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Applying Ferrocement Concept for Non- Gravity Weir Construction in Rural Area.

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Abstract – *Now days, rural region of India is facing the problem of drought as a reason of not storing rain water and lack of ground water. Weir can overcome this problem but weirs in RCC are not economical. Moreover due to lack of financial funds, it is not easily possible to construct weir in RCC. As a result, weir in ferrocement can be solution to overcome this problem, as it has capability to prevail over this cost barrier. The foremost goal of this study is to examine the parameters of non-gravity weir in ferrocement in terms of suitability, economic approach and construction period. The current work is the study of construction of non-gravity weir in ferrocement and study says that ferrocement can be good substitute to RCC in non-gravity weir construction as it will take less time and less cost to construct as compared with RCC.*

Key Words: **Ferrocement, non-gravity weir, cost effective, time effective, RCC.**

1. INTRODUCTION

Ferrocement technology was invented by Joseph Louis who constructed a boat with the system in 1848. Ferrocement is the composite of iron (ferrous) and cement. It combines the properties of thin sections and high strength of steel. In construction of ferrocement structure wire meshes are filled in with cement mortar. It is a composite which is formed with closely knit wire mesh, tightly wound round skeletal steel and impregnated with rich cement mortar. As encasing material, ferrocement is resistant to take tension and flexure. It also takes over the properties like durability and imperviousness. Ferrocement structure are usually constructed with less thickness ultimately reduces the required cement mortar which eventually minimize the construction cost.

In rural region in India where there is lack of financial funds ferrocement can be an effective and low-cost alternative construction material. The prominent goal of this research is to propose a non-gravity weir using ferrocement technology which will reduce cost and time of weir projects.

2. RESEARCH METHODOLOGY

Suitability of ferrocement for water retaining structure has analyzed. Along with comparison of cost estimation for proposed ferrocement weir and RCC weir has done. Additionally comparative study is also given showing property comparison of ferrocement and RCC.

2.1 Suitability of Ferrocement for Weir Structure

Initially ferrocement was used in the construction of boats as it is highly impermeable and light weight. A typical use of ferrocement comprises water tanks, silos, boats and roofing [5]. Ferrocement structures have upper hand over the typical materials like RCC and wood as these are strong, durable and waterproof [4]. Study says ferrocement has excellent tensile and flexural behavior also it is an optimum low-cost material for low-rise, earthquake resistant structures [3]. Ferro-cement has considerable strength and it can maintain functional water-tightness. Plain concrete has little resistance to impact (impulsive loads). The addition of finely dispersed steel increases the impact strength significantly. Although the mortar in tension cracks readily, the steel wires allow for a significant absorption of energy and act as crack arrestors [9].

By studying the properties of ferrocement, we concluded that ferrocement can be a good substitute to the RCC in weir construction.

2.2 Technical Parameters

Under previous heading we end up with non-gravity weir can be constructed using ferrocement technology.

We have designed a non-gravity weir in ferrocement for catchment area 336 m^2.

Study says, an arch i.e. semicircular shape is strong enough for resisting the compressive force of water on the upstream side of weir.

A curve or arch is the strongest form of structure because lateral pressure on arch cause the walls of arch to go into partial compression rather than tension [10]. So we have devided the 8m vertical wall of weir in semicircular vaults with intermediate inclined counterforts to counter deflection. The inner diameter of vaults is 1.2m and outer diameter is 1.9m. the thickness of each vault is 35mm [fig.9].

height of each vault is 1.5m and width of slab beneath the vertical wall is 1.2m [fig.2].

