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Design of Rainwater Harvesting System WCEM, Nagpur

Nikita Shete[1], Apurva Bawane[2], Ayushi Amberwade[3], Shubham Nomulwar[4], Shubham Kotangle[5], Nashik Nimsarkar[6], Nitesh Rathode[7], Sudhir Mate[8], Shweta Yelne[9]
[1,2,3,4,5,6,7,8]*Student, Department of Civil Engineering, WCEM, Nagpur, India*
[9]*Professor, Department of Civil Engineering, WCEM, Nagpur, India*

***Abstract*: The Water scarcity is serious problem throught the world for both urban and rural community. The conventional water sources namely well, river and reserviors, etc. are inadequate to full fill water demand due to unbalance rainfall. While the rainwater harvesting system investigate a new water sources. This project evaluates the potential for water saving by using rain water in wainganga collage in dongargoan. The roof top of the collage having catchment area is 4426 sq. m. Using average rainfall data, calculation for rainwater endownment and rain water haversting (RWH) potential were made. Volume of water that can be collected in one year was calculated. Suitable filter media for removing suspended particles and reducing turbidity has been proposed. The testing of pure water and comparison with the standard of drinking water parameter .design the filter media for removing the suspended matter present in water. The well is to be design for storage filer water purpose and recharge a ground water table. The developed system satisfies the social requirements and can be implemented in rural area by considering almost all the technical aspect.**

***Keywords*: catchment, rain water harvesting (RWH), filter, recharge pit**

1. 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 and further uses rain water harvesting is a simple technique of catching and holding rain water where it is fall. Either we can store in a tanks for further use or we can use a recharge ground

water depending upon a setution. RWH system provide sources of soft, high quality water reduse dependence on well and other sources and it many contexts are cost effective. RWH system is economically cheaper in construction compared to other sources. i.e., well, canal, dam, diversion, etc.

2. Literature review

1. Meda Kalyam Kumar (Dec 2015)

They use average data rainfall calculate the water harvesting potential volume of water collecting per year provide suitable hydro cyclone for removing suspended particles and reducing turbidity by using various layers.

2. Amit Vashisth (2017)

- They are working at LIMT Faridabad campus study. The volume of tank has been ascertained with most suitable strategy for estimation.
- The darcy equation is used to know the potential of rainwater harvesting collection and pipe

3. Methodology

- Analysis the condition of WCEM Campus.
- Study the various Literature paper.
- Rainfall data collection, assume suitable data.
- Design of rainwater harvesting component.
- Cost analysis.

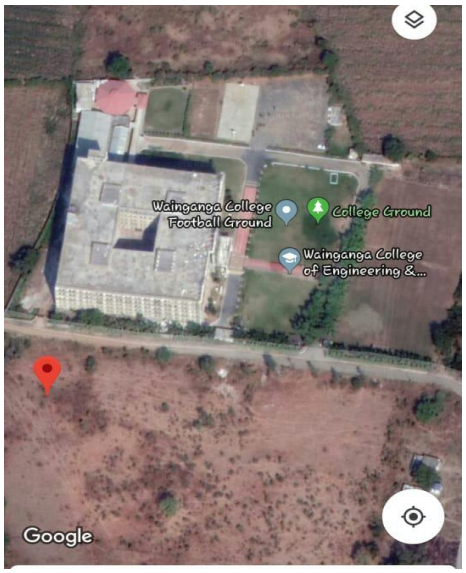

Fig. 1. Study area

4. Design potential harvesting

V = volume of water that can be harvested annually in m^3
C= Runoff coefficient
P = Annual rainfall in (m)
A = Catchment area in (m^2)

By applying values ,

V = A X P X C

=4426 X 0.227 X 0.8

volume = 803.76 m^3

Discharge calculation,

Area =A = 4426 m^2

Intensity of rain fall = I =60 mm/hour

Coefficient = C =0.8

Q = C×I×A

Q= 0.8×(60/3600000) ×4426

Q= 0.05901 m^3/s

Assume rainfall days = 35 days

Volume of water harvesting per year = 803.76 m^3/year

So,

Volume of water collected per day = 803.76 / 35 = 22.90 / day

We are considering factor of safety = 3

Therefore,

volume of water harvested = 22.90 x 3

= 68.70 m^3/day

Design of pipes:

Size of downtake pipes:

Roof area

Intensity of rainfall

Discharge (m^3/sec) = Roof area (m^2) x intensity of rainfall (m/sec)

Q= A x I

Intensity of rainfall = highest amount of rainfall in mm per hour

Also, Discharge = area of pipe x flow through velocity

Q =a x V

Flow through velocity = 1 to 1.8 (m/sec) (standard)

A x I = a x V

a = (A x I) / V

a = Q / V

$\pi d^2 / 4$ = Q / V

D = Square root of 4Q / 4

Roof area = 4426 m^2

Assume Intensity of rainfall = 60 mm/hr.

=60/1000×60×60=0.0016/1000 m/se

Discharge (m^3/sec) = Roof area (m^2) x intensity of rainfall (m/sec)

Q = A x I

Discharge = 4426 X 0.0016/1000 =0.00708 m3/sec

=0.0078m^3/sec

Discharge = area of conduit/pipe x flow through velocity

Q = a x V

(Q) 0.0078 = a x V

Area of pipe = Q/V

$\pi d^2/4$ = 0.0078/1.2

Diameter of the pipe/conduit

D = √ 4Q / 4

= √4 x 0.00708/ π x 1

=7.28cm

=3 inches

Nearest standard size of pipe for available = 3 inches

Design of well

Time Concentration

Tc= 0.0195 L0.77 x S-0.385

= 0.0195 x 227 x 0.005

Tc = 9.205 minutes = 9.025/60 = 0.1673 hr

Total discharge of building = 0.05901 m^3 / hr

Q = 212.43 m^3 / hr

Volume of well = Q x T.L = 212.43 x 0.163

= 35.62 x 2

= 71.24 m^3

Volume of well = 71.24 m^3

Area V = A x h …… Assume 12 m deep

71.24 = π/4 x d^2 x 10

H = h + F.B

= 12 + 0.5

H = 12.5 m

d = 2.8 m

Table 1
Filteration: Slow sand filter

Material	Particle Size (mm)	Depth (m)
Sand	2 – 4 mm	0.4 m
Course gravel	12 – 20 mm	0.4 m
Pebbles	0 – 40 mm	0.5 m
Boulder	60 – 80 mm	0.5 m

5. Result

- Total Annual Rain water harvesting = 8,03,760 Liter
- Size of filtration tank = 1.8 x 1.5 x 2.1
- Diameter of Rain water pipe = 75 mm and length 227
- Size of well 2.8 m diameter and 12.5 m depth
- Approximate cost of filtration tank = 33,311.76 /-
- Approximate cost of well = 60,630.99 /-

6. Benefits

- Rainwater is a comparatively clean and totally free source of water.
- It is free, the only cost is for collection and used.
- It is used in those areas which face insufficient water resources.
- It can be used to recharge the ground water.
- It can provide an excellent backup sources of water for emergencies.

7. Conclusion

This paper presented design of design of rainwater harvesting system

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