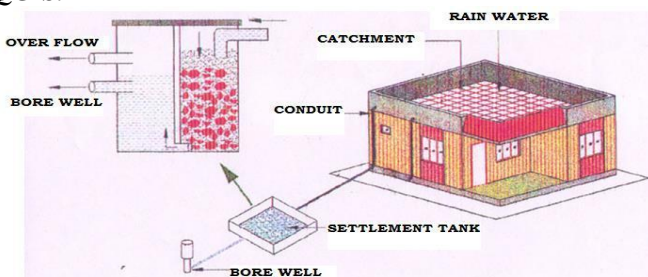


## DETAILED ESTIMATION OF RAINWATER HARVESTING PLANT AT RESIDENTIAL PLOT

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**ABSTRACT:** Water scarcity is serious problem throughout the world for both urban & rural community. Urbanization, industrial development & increase in agricultural field & production has resulted in overexploitation of groundwater & surface water resources and resultant deterioration in water quality. The conventional water sources namely well, river and reservoirs, etc. are inadequate to fulfill water demand due to unbalanced rainfall. While the rainwater harvesting system investigate a new water source. The aim of the present study is to use rainwater and thus taking close to the concept of nature conservation. In this study it has been observed that during inspection of various complexes by NGT team, they have fined the reputed hospitals and hotels to the order of Rs.3.00 to 5.00 lacs due to nonfunctional of the rain water harvesting structure, so it is imperative on the part of DDA Engineers to provide Rain water harvesting structures in DDA complexes like, Offices of Chief Engineers, Circle offices, Vikas Sadan, Vikas Minar etc. and ensure its functionality before onset of monsoon .”The expected outcome of the study is the development of rainwater harvesting system for catchment area of DDA office area. The result analysis shows that the construction cost of RWH is Rs.4.84 lakhs respectively and is reasonably well in comparison with conventional water sources. The developed system satisfies the social requirements and can be implemented in rural areas by considering almost all the technical aspect.

**Keywords:** Catchment, Rain water harvesting, Recharge pit, QGIS.



### I. INTRODUCTION

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. RWH is the technique of collecting water from roof, Filtering and storing for further uses. Rainwater Harvesting is a simple technique of catching and holding rainwater where it falls. Either, we can store it in tanks for further use or we can use it to recharge groundwater depending upon the situation. RWH system provides sources of soft, high quality water reduces

dependence on well and other sources and in many contexts are cost effective. RWH system is economically cheaper in construction compared to other sources, i.e. well, canal, dam, diversion, etc.

Components of water Harvesting System:

A Rainwater harvesting system comprises of components for – transporting rainwater through pipes or drains, filtration, and tanks for storage of harvested water. The details of the components of rainwater harvesting system has shown in figure.1

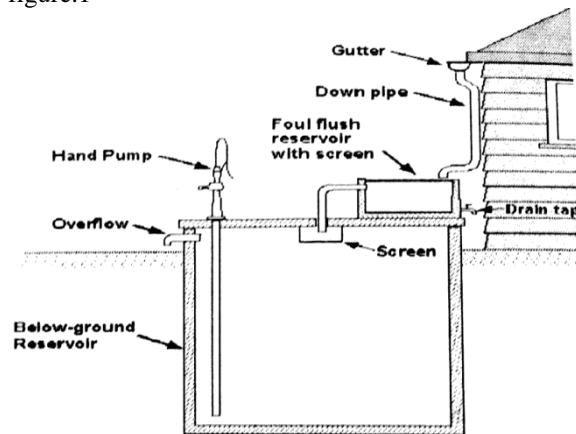


Figure 1: Components of Rainwater Harvesting System

The design and installation of RWH system includes following:

- Rainwater Catchment and Conveyance
- Rainwater Storage and Tank Sizing and
- Rainwater Quality and Treatment

With above literature it is found that the rainwater harvesting system can be developed with qualitative and quantitative approach for the case study under consideration. This paper mainly aims to explore the economic benefit of rainwater harvesting system and the methodology has been demonstrated through application to the DELHI DEVELOPMENT AUTHORITY state of DELHI, India.

The Description of the Case Study:

The DDA Divisonal office where this RWH project is implemented is situated at Sarita vihar. The divisional office is surrounded by residential area. The residential accommodation is provided to all the officials of DDA. It was observed that during inspection of various complexes by NGT team, they have fined the reputed hospitals and hotels to the order of Rs. 3.00 to 5.00 lacs due to nonfunctional of the rain water harvesting structure, so it is imperative on the part of DDA Engineers to provide Rain water harvesting

structures in DDA complexes like, Offices of Chief Engineers, Circle offices, Vikas Sadan, Vikas Minar etc. and ensure its functionality before onset of monsoon Hence, keeping in view all the above problems Therefore, in this situation, rain water harvesting system can be considered as a best solution for fighting against water scarcity in campus.

