	Kg
Horizontal reinforcement 8 Ø 67 mm c/c	3163.97	Kg

Table-2: Ferro cement quantity

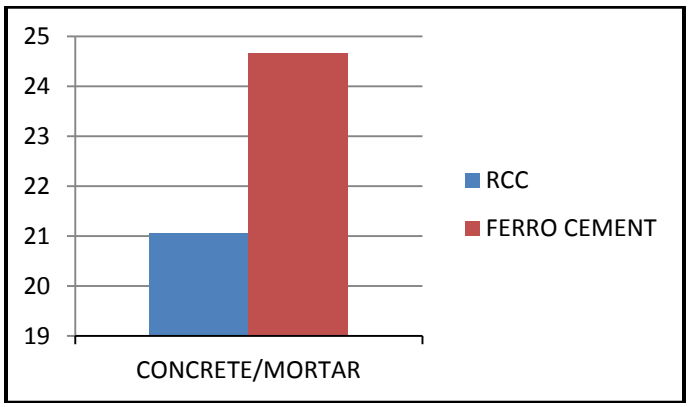

Chart-1: concrete/mortar quantity

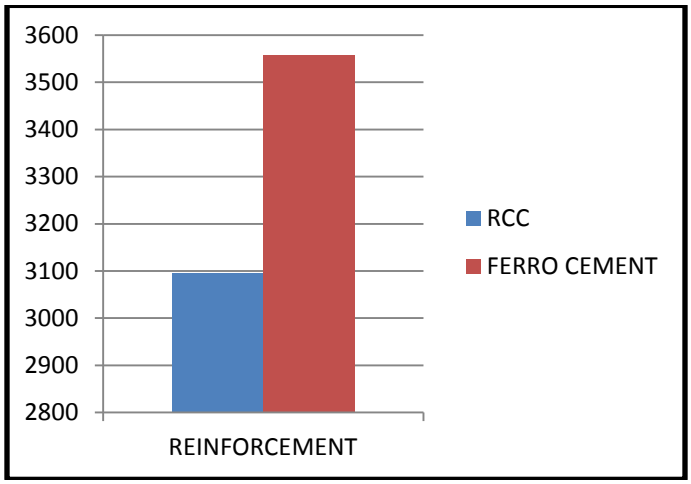

Chart-2: Reinforcement quantity

From chart-1 and chart-2 we can say that the quantity of the materials such as mortar, reinforcement, etc require for the construction of water tank are more in Ferro cement is more than RCC. Chart-2 shows that the amount of reinforcement required is more due to which the reinforcement covering the surface area would be more.

8. ESTIMATE

The estimate of RCC water tank and Ferro cement water tank are carried out

Table-3: RCC estimate

MATERIALS	QUANTITY	RATE	PER	AMOUNT (RS)
Concrete	21.04	5400	Bag	113618.76
10 mm Ø 100 mm c/c	466.66	45	Kg	21000
10 mm Ø 100 mm c/c	190208 1.60	45	Kg	8550
10 mm Ø 164 mm c/c	2081.60	45	Kg	92672.2
8 mm Ø 280 mm c/c	142.35	45	Kg	6406.17
10 mm Ø 273 mm c/c	215.62	45	Kg	9703.36
Total				252950.49
Add 5% contingencies				12647.5
Grand total				265600

MATERIALS	QUANTITY	RATE	PER	AMOUNT (RS)
Mortar	24,65	3200	M^3	78880.2
1.25mm Ø 2 mm c/c	82.34	55	M^2	4529.11
1.25 mm Ø 4 mm c/c	70.56	55	M^2	3881.48
1.25 mm Ø 2 mm c/c	82.34	55	M^2	4529.11
1.25 mm Ø & 4 mm c/c	70.57	55	M^2	3881.48
1.27 mm Ø @ 7 mm c/c	49.58	55	M^2	2727.41
2 mm Ø @ 11 mm c/c	41.07	55	M^2	2258.85
8 mm Ø @ 67 mm c/c	3163.97	45	Kg	142378.66
Total				243066.42
Add 5% contingencies				12153.32
Grand total				255219.7

Table-4: Ferro cement estimate

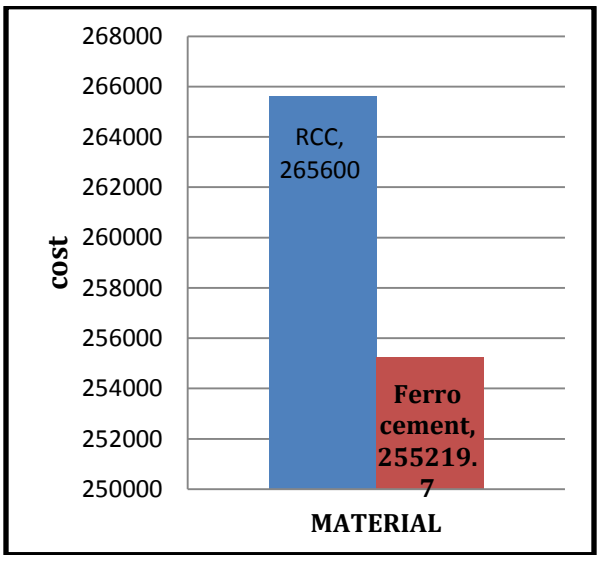

Chart-3: Cost comparison (Material vs. Cost)

9. CONCLUSIONS

By studying our topic "Comparative Study between Ferro Cement and RCC water tank" we concluded that cost of RCC water tank is 265600 RS. and the cost of Ferro cement water tank is 255300 RS. Therefore we can say that the cost of RCC water tank is more than the cost of the Ferro cement water tank. The cost of Ferro cement water tank is less by the 10,300 RS.

Therefore we can say that the Ferro cement tank is economical than the RCC water tank. Also, the amount of steel and mortar required for the Ferro cement water tank is more than the RCC water tank but the cost of the reinforcement used is less due to which the cost of Ferro cement is less.

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