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DESIGN OF SMALL WATER HARVESTING STRUCTURES USING FERROCEMENT IN PURANDAR AREA

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Abstract- Earth does not have same climatic condition it may vary according to number of parameter, as we know, in past few years some part of Maharashtra facing drought and scarcity of water, but now recently we face flood and heavy rainfall there is huge need of economical water harvesting structure, and ferrocement collection of data (rainfall, discharge, climatic condition, morphological condition, geology, toposheet, area, streams, nature of streams) and to study and represent this data with different thematic maps, and the design and analysis of ferrocement in small water harvesting structure.

Keywords- *Ferrocement, Literature Study, Thematic maps, Economic Structure.*

I INTRODUCTION

Ferrocement consists of a thin sheet of cement mortar which is reinforced with a cage made of wire mesh and steel bars. Because Ferrocement is structurally more suitable than masonry, the thickness of the walls is as low as 10 to 15mm. Ferrocement components can be casted in any shape using different molds. The technology is extremely simple to be implement, and even semi-skilled workers can learn it with ease. Ferrocement requires only a few easily available materials - cement, sand, galvanized iron (GI) wire mesh, and mild steel (MS) bars - in small amounts compared to masonry and RCC

One of the primary requirements of a water harvesting system is that of structure to store the harvested water in a hygienic condition. This need is more in high-rainfall areas, where it is more feasible to store water in water harvesting structures for direct use, rather than for improving the groundwater table. Generally, in small domestic areas, the cost of constructing structure with conventional materials like masonry or RCC is far more recommended than that of the rainwater collection and piping component.

Ferrocement can provide Economy and ease in build solution to the need for low-cost containers. This technology is particularly relevant for regions like Meghalaya, Arunachal Pradesh and Kerala, which have high frequency of rainfall. Now a day's Maharashtra also facing a high frequency of rainfall, Need to concentrate on water harvesting system.

The Structural Engineering Research Centre (SERC), Ghaziabad, has done research and development on a large number of low-cost structures and implements like water/grain storage containers, irrigation channels, biogas digesters and septic tanks, primarily using Ferrocement. SERC scientists are imparting training in Ferrocement technology to rural artisans under the National Drinking Water Mission.

Watershed is a geographical term, originally. The area that drains into a single river is the watershed for that river. Watershed can also mean a ridge, like that formed by a chain of mountains, which sends water to two different rivers on either side.

Soil conservation is need to protect the soil from harsh weather and stop erosion and when we start conserving soil it gets more and more nutrients ,the much conserve soil the much crops grow.

II LITERATURE STUDY:

1. Evaluation of cases of retaining wall failure (By Mu'azu Mohammed ABDULLAHI issue 14, Jan-June 2009): They have studied the causes like sliding of soil, slip of surrounding

soil, overturning, sliding forward, faulty design, water pressure, lateral earth pressure. Earth pressure is not a unique property of the soil or rock, but it is a function of material that the retaining structure must support, the loads that the soil behind the structure must carry groundwater condition and the amount of deflection retaining structure undergoes. Theories of soil mechanics deals with earth pressure on retaining wall, unfortunately, the engineer using theories have not always realized the Dynamics statistical framework for seasonal stream flow forecasting in an agricultural watershed (BY Gabriele Villarini,A.Allen Bradley.Gabriel A.Vecchi. 30 march 2016).

2. In Analysis of land use and land cover change dynamics using GIS and remote sensing during 1984 and 2015 in the Barossa`1 watershed in the northern central highland of Ethiopia. (By S.K.Tripathi. Deepak khare.18th AUG 2016): This paper presents in the last 31 years use and land cover dynamics have undergone considerable change in the Beressa watershed. The land use and land cover dynamics observation showed the expansion of farm land settlement and land leading on the country the grazing land barren and land decline. Contrary to the finding other studies elsewhere, minali and Rao, Nurelegn and Amar Aares at all even through farming and settlement or rapidly expanded the trend of forest cover was increased. Increasing forest cover was possible due to the incentives provided by the government for community and household level tree plantation. The support of government and efforts of communities because it has a positive impact in pretesting the ecology and the economic well being of the community it into a body of water.