#### MATERIAL PROPERTIES

The physical and mechanical properties of all ingredients like sand, natural coarse aggregates, cement and demolished coarse aggregates are per IS: 2386-1963 were determined.

#### Cement

OPC (Ordinary Portland Cement) of grade 43 was used which conformed to IS: 8112-1989. Testing of cement was done as per IS: 4031-1968. Natural Fine

#### Aggregates

Natural coarse sand was used as fine aggregate. The sand conformed to zone II as per IS: 383-1970.

#### Natural Coarse Aggregates

Coarse aggregates of size 10mm and 20mm were used.

#### Water

Properties of water used were as per clause no. 5.4 of IS 456-2000. It was free from deleterious materials. Water was used for mixing and curing of concrete. Portable water is generally taken for mixing and curing of concrete.

#### Mix Proportion

As per design of concrete mix M20 (1:1.5:3) for wall of storage tank and M15 (1:2:4) for floor respectively.

#### STEEL

steel reinforcement are used , generally, in the form of bars or circular cross section in concrete structure.

Mild steel bars conforming to IS:432(part 1) and cold worked steel high strength deformed bars conforming to IS:1786(grade Fe 415 and grade Fe 500, where 415 and 500 indicate yield stresses) are commonly used.

Start from 8mm diameter. For underground tank construction bars of diameter 12mm are used.

In this project, Fe500 of different diameters was used at all the places.

Water Pipe: Polyvinyl chloride pipes, seamless aluminium, Galvanised steel / iron of various sizes required.

Water Pump: Capacity of 1 HP

#### Design of RWHsystem:

For the proposed location in DELHI DEVELOPMENT AUTHORITY, visual inspection, survey by Auto level has been carriedout and required analysis is done.

#### ESTIMATION AND COSTING OF RWH:

| Sr.No. | Description of Work  | Quantity | Unit | Rate   | Amount   |
|--------|--|----------|------|--------|----------|
| 1      | Taking out existing CC interlocking paver blocks from footpath/ central verge, including removal of rubbish etc.   | 21.00    | Sqm  | 48.30  | 1,014.00 |
| 2      | Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer  | 2.00     | cum  | 892.7  | 1,785.00 |
| 3      | Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas (exceeding 30cm in depth. 1.5m in width as well as 10 sqm on plan)                      | 62.00    | cum  | 155.60 | 9,647.00 |
| 4      | Supplying,filling, spreading & leveling stone boulders of size range 5 cm to 20 cm, in recharge pit, in the required thickness, for all leads & lifts, all complete as per direction | 3.00     | cum  | 504.15 | 1,512.00 |

|    |   |       |       |  |          |            |           |  |  |  |  |  |  |
|----|---|-------|-------|--|----------|------------|-----------|--|--|--|--|--|--|
|    | of Engineer-in-Charge.  |       |       |  |          |            |           |  |  |  |  |  |  |
| 5  | Supplying and filling in plinth with Jamuna sand under floors, including watering, ramming, consolidating and dressing complete.                                | 2.00  | cum   |  | 910.25   | 1,821.00   |           |  |  |  |  |  |  |
| 6  | Extra for every additional lift of 1.5 m or part thereof in excavation /banking excavated or stacked materials. (a) All kinds of soil.                          | 31.50 | cum   |  | 46.25    | 1,457.00   |           |  |  |  |  |  |  |
| 7  | Providing fixing installing, testing and commissioning of micro filter of FRP Container with stainless steel 304 grade stainer                                  | 1.00  | each  |  | 6279.00  | 62,791.00  |           |  |  |  |  |  |  |
| 8  | Providing and wrapping/laying / fixing of double fold long fibre Geo Textile membrane of weight 400gms/sqm  | 46.00 | sqm   |  | 1169.00  | 53,774.00  |           |  |  |  |  |  |  |
| 9  | Providing and installing in position Recycled polypropylenomular structure with large plates/modular and small plates/modul                                     | 17.50 | cum   |  | 15698.00 | 274,715.00 |           |  |  |  |  |  |  |
|    | ar having more than 95% void volume ratio fixed in arrangements   |       |       |  |          |            |           |  |  |  |  |  |  |
| 10 | Providing and installing in position FRP inspection chamber of nominal size 500*500*500 mm for polymer structure as above                                       | 5.00  | Each  |  |          | 4186.00    | 20,930.00 |  |  |  |  |  |  |
| 11 | Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply  | 4.00  | Metre |  |          | 3426.25    | 13,705.00 |  |  |  |  |  |  |
| 12 | Brickwork with common burnt clay F.P.S. (non modular)bricks of class designation 7.5 in foundation and plinth (a) cement mortar 1:4(one cement : 4 coarse sand) | 0.75  | cum   |  |          | 4918.65    | 3,689.00  |  |  |  |  |  |  |
| 13 | Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : (a)          | 0.35  | Cum   |  |          | 4301.15    | 1,505.00  |  |  |  |  |  |  |



|  |   |  |  |               |            |
|--|---|--|--|---------------|------------|
|  | rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means including loading, transporting, unloading beyond 50 m initial lead, for all loads including all lifts involved. |  |  | 123.70        | 3,093.00   |
|  |   |  |  | Total         | 466,549.00 |
|  |   |  |  | contingencies | 23,327.00  |
|  |   |  |  | Total         | 489,876.00 |

