

CONSERVATION OF ROAD RUNOFF WATER FOR GROUND WATER RECHARGE BY AQUA-BUILD METHOD

KATHE AJINKYA D ¹, PATIL PRATIK S ², PATIL MAYUR G ³, KANSHETTE KAPIL G ⁴

Dr. D. Y. PATIL SCHOOL OF ENGINEERING AND TECHNOLOGY, CHARHOLI (BK.), PUNE – 412105

Abstract: *In India an issue about water order couldn't solved in the required area. Many people's are hunting for water. Also, ground water level reduces due to raise of a mixture of demands. Ground water, which is the source for more than 85 percent of India's rural domestic water needs, 50 percent of its urban water requirements and more than 50 percent of its irrigation requirements is depleting fast in many areas due to its large-scale taking out for various sectors. Our approach is the method should be safe disposal of surface water from roads for ground water recharge & to make a clear roadway for vehicles & pedestrians. Our method is not only use for urban- like industrial, agricultural & drinking but also an option for rural areas that be short of more traditional source of water for drinking & other use. This method is useful for urban & rural, arid, semi-arid region & are able to store large volume of water. Though this method is broadly applicable throughout India, it has been more advantageous in arid & semi-arid region. This method meets our project objectives. Hydro geologically sound, intelligent tool to enhance the sustainability of minimizing siltation in reservoir & regaining life of reservoir as well as other surface water storage structure.*

Keywords - 'Aqua-build' method, run-off, ground water recharge, existing road water storage, irregular rainfall.

1.1 INTRODUCTION

There are several types of methods are used for road run –off conservation. Those methods are morrom pits, large & large small pans, dams on hillside , valley dams. Many of these methods were trailed due to their availability and ease of installation. So many problems are there due to suitability and environmental impacts are often doubtful. This research will focus on a inventing technology called 'aqua-build' method. 'Aqua-build' method is a method to protect road run-off (water) for ground water recharge & to make a clear roadway for vehicles & pedestrians. Also, it forms a water (runoff) transport ways to convey water to the required area instead of storing water at a one point. In 'aqua-build' method, is useful for two different cases i.e.

i) Highway or uncrowned area and ii) Roads in crowded area (urban area).

1.2 METHODOLOGY:

1 Basic things and material used for 'aqua-build' unit

This section will spotlight on a inventing technology called 'aqua-build' method. 'Aqua-build' method is a method to protect road run-off (water) for ground water recharge & to make a clear roadway for vehicles & pedestrians. Also, it forms a water (runoff) carrying ways to convey water to the required area instead of storing water at a one point. Many types of method have

been trailed for road run-off preservation. These include morrom pits, large pans, small pans, hillside dams, valley dams. Many of these methods were trailed due to their availability and ease of installation. So many problems are there due to suitability and environmental impacts are often doubtful.

In 'aqua-build' method, is useful for two different cases i.e.

i) Highway or uncrowned area and ii) Roads in crowded area (urban area).

i) Case I - Highway or uncrowned area:

Highway or uncrowned area where adequate space available after carriageway to side drain. A corrugated HDPE sheet of 1000mmx1000mm and 500mmx500mm having 25-50 mm thick is inclined at 30° angle, having channel on all sides for fixing one sheet with other to maintain stability of sheets. Sheet is provided by vertical support made up of same material at both ends. Two ducts of 150mm diameter are provided in each vertical support to pass pipe through it for the disposal of surface water to main HDPE pipe (run-off collector pipe) 300-500mm diameter which is laid parallel to roadway in the side trench, providing slope to carry collected run-off towards injection well by the principle of gravitational force. The bottom vertical support carry 2 more ducts for disposal of rainwater which percolated through shoulder, side slope and berm of road. All four ducts are spaced at a identical distance (230mm), depending upon the size of sheet going to use.

ii) Case II- a) Dug cum bore well :

This is appropriate for roads located in crowdly surrounding and having hard strata below ground level

In spherical dug cum core well, a spherical dug of 1000mm dia. made in ground at 3-5m depth from ground. The bore is located centrally having diameter of 150-200mm diameter. At ground level a concrete cover is provided on entire dug, cover divided in 3spherical portion. The outer portion (larger size) madeup of small holes in zig-zag pattern. Middle part of cover having no terms of holes. The inner (smaller size) part having central duct for bore well.