3. Ferrocement; A modern technology with its Application in the Water Resource department. (WRD) (By A.R.Khandelwal, S.S.Deshmukh. 4th April 2016): Ferrocement has a history of more than 150 year. It remains in the background up to 1940 and has boomed as a construction material in the last two to three decades. Originally 1940. Nervi in Italy has named this composite of Ferro (IRON) and cement (cement mortar) as ferrocement. All over the world it is known as ferrocement. The matrix of this composite is not plain cement but cement motor in the form of micro concrete. Hence it is also named as ferroconcrete and both these words, that is ferrocement and ferroconcrete are used interchangeably. Closely space and thoroughly distributed continuous fine wire mesh reinforcement in brittle matrix of cement mortaring founds ferrocrete. These ingredients of ferrerocrete remains strongly bonded together up to yield of steel wire and hence more like a homogeneous and ductile material. Ferrocement is a cement based on composite material which has provided an ideal construction material for thin wall structure of various size and shapes (Even complicated geometrics), water storage tank.

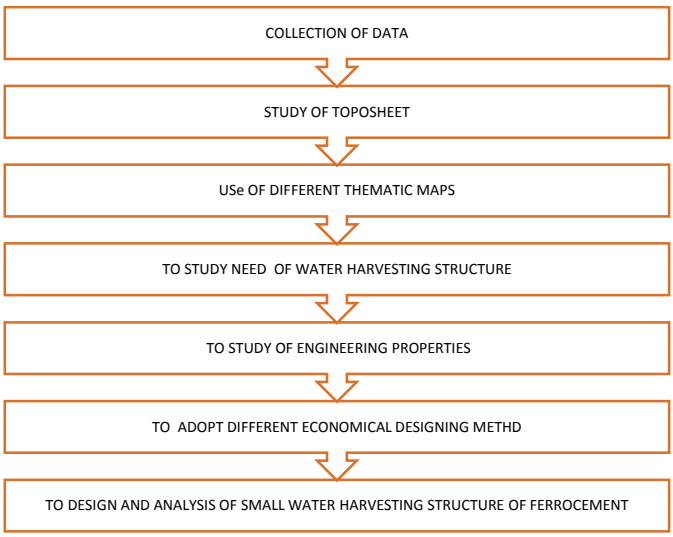
4.Integrated Watershed Management evaluation development and emerging trends (by Guangyu Wang. Shari Mang. Haisheng Cai. 9, July2015): A watershed is a topographically delineated area that is drained by system it is the total area above some point on stream or river that drains past. A watershed is also a hydrological response unit a biophysical unit and a holistic ecosystem in terms of the material, energy and uniformities that flow through it therefore, as well as being a useful unit for physically analysis it can be also a suitable socio economic political unit for measurement planning and implementation watershed can vary in size from thousands of square kilometers to a small area drained by a freshet. Watershed management is the process of the organizing and guiding land water and other natural resources used in a watershed to provide the appropriate goods and service while mitigating the impact of soil and watershed resources.

It includes socio economic human institutional and biophysical inter relationship among soil, water connection between upland and downstream areas in case it is resources management with the watershed as the basis organizing units.

5.Morphometric Analysis of Upper Karha Watershed in Semi-Arid Area, Western Maharashtra, India- Satish S. Deshmukh, Abhaykumar S. Wayal-ISSN2230-7540-April-2018 : As demand of water has increasing over the year so the assessment of water quantity and quality of its best used in necessity, the Morphometric parameter of a watershed are reflective of its hydrological response to a respectable extent and may be useful in synthesizing its hydrological behavior, areal linear and relief properties fir the quantitative analysis of Morphometric parameters using GIS software is found to be of huge utility in drainage basin elevation flood prediction and natural resources management.

III METHODOLOGY:

(Self-prepared)



Collection of data: Toposheet, IMD data (climatic data), secondary data (runoff at stream gauge station), rational equation, Satellite images, Study of watershed using ARC-GIS.

Study of Toposheet: The toposheet were collected from Google earth of scale 1;50000. The geo-referencing of toposheet is completed with the help of ARC-GIS software. The Catro DEM of 30m resolution is used. The boundary of watershed basin was delineation with using ARCSwat tool. The DEM data was downloaded of study area from internet. And further used for engineering properties.

Use of different thematic map: Decreasing retain earth height by re-grading backfill earth surface, and landscape changing or pressing down drainage culvert at the wall back face.

