

Rain Water Conservation via Road Drainage System in India

1.Mr.Shrikant A. Boga, 2.Mr.Pradeep S Dara.

1. Lecturer, Civil Engineering Department, A.G.P.P.I, Maharashtra, India
2. Lecturer, Civil Engineering Department, A.G.P.P.I, Maharashtra, India

Abstract: In Current Situation Rain Water is not effectively collected but keeping in view the future demand of fresh water it is our need to act for collection of this water, for this effective drainage system is required. Poor drainage motives early pavement distresses main to riding issues and structural screw ups and to beautify the street performance, it is vital to furnish sufficient drainage. The overview covered: significance of dual carriageway drainage gadget in avenue construction, requirement of motorway drainage system, and consequences of terrible drainage device on roads. The lookup pointed out areas of difficulty for drainage designers and street engineers that are of brilliant significance all through avenue building to make certain that, the developed street is put use besides failure earlier than the proper format life.

Key words - Poor Drainage, Rain water, Pavement, carriageway.

I. INTRODUCTION

With two thirds of the earth's floor included by way of water and the human physique consisting of seventy five percentage of it, it is certainly clear that water is one of the top factors accountable for lifestyles on earth. Water circulates through the land simply as it does through the human body, transporting, dissolving, and replenishing vitamins and natural matter, whilst carrying away waste material. With two thirds of the earth's floor protected through water and the human physique consisting of seventy five percentage of it, it is naturally clear that water is one of the top factors accountable for existence on earth. Water circulates thru the land simply as it does thru the human body, transporting, dissolving, and replenishing vitamins and natural matter, whilst carrying away waste material. Further in the body, it regulates the things to do of fluids, tissues, cells, lymph, blood and glandular secretion.

1.1PRESENT WATER SCENARIO

According to the provisional records supplied through census 2011, populace in India quantities to 1.21 billion with round 30% of them dwelling in cities. The cutting-edge projections endorse that 40% of the Indians will have moved into the cities by way of 2021. Urban populace will upward shove from 360 million to 575 million by using 2021. India can reap 4 fold Growths in its per capita income. Currently 70% of the GDP is generated

in the cities which will solely develop in the coming years. While urbanization has fueled boom into our Economy, it has additionally created a lot strain on the existing bodily infrastructure of the country. To preserve the increase momentum going, India need to improve a internally constant practices throughout each and every factor of the deliberate urbanization like funding, planning, governance, sectorial insurance policies and form and sample of the urbanization. India is nonetheless waking up to its city realities and the possibilities its cities can provide for monetary and social transformation. Providing environment friendly utility offerings like water supply, waste management, and transportation to such a massive and unexpectedly developing populace will be a large mission and will require very robust economic and technical sources. From previous experiences and by using the evaluation of the modern scenario it is clear that there will be large demand- provide hole of the public utility offerings and its infrastructure. It would end result into disappointment if we simply count on Central and State Government to bridge the gap. The non-public zone will have to come up with its monetary resources, technical understanding and managerial capabilities to whole the task. The administrative and political shape in India is no longer able sufficient to entice the non-public buyers to fund the public utility offerings projects. The Urban neighborhood our bodies ought to enhance their effectivity and stability sheet to entice personal partners. There is additionally very sturdy want of improvement on reforms side, which is politically very touchy area.

1.2 EFFECT OF WATER CRISIS:

There are a number of foremost manifestations of the water crisis.

- Inadequate get right of entry to to protected consuming water for about 884 million people
- Inadequate get entry to to sanitation for 2.5 billion people, which frequently leads to water pollution
- Groundwater over drafting (excessive use) main to diminished agricultural yields
- Overuse and air pollution of water sources harming biodiversity
- Regional conflicts over scarce water assets every now and then ensuing in warfare.

2.0 NEED OF WATER CONSERVATION

Water conservation consists of all the policies, techniques and things to do to sustainably control the herbal useful resource of sparkling water, to shield the hydrosphere, and to meet the contemporary and future human demand. Population, family size, and boom and affluence all have an effect on how plenty water is used. Factors such as local weather trade have accelerated pressures on herbal water sources in particular in manufacturing and agricultural irrigation. Many US cities have already applied insurance policies aimed at water conservation, with a whole lot success. The desires of water conservation efforts include:

- Ensuring availability of water for future generations the place the withdrawal of freshwater from an ecosystem does no longer exceed its herbal alternative rate.
- Energy conservation as water pumping, transport and wastewater remedy services devour a extensive quantity of energy. In some areas of the world over 15% of complete electrical energy consumption is dedicated to water management.