Function- Middle and outer spherical part divided vertically by vertical solid partition. Outer part collects water and then passing over partition gets collect into middle part (having filter material) and then through perplex compartment water diverted to inner part from where water can be lifted by bore well. An air vent is also provided on top of bore shaft and a wire mesh at the bottom of it.

b) Trench with recharge well- This method is ideally suited for area where permeable horizontal is within three meter below ground level. Recharge well of 100-300mm diameter is constructed to a depth of at least 3-5m below water level.

A lateral trench of 1.5m to 3m width and 10 to 30m length depending water availability is constructed with the recharge well in the centre. The trench is back filled with boulders, gravels and coarse sand to act as a filter media for the recharge well.

Main Items/Materials used for 'aqua-build' method

- Corrugated HDPE sheet- Made of HDPE material which is corrugated act as a bed to collect rain water from berm, side slope, shoulder and excess run-off and delivered collected water to main carrying distribution pipe.
- Duct delivery pipe- Hollow PVC pipes forms pipe network to transfer run-off from carriageway to shoulder and then shoulder to run-off collector and carrying pipe.
- Sieves- Depending upon silt types different types of sieve which are made of G.I. material, are attached in water carrying pipes and fittings remove it to collect settled sediments/silt particles cleaning
- Run-off collector and carrying pipe (main pipe)- To carry collected run-off and to discharge in to injection well
- Injection well- To increase ground water by road run-off delivered by run-off collector and carrying pipe (main pipe)
- The above listed materials are main materials that are used in this method.

1.4 Water Quality issues

There are so many problem of water quality issues related with the use of surface methods, including pollution of water. This needs extra water treatment processes to maintain safe to drink water quality. Depending on the severity of depletion it may be necessary to add oxygen to the water storage by aerating to avoid anaerobic conditions. This will impact upon the cost effectiveness of the operation and may result in increased evaporation.

Overcome on Water Quality issues by 'aqua-build' method –

Currently in 'aqua-build' method covers are made from HDPE material, which are relatively stable and do not leach chemicals into the water storage. Also, as the water gets filter through natural filter bed, the quality of water is good, a potable water which is 99% suitable for drinking purpose. Any material that comes into contact with potable water should be tested. After performed test, quality of water is suitable for drinking purpose. 'Aqua-build' method is made from HDPE material. It is unexpected that there would be any contamination of the water supplies from the materials.

1.4 Environmental issues

Overcome on Environmental issues by 'aqua-build' method –

The suitability of 'aqua-build' method will not harmful for environment. As this method is not covering entire water storage surface area like shade to store water on surface but should be carrying and collect water below ground level for ground water recharge.

1.5 Safety issues

Overcome on Safety issues by 'aqua-build' method

This method is made up of HDPE material. Also it laying below ground level in the side slope of road way where there is quite safety of materials which is enclosed in it. No suddenly damages of materials which is going to be use in this method by road accident vehicles as materials are covered by quite ample upper ground natural strata.

1.6 Effectiveness

The coherence of run-off conservation is dependent on the proportion of the storage that is collected. Water which is stored can be lifted up by means of pump which requires less power to run to lift more water as we assured the quantum of water storage in injection well below ground level.

Volume of rainwater running off roads

The volume of rainwater running off from a 1 km long murrum or tarmac road from a rain shower of 30mm, can be estimated as follows:

Road area: 1,000 m long and 4 m wide

Road surface: Murrum or soil

Run-off efficiency: 80%

Rainfall: 30 millimetres

$1,000 \text{ m} \times 4 \text{ m} \times 80 \times 30 \text{ mm} = 96,000 \text{ litres} = 96 \text{ cubic metres from 1 km road}$

100 Bearing in mind that the average annual rainfall in a season is about 600 mm

The total annual volume of run-off water from a 1 km long murrum road is:

$1,000 \text{ m} \times 4 \text{ m} \times 80 \times 600 \text{ mm} = 1,920,000 \text{ litres} = 1,920 \text{ cubic metres}$

Considering that one cow consumes about 20 litres of water in a day, then 185 local cows can be watered every day in a year (1,920,000 litres minus 30% loss (576, 000 litres) = 1,344,000 litres/ 20 litres / 364 days = 185) from only 1 km of Murom road.