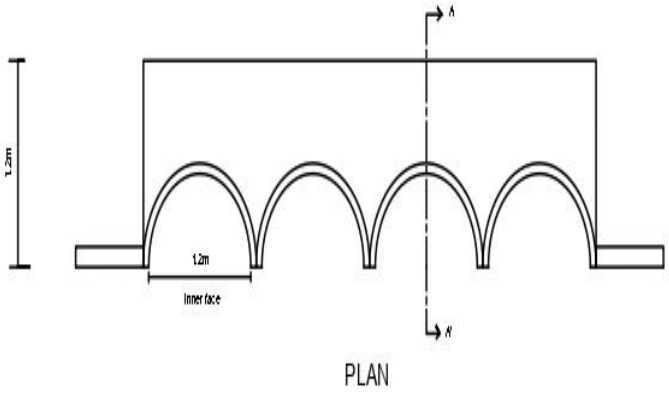

Figure 1- Plan

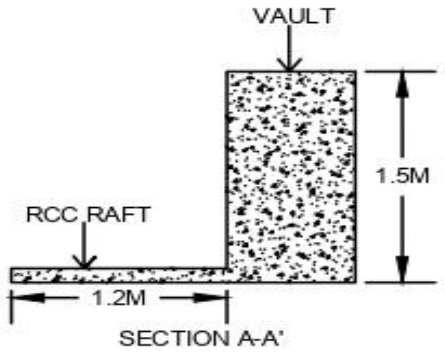

Figure 2 – section A-A'

Fabrication of skeleton: Steel rod of 8 mm should place at a particular distance (as per calculation) to prepare framework of specific height and diameter (as per calculations). To make skeleton strong, use 4 horizontal and 2 vertical stiffeners. Keep the steel rods at a distance of one foot. A steel mat should be prepared to cover the floor of the 1.2M wide layout. Then 8mm diameter rods to be inserted in drilled holes and then the skeleton should tie perfectly with winding wires. To give the stability and strength to skeleton 8mm diameter bars should be fixed perpendicular to skeleton. All the counterfort rods should tie at an equal distance to main vertical rod of arch.

Fixing of bars and meshes: layer of 24 gauge chicken mesh should tie on both sides of the 14 gauge weld mesh by hook. By tying these two meshes, one layer of these meshes will be formed. The tied mesh layer then should be wrapped around the skeleton by using binding wires. Another layer of chicken mesh ties to inner side of skeleton.

Application of mortar: After casting skeleton, the holes should be filled with cement mortar (1:2) and leave it for 1 day. Prepare (1): (2.5): (3.5) cement mortar mix proportion [9]. Then that concrete should place on floor as raft after that prepare mortar mix (1:3) for plastering.

Curing: Last process is to plaster the arches of weir by using this mortar and leave it to set. Then curing should be done for 10-12 days after masonry work done.

We have built model representing the proposed non-gravity weir structure.

Image 1- Fabrication of skeleton

Image 2- Fixing of bars and meshes

Image 3- Application of mortar

2.3 Cost Analysis

A. By comparing cost estimation for both RCC and ferrocement non-gravity weir construction it results that, The difference in cost of 1 cubic meter block of RCC and ferrocement for construction of non-gravity weir is RS. 800/-
B. Ferrocement construction does not require formwork, so expenses needed for formwork ultimately eliminated.

C. Study says, curing essential for ferrocement structure is about 10 to 12 days (maximum) so, water charges and labor charges needed for curing is eventually less as compared to RCC [9].

D. Maintenance cost of ferrocement structure is almost negligible [1].

2.4 Time Analysis

1. Time required for construction of non-gravity weir using ferrocement in rural region is came to be 25 days.

2. Time required for RCC weir structure construction was calculated by prior industry experience which came to be 50 Days.

CONCLUSIONS

From the study of ferrocement, we concluded that ferrocement is useful in water retaining structure and ferrocement concreting concept can be applied in construction of non-gravity weir.

By studying property comparison of RCC and ferrocement, we learned that the ferrocement have tensile strength, superior bond and shear strength than RCC and ferrocement shows strength to weight ratio values higher than RCC.

By the stability check and calculations, it concluded that the proposed ferrocement non-gravity weir possess all the safety aspects as per standard norms.

By the comparison of estimated cost of ferrocement and RCC per cubic meter of non-gravity weir, we concluded that ferrocement is economical over RCC.

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