Fig.1.1. Need of Water Conservation

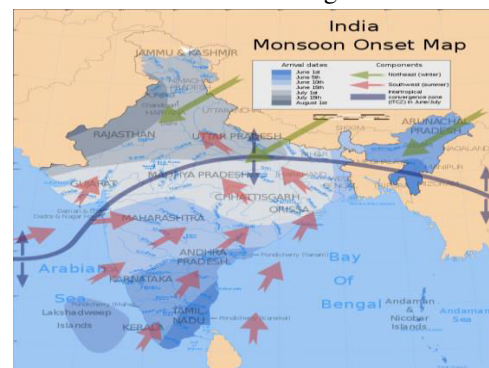
2.1 CLIMATE OF RAIN IN INDIA

The Climate of India consists of a huge vary of climate stipulations throughout a enormous geographic scale and different topography, making generalizations

difficult. Based on the Köppen system, India hosts six main climatic subtypes, ranging from arid wilderness in the west, alpine tundra and glaciers in the north, and humid tropical areas helping rainforests in the southwest and the island territories. Many areas have starkly distinctive microclimates. The country's meteorological branch follows the global general of 4 climatologically seasons with some nearby adjustments: wintry weather (December, January and February), summer season (March, April and May), a monsoon wet season (June to September), and a post-monsoon length (October to November).

India's geography and geology are climatically pivotal: the Tharp Desert in the northwest and the Himalayas in the north work in tandem to impact a culturally and economically necessary monsoonal regime. As Earth's perfect and most huge mountain range, the Himalayas bar the inflow of frigid katabatic winds from the icy Tibetan Plateau and northerly Central Asia. Most of North India is for this reason saved heat or is solely mildly chilly or bloodless at some stage in winter; the identical thermal dam maintains most areas in India warm in summer.

Though the Tropic of Cancer—the boundary between the tropics and subtropics—passes thru the center of India, the bulk of the united states of America can be viewed as climatically tropical. As in tons of the tropics, monsoonal and different climate patterns in India can be wildly unstable: epochal droughts, floods, cyclones, and different herbal mess ups are sporadic, however have displaced or ended thousands and thousands of human lives. There is one Scientific opinion which states that in South Asia such climatic activities are in all likelihood to trade in unpredictability, frequency, and severity. Ongoing and future vegetative modifications and cutting-edge sea degree rises and the attendant inundation of India's low-lying coastal areas are different impacts, modern or predicted, that are attributable to world warming.



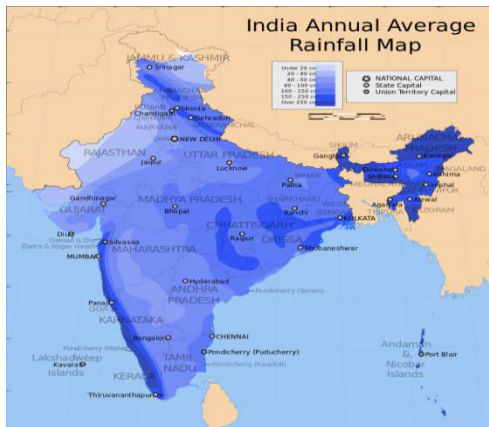


Fig.2.1:India Climate Map

2.2 RAINFALL EVER RECORDED

Cherrapunji, India, is one of the wettest locations on Earth, thanks to monsoon rains every year. Cherrapunji now holds the world report 48-hour rainfall with a whopping 2,493 mm, or 98.15 inches, of rain on June 15-16, 1995, the World Meteorological Organization (WMO) announced Friday.

Sohra or Cherrapunji has a slight subtropical highland climate, with monsoonal influences usual of India. The city's annual rainfall common stands at 11,777 millimeters (463.7 in). This parent locations it at the back of solely close by Mawsynram, Meghalaya, whose common is 11,873 millimeters (467.4 in)

HIGHEST RAINFALL

Here, we have accumulated a listing of 5 wettest locations In India who have acquired the absolute best stage of rainfall over the years.