This example shows clearly that roads can supply huge volumes of water for livestock, irrigation, forestry, construction works, etc., provided the harvested water can be stored until it can be used in the dry season.

EXPERIMENTATION /RESULT & DISCUSSION

Road Specification:

Length- 1.0 Km

Width- 4.0 M

Type of road-Bituminous road

CALCULATION'S

From metrological rainfall report 2015-16

for our site location average rainfall intensity is 450mm per month. From that data calculation is given below.

$i = 450\text{mm/month}$ (Rainfall intensity)

So, for 1 day is =15mm.

Working area = $1000 \times 4 = 4000$ sq. meter.

(1000m length of road and 4m width of road)

So we get 60,000 liter water per day.

Take 80% efficiency of runoff and 20% losses due to the evaporation, percolation etc.

Max runoff efficiency= 80% (20% losses).

From 2016 rainfall report we get

38,87,680 liter water in one year from our working area

Maximum rainfall in months storage.

From maximum rainfall in one month we get 14,40,000 liters water.

Injected well size

Out of total annual rainfall 66% rainfall occur in two months that is 800-900mm.

That is 28,00,000 liters water get in two months.

so we design injected well for 30,00,000 liters water.

So we design three tank for our working area, each tank storage 10,00,000 liter.

1000000 liter=1000 m³

So tank size as follow

Diameter of tank= 5 meter

Depth of tank= 55meter

As per storage and rainfall intensity take 12 inches (30.48cm) convey pipe and 24 inches (60.96cm) Main discharge pipe.

Discharge

$Q = A \times V$

Consider standard velocity of pipe flowing water is 9m/s

so get discharge (Q) =0.6361lit/sec.

Storage size

As ample space available below ground level, large quantity of water that can be stored through injection well. This system is currently under testing to know the working of the system and will require research to know storage details as it depends on topography of the area, can be made economically for roads.

Ease of installation and maintenance

Installation- The ease of installation for 'aqua-build' method is related to the surrounding conditions, the length of the road to be covered and weather conditions. However more experience will be gain in installing 'aqua-build' method after covering it for maximum road length. Use of medium hoisting equipment's nearer to roadway where there is availability of land in order to lift and to keep pipes and equipment's, if required. Installing of 'aqua-build' method in monsoon has not been attempted and may have teething difficulties. Depending upon the topography, survey, favorable conditions of road length and surrounding land a number of injection well is need to be installed. From ground level, the minimum depth of 1.5 to 2m should be provided for peak point of the entire system, it means entire system will be at a depth of 1.5 to 2m from ground level.

Maintenance

Low levels of maintenance are required by 'aqua-build' method once it is installed. As the product is relatively new it is likely that there are still a number of minor problems to be dealt with. For easy maintenance point of view, each unit length (in km), method is marked by different colour strips on sheet. Also, zones are formed only for those units (methods) having the same colour for placing sheet by giving identical number for each unit which representing unit number followed by zone number e.g. '01 ZONE- A' it means that the number 01 (02, 03.....so on) which designates as 'aqua-build' method number per unit length in 'km' road length and ZONE-A (ZONE-B, ZONE-C.....so on) which designates as the type of zone for a particular unit in which it's belongs to respectively; So that for maintenance it will be easier for checking and keeping record each unit and each zone. Also, depending upon size of 'aqua-build' method unit length in 'km' and type of storage in which units are going to be placed, fix up the number of units need to be placed in each zone. Periodic maintenance will be required and will be inspect by inspection. This will helpful for sheet locking groove, sieves provided, pipe fittings. Inspection and maintenance work will be carried out other than monsoon season. Visual check should be applied during monsoon to check whether the run-off flows through system or not. If water does not stand on the road surface it means system is running well without any difficulty. At the same time delivery of water carrying pipe end connecting with injection well to check the disposal of run-off.