The detailed estimate amounting to Rs. 4, 89,876.00 (Rs. A four Lacs Eighty Nine Thousand Eight Hundred & Seventy Six Only) i/c 5% contingency is hereby technically sanctioned.

## II. RESULTS AND DISCUSSIONS

### Catchment Area

1 x 41.75 x 37.90 1582.33 sqm  
Less dia of park 1 x 12.80 x 15.60 - 199.68 sqm  
1382.65 sqm  
Run off coefficient 80%/60%  
Rain fall in hours 26 m  
Discharge "Q" 1382.65 x 80/100 x 26/1000 28.76 cum  
Assuming 60% discharge percolation 28.76 x 60/100 17.26 cum

Thus polymer structure of 17.50 cum is sufficient to harvest the vol. of rainwater.

Size of pit 5.00 x 2.50 x 1.40 17.50 cum

**ITEM NO. 1** Taking out existing CC interlocking paver blocks from footpath/ central verge, including removal of rubbish etc., disposal of unserviceable material to the dumping ground, for which payment shall be made separately and stacking of serviceable material within 50 metre lead as per direction of Engineer-in-Charge.

1 x 6.00 x 3.50 21.00 sqm

**ITEM NO. 2** Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge. (a) Nominal concrete 1:3:6 or richer mix (i/c equivalent design

mix)  
1 x 6.00 x 3.5 x 0.10 2.10 cum  
Say 2.00 cum

**ITEM NO. 3** Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas (exceeding 30cm in depth. 1.5m in width as well as 10 sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.

(a) All kinds of soil  
1 x 6.00 x 3.50 x 2.95 61.95 cum  
Say 62.00 cum

**ITEM NO. 4** Supplying, filling, spreading & leveling stone boulders of size range 5 cm to 20 cm, in recharge pit, in the required thickness, for all leads & lifts, all complete as per direction of Engineer-in-Charge.

1 x 6.00 x 3.50 x 0.15 3.15 cum  
say 3.00 cum

**ITEM NO. 5** Supplying and filling in plinth with Jamuna sand under floors, including watering, ramming, consolidating and dressing complete.

1 x 6.00 x 3.50 x 0.10 2.10 cum  
Say 2.00 cum

**ITEM NO.6** Extra for every additional lift of 1.5 m or part there of in excavation /banking excavated or stacked materials. (a) All kinds of soil.

1 x 6.00 x 3.50 x 1.50 31.50 cum

**ITEM NO. 7** Providing fixing installing, testing and commissioning of micro filter of FRP Container with stainless steel 304 grade stainer, capable of eliminating finer particulate matter up to 100 microns in size, including connection with drain and pit complete as per approved design and direction of the Engineer-in-charge. Pure rain or similar brand capacity 40kl. (The filter should be tested by NABL Laboratory).

1 x 1 1.00 No.

**ITEM NO. 8** Providing and wrapping/laying / fixing of double fold long fibre Geo Textile membrane of weight 400gms/sqm,type tested as per relevant international standard for tear, tensile strength ,elongation %, puncture and percolation parameters ,to act as a filter medium, including overlapping at joints and welding with extrusion welder etc. complete as per approved design directions of Engineer-in-charge. (Manufacture test certificate is to be submitted).

2 x 5.00 x 2.50 25.00 sqm  
2 x 5.00 x 1.40 14.00 sqm  
2 x 2.50 x 1.40 + 7.00 sqm  
46.00 sqm

**ITEM NO. 9** Providing and installing in position Recycled poly propylene modular structure with large plates/modular and small plates/modular having more than 95% void volume ratio fixed in arrangements as per approved pattern / design to bear ultimate compressive stress of 14 t/sqm



suitable for traffic load (with adequate backfill) of 35 to 40 t/sqm (the design to be approved from the Engineer-in-charge) complete as per directions of Engineer-in-Charge. (cross wave or equivalent, Poly Propylene modular boxes should be certified by GRIHA) Size: (494 x 494 x 220)mm

1 x 5.00 x 2.50 x 1.40                      17.50 cum

**ITEM NO. 10** Providing and installing in position FRP inspection chamber of nominal size 500\*500\*500 mm for polymer structure as above

For 2.50 depth                      2.50/0.50                      5 Nos.