- Mawsynram. The scenic village Mawsynram which is located in the East Khasi Hills district of Meghalaya country is reportedly the wettest region on Earth. ...
- Agumbe - 7620 mm
- Cherrapunji - 11873 mm
- Amboli - 3589 mm

2.3 RAIN WATER GOES DOWN THE DRAIN

The outlook is grim for water parched Chennai, with extra than 50% of the rainwater in the metropolis being wasted due to lack of storage facilities. In many cases, successive governments have openly helped in the destruction of lakes through permitting land sharks to encroach upon them and via ill-advised infrastructure development.

The city, with an place of 426sqkm, receives an common of 130cm of rainfall a year. This interprets to 9.1 million

liters a day, guaranteeing every individual one hundred forty liters a day in the course of the year. Even assuming that solely 60% of the water is harvested, every person will get eighty four liters a day. This is decrease than the ministry of city development's estimated person requirement of a hundred thirty five liters a day, however it has the attainable to put an cease to the city's severe water problem.

Most rainwater in the metropolis dissipates in floor run-offs due to the fact of a scarcity of rainwater harvesting pits and storm water drain networks. A massive quantity of the water enters a range of canals and is flushed into sea rather of filling water reservoirs. "Storm water drains forestall waterlogging, however they additionally account for most of the loss of rainwater," a employer official said.

2.4 WATER CYCLE

The water cycle, additionally recognized as the hydrological cycle or the hydrologic cycle, describes the non-stop motion of water on, above and under the floor of the Earth. The mass of water on Earth stays pretty consistent over time however the partitioning of the water into the principal reservoirs of ice, fresh water, saline water and atmospheric water is variable relying on a vast vary of climatic variables. The water strikes from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by using the bodily techniques of evaporation, condensation, precipitation, infiltration, floor runoff, and subsurface flow. In doing so, the water goes via unique forms: liquid, stable (ice) and vapor.

The water cycle includes the alternate of energy, which leads to temperature changes. When water evaporates, it takes up strength from its environment and cools the environment. When it condenses, it releases strength and warms the environment.

These heat exchanges have an effect on climate. The evaporative section of the cycle purifies water which then replenishes the land with freshwater.

The float of liquid water and ice transports minerals throughout the globe. It is additionally worried in reshaping the geological facets of the Earth, thru methods inclusive of erosion and sedimentation. The water cycle is additionally imperative for the upkeep of most existence and ecosystems on the planet.



Fig.2.2: Cycle of Water

3.0 CONCEPT OF ROAD DRAINAGE

It has been considered many instances that water in pavements is one of the primary motives of untimely pavement failure. Water may also enter the pavement due to a range of motives which may additionally be stagnation of water on the floor or misguided building of the roads main to seepage of water into the pavement and consequently inflicting injury to the same. Water in the pavement gadget can lead to moisture damage, modulus discount and loss of strength.

Highway drainage is the procedure of putting off and controlling extra floor and sub-surface water inside the proper way. This consists of interception and diversion of water from the street floor and sub-grade. The set up of appropriate floor and sub-floor drainage device is an fundamental section of motorway plan and construction. During rain, phase of the rain water flows on Surface and section of it percolates via the soil mass as gravitational water till it reaches the floor water beneath the water table. Removal and diversion of floor water from the roadway and adjoining land is termed as floor drainage, whilst the elimination of extra soil-water from the sub-grade is termed as sub-surface water.

3.1. TYPES OF DRAINAGE SYSTEM FOR ROAD

- General. ...
- Pavement and wearing course. The pavement or wearing course is the top layer of a road. ...
- Side ditches. ...
- Outlet ditches. ...
- Main road culverts. ...
- Access road culverts. ...
- Road drainage structures & layers.

3.2. HOW TO STORE THE RAIN WATER BY ROAD DRAINAGE SYSTEM

Water is a prestigious suppose in the world and each and every drop of it. is useful to human life. So with the aid of saving it through avenue drainage device thru the over glide of the rain water on the avenue flowing thru the mesh

of the kerb. Without any dust or dirt any flowing via conduit getting saved into the storage tank. And this effects in a use of rain water in every day purposes.