Cost

Presently the cost of single model of 'aqua-build' method is Rs. 15,779/-. According to the present cost of 'aqua-build' method, the cost of installing 'aqua-build' method on water storages is approximately Rs. 1.5 lakh for 6m length with recharge well but without manufacturing company's construction cost and machinery cost for special HDPE sheet. But in future, when the mass production of such unit will be available, the cost of will be less. This price is comprised of the supply price of the material, preparation of the material by the installer at the warehouse, installation at the site and includes transport to a site. If the demand for 'aqua-build' method increases, the supply price for the material would drop as the manufacturer achieves economies of scale.

1.2 REFERENCES

- Irrigation engineering and Hydraulic structures – S. K. Garg, Khanna publishers.
- Irrigation and water power engineering – Dr. B.C. Punmia , Dr. Pande B. B. Lal, Laxmi publications
- Irrigation water resources and water power engineering – P. N. Modi, Standard Book House
- Irrigation Engineering- Sonarkar, Nimbalkar, Nirali Prakashan
- “RAIN WATER HARVESTING SYSTEM” Student, Dept. of Civil Engineering , VNIET Nagpur, Maharashtra , India. Prof., Dept. of Civil Engineering , VNIET Nagpur, Maharashtra , India. Volume: 03 Issue: 04 | Apr-2016
- J.R.Julius¹, Dr.R.Angeline Prabhavathy, Dr. G.Ravikumar“RAINWATER HARVESTING (RWH)- A REVIEW” ¹Research Scholar, Hindustan University, Chennai, India ²Professor, Department of Civil Engineering, Hindustan University, Chennai, India ³Associate Professor, A.C.Tech, Anna University, Chennai, India. International Journal of Scientific & Engineering Research, Volume 4, Issue 8, August-2013 ISSN 2229-5518.
- “ANALYSIS OF CYLINDRICAL WATER TANKS- WIND OR EARTHQUAKE” ¹M.Tech Student Visvesvaraya National Institute of Technology Nagpur, ²Professor Visvesvaraya National Institute of Technology Nagpur. International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 3, Issue-7, July-2015
- “RAIN WATER HARVESTING SYSTEM FOR COLLEGE OF ENGINEERING,TEERTHANKER MAHAVEER UNIVERSITY, MORADABAD” International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 8, August 2014 ISSN: 2319-8753
- “ GLASS FIBRE REINFORCED CONCRETE USE IN CONSTRUCTION”
- M.E. Civil (MIT) College, Sulaimaniyah International Airport,Iraq. **Head and Professor of Civil Esng. Dept., MIT College, Pune. -International Journal of Technology And Engineering System(IJTES): Jan –March 2011- Vol.2.No.2.

CONCLUSION AND FUTURE SCOPE:

1) Effective useful in SMART-CITY

This project useful in smart city for reducing & control of flood.

Runoff water useful for water treatment plant & less treatment require in sewage treatment plant.

2) Effective useful on HIGHWAY

Water usable for towns & villages near by highway.

Also useful for gardening & agriculture purpose

An important conclusion from this study includes:

- Several run-off conservation methods are able to “save” water, but having certain drawbacks. Subsurface water storage has no evaporation losses.
- As “aqua-build’ method is directly placed below ground and to store water surface below ground, there is no requirement of extra land surface for laying of such method.
- Increased agricultural production from fields irrigated by road water;
- ‘Aqua-build’ method method will be not only widely applicable throughout India but also will be applicable throughout the world; and it will be more advantageous in arid & semi-arid region.

- This method will be environment friendly technology as its-social acceptance, hydro geologically sound, intelligent tool to enhance the sustainability of ground water resources.
- 'Aqua-build' method entail a large capital expenditure and lower operations and maintenance costs;
- New clause of RSWH by municipal corporation will take in account for sanctioning plan of buildings and also by IRC to consider this method for road design and construction.