(self-prepared)

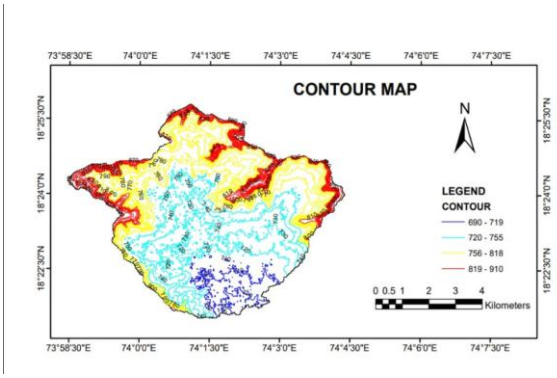


Image 1: Contour map

(self-prepared)

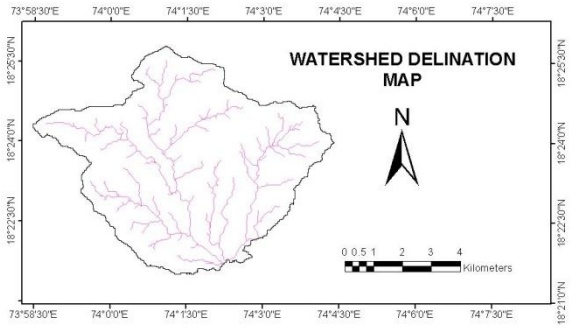


Image 2:watershed delination map

(self-prepared)

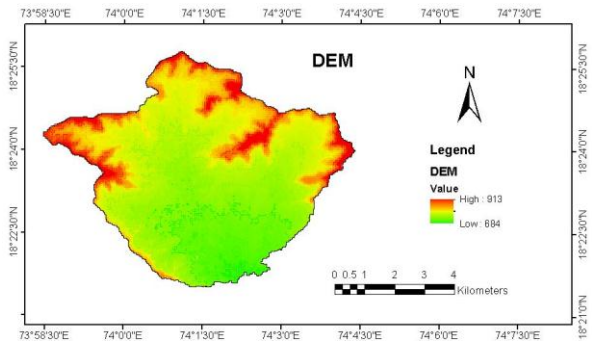


Image 3: Dem map

To study need of water harvesting structure: According to collection of data, and engineering properties and ground water table, rainfall, runoff, discharge, storage of water, irrigation needs, water required per year for multi-purpose according to area chosen structures are decided respectively

To Study of engineering properties of watershed and ferrocement: With consideration of above points, the study of engineering properties i.e., strength of ferrocement, soundness, fineness, consistency, setting time, strength, heat of hydration, chemical composition etc.

(goggle image)

S. No.	Parameters	Range
1.	**Wire mesh**	
	(a) Type of mesh	Welded wire or square woven or chicken wire mesh or galvanized wire mesh or expanded metal
	(b) Diameter of wiere	Diameter of wire may be between 0.5 to 1.5 mm
	(c) Size of mesh opening	It may be between 5 to 25 mm
	(d) Distance between mesh layers	The distance between two layers should be greater than 2 mm
	(e) Volume fraction of reinforcement	Upto 8% in both directions corresponding to 650 kg/m^3 of concrete
	(f) Specific surface of rainforcement	Upto 4 cm^2/cm^3 in both directions
2.	**Skeleton reinforcement**	
	(a) Type	Rods, strands, wires or wire fabrics
	(b) Diameter	3 to 10 mm
	(c) Grid size	50 to 100 mm
3.	**Mortar composition**	
	(a) Portland cement	Any type depending on application
	(b) Cement sand ratio	1:2 to 1:3 or 1:1.75 to 1:2.5
	(c) Water/cement ratio	It may range from 0.35 to 0.6, but normally a w/c ratio of 0.35 to 0.4 is used
	(d) Fine aggregate	Fine sand all passing IS 4.75 mm sieve and 5% by mass passing through IS 1.18 mm sieve. Thus the sand of continuous grading curve between 1.18 mm and 2.36 mm size should be used.
4.	**Matrix Properties**	
	(a) Thickness	The mortar thickness may be between 10 to 60 mm but normally it should be between 20 to 30 mm
	(b) Cover to reinforcement	1.5 to 5 mm
	(c) Compressive strength	27.5 to 60 MPa
	(d) Ultimate tensile strength	34.5 MPa
	(e) Allowable tensile stress	10.0 MPa
	(f) Modulus of rupture	55.0 MPa

Image 4: Engineering properties of ferrocement

(self-prepred)