**ITEM NO. 11** Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings including jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of Engineer in Charge. External work: 150mm nominal inner dia pipes.

1 x 4.00                                      4.00 m

**ITEM NO. 12** Brickwork with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth (a) cement mortar 1:4 (one cement : 4 coarse sand)

2 x 0.96 x 0.23 x 0.45                      0.20 cum  
2 x 0.50 x 0.23 x 0.45                      + 0.10 cum  
0.30 cum (A)

For Filter Chamber

2 x 1.26 x 0.23 x 0.45                      0.26 cum  
2 x 0.90 x 0.23 x 0.45                      + 0.19 cum  
0.45 cum (B)  
A + B                      0.75 cum

**ITEM NO. 13** Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : (a) 1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size)

1 x 1.11 x 1.11 x 0.10                      0.12 cum  
1 x 1.41 x 1.51 x 0.10                      + 0.21 cum  
0.33 cum

Say                      0.35 cum

**ITEM NO. 14** 12 mm cement plaster with a floating coat of neat cement of mix: (a) 1:4 (1 cement : 4 fine sand)

4 x 0.50 x 0.45                                      0.90 sqm  
2 x (0.90+0.80) x 0.45                      + 1.53 sqm  
2.43 sqm

Say                      2.50 sqm

**ITEM NO. 15** 15 mm cement plaster on rough side of single or half brick wall finished with a floating coat of neat cement of mix : (a) 1:4 (1 cement: 4 fine sand)

2 x (0.96+0.96+1.36+1.26) x 0.45                      4.09 sqm  
2 x (0.96+0.50) x 0.23                                      0.67 sqm  
2 x (1.36+0.80) x 0.23                                      + 0.99 sqm  
5.75 sqm

Say                      6.00 sqm

**ITEM NO. 16** Providing and placing in position 100mm thick factory made machine batched & machine mixed Precast RCC Rectangular Covers on drains of footpath of various sizes, of M-25 grade cement concrete for RCC work, including cost of centering, shuttering, reinforcement of 8mm dia TMT bars of Fe500 grade @ maximum 100mm c/c on both ways, neat cement punning on finished surface, properly encased on all edges with 1.6 mm thick, 100mm wide MS sheet duly painted over priming coat, reinforcement to be welded at edges with MS sheet and providing 2 Nos. 12 mm dia bar for hooks etc i/c cost of cartage, all leads & lift, handling at site etc. all complete as per direction of Engineer-in-Charge

1 x 0.70 x 0.70                                      0.49 sqm  
1 x 0.95 x 0.95                                      + 0.90 sqm  
1.39 sqm

Say                      1.40 sqm

**ITEM NO. 17** Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.

Total excavation (ITEM 3)                      62.00 cum

LESS

ITEM NO. 4                                      3.15 cum  
ITEM NO. 5                                      2.10 cum  
ITEM NO. 9                                      17.50 cum  
ITEM NO. 12                                      0.75 cum  
ITEM NO. 13                                      0.33 cum  
ITEM NO. 7                                      0.57 cum

Inspn Chamber 1 x 0.50 x 0.50 x 1.30                      + 0.33 cum  
- 24.73 cum

37.27 cum

Say                      37.00 cum

**ITEM NO. 18** Laying old cement concrete interlocking paver blocks of any design/ shape laid in required line, level, curvature, colour and pattern over and including 50 mm thick compacted bed of coarse sand, filling the joints with fine sand etc. all complete as per the direction of Engineer-in-charge. (Old CC paver blocks shall be supplied by the department free of cost).

21.00 x 75%                                      15.75 sqm

Say                      16.00 sqm

**ITEM NO. 19** Providing and laying 60mm thick factory made cement concrete interlocking paver block of M -30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with fine sand etc. all complete as per the direction of Engineer-in-charge.

L.S.                                      5.00 sqm

**ITEM NO. 20** Disposal of building rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means including loading, transporting, unloading beyond 50 m initial lead, for all loads including all lifts involved.

ITEM NO.3                      62.00 cum

LESS

ITEM NO.17                    - 37.00 cum  
   25.00 cum

### III. CONCLUSION

Recharge of ground water table is a gradual process, we can not suddenly increase the ground water table after constructing recharge structures, by constructing any type of recharge structure, and we can give our contribution in aquifer recharge. This will help to rejuvenate the depleting ground water resources. Also help to save the little amount of rain water which used to drain away from many years. Thus it is concluded that implementation of RWH system in DELHI DEVELOPMENT AUTHORITY, Sarita vihar, Divisional Office would result in the form of the best approach to deal with present scenario of water scarcity and storing huge quantity of water in a year.

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