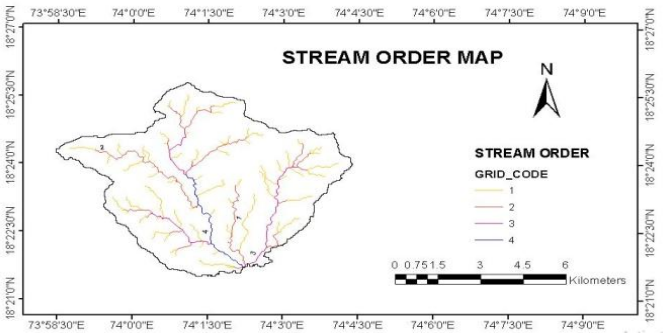
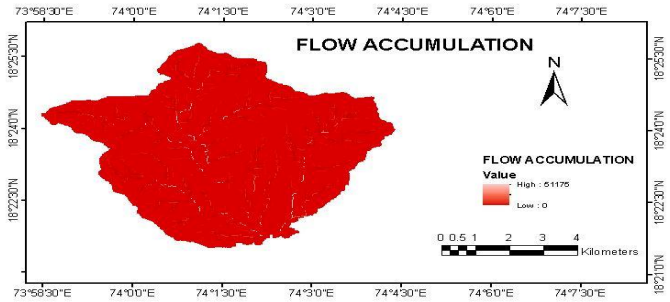


Image 5: Stream Order Map

(self-prepared)



To adopt different economical designing methods: With the study of all parameters we have adopted different methods to design the structures accordingly and suggest the economical design.

IV RESULT AND DISCUSSION:

There are three type of construction methods of ferrocement are as follows

- Armature system.
- Closed mould system.
- Integated mould system.

And the following reinforcement used in construction of ferrocement structure.

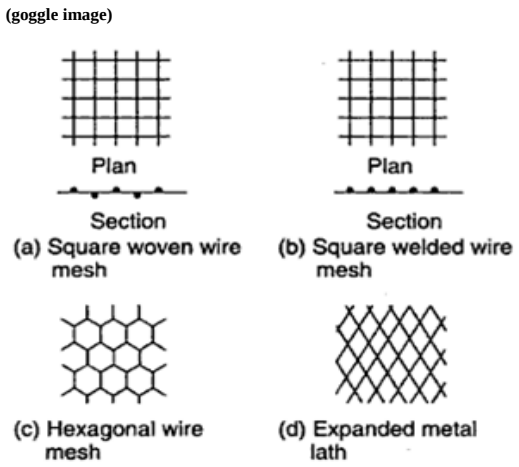


Image 1: *Types of steel reinforcement used in ferrocement*

V DESIGN:

STEP 1: estimate the condition of watershed before designing.

STEP 2: find out the value of 'n'

Where n is value of manning's roughness co-efficient.

STEP 3: find out the value of 'v'

Where 'v' is maximum permissible average velocity.

STEP 4: Calculate the average flow and discharge 'Q'

STEP 5: calculate the width of stream

$$W = \frac{Q}{d_{av} * v}$$

STEP 6: from field survey, available width at

$$D_{av} = w$$

If yes then design accepted

And if not then according to available depth further designing shall proceed.

Where, D_{av}= available depth

W= width

V= velocity

Q= discharge

Parameters	***Reinforced cement concrete (RCC)***	***Ferrocement***
Strength to weight ratio	***Low***	*High*
Performance	*High*	*High*
Equipment required	*Comparatively more*	*Less requirement*
Thickness	*Min 75mm thick*	*Much thin 925 to 50mm0*
Ductility	*Less*	*More*
Skilled required	*Skilled labour*	*Semi skilled labours*
Durability	*High*	*High*
Formwork	*Quite essential*	*Wire mashes can tied tightly*
Labour cost	*Moderate*	*Very high*
Specific surface	*Very high*	*Low*
Reinforcement	*Steel bar*	*Steel wire mash*
Matrix composition	*Cement fine aggregate course aggregate water*	*Rich mix of cement and fine aggregate*

Table 1*: Comparative Analysis*

VI CONCLUSION:

- Our expected conclusion of this study is to use ferrocement in small water harvesting structures (water tank, bandhara wall etc.) and to suggest the use of ferrocement in small water harvesting structure and soil conserving structure.
- Feerocement is economical as compared to the conventional cement as its easily molded and thin, the thickness of ferrocement is generally between 10mm to 30mm.
- The type of quantity and strength properties of reinforced mesh; the mechanical properties ferrocement is totally depend upon.
- It recharges ground water table and also effective remedial measure on scarcity and drought condition, effective crop

cultivation or other irrigational purpose etc.

Advantages	Disadvantages
High ductility	Low shear strength
High resistance to cracking width	Low ductility
Good fire resistance	Susceptibility to stress rupture failure
Good impermeability	Large no of labours required
Low maintained cost	Tying rods together is tedious and time consuming
Eliminate waste	Fear of corrosion
Simplicity in construction	Punctured by collision with pointed object

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