Fig.3.1: Storage System of Rain Water

3.3 ADVANTAGES OF ROAD DRAINAGE TO THE ROAD PAVEMENT:

- **CONTROL OF SEEPAGE FLOW**

When the well-known floor and tightly closed strata beneath are sloping, seepage go with the flow is probably to exist. If the seepage quarter is at depth much less than 0.6 to 0.9 meter from the sub grade level, longitudinal pipe drain in trench crammed with filler cloth and clay seal can also be developed to intercept the seepage flow.

- **NECESSITY OF HIGHWAY DRAINAGE :**

Excess moisture in soil sub-grade motives instability underneath the street surface. The pavement might also fail due to sub-grade failure. In some clayey soil version in moisture content material reasons extensive version in quantity of sub-grade. This on occasion contributes to pavement failure. The waves and corrugations shaped in case of bendy pavements additionally play an vital function in pavement failure. Sustained contact of water with bituminous pavements motives failure due Stripping bitumen from the aggregates like loosening of some of the bituminous Pavement layer and formation of pot holes. The high motive of disasters in inflexible pavements with the aid of mud pumping is due to the Presence of water in excellent sub-grade soil. Excess water on shoulders and pavement facet motives massive damage. Excess moisture reasons make bigger in weight and hence extend in stress and simultaneous discount in power in soil mass. This is one of the principal motives of failure of earth slope and embankment foundations. In area the place freezing temperatures are accepted in winter, the presence of water in sub-grade and a non-stop furnish of water from the floor water can purpose great harm to the pavement due to in frost action.

3.4. IF WE NOT STORE THE RAIN WATER

- Road subgrade receives gathered due to rain water.
- Ruts get fashioned on the avenue due to standing of road.
- Due to heavy rainfall the water get accumulate on the avenue surfaces so the motors can't move.



Fig.3.2: Effect of Rain Water on Road

4.1 Road Drainage System

The main motive of a street drainage machine is to do away with the water from the street and its surroundings. The street drainage device consists of two parts: In Sweden “dewatering” is similarly divided into two parts: runoff and dewatering “Runoff” covers the water flowing from the floor of the pavement with the aid of avenue shoulders and internal slopes to the ditches. “Dewatering” covers the series and transport of water from the floor and shape of the avenue so that there will be no ponds on the avenue or in the ditches.

4.1.1: COURSE MESH

Screening gets rid of objects such as rags, paper, plastics, and metals to stop harm and clogging of water.

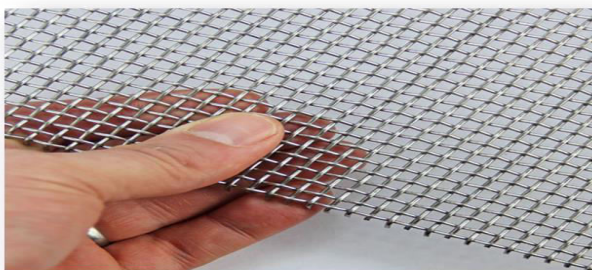


Fig. 4.1: Course Mesh

4.1.2: CROSS FALL

A move fall is a gradient throughout the route floor which approves water to drift toward the decrease course edge. It is typically advocated to produce a go fall inwards toward the slope, when a course contours round a slope, to forestall customers on wheels inadvertently guidance off the aspect of the path.

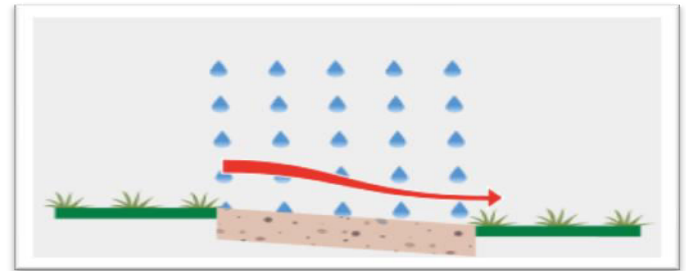


Fig.: 4.2 Cross Fall

4.1.3: ROAD SHOULDER

A shoulder or challenging shoulder is an emergency stopping lane with the aid of the verge of a street or motorway, on the proper in nations which power on the right, or on the left aspect in India, Japan, the UK, Australia, and different left-side riding countries. Many wider US and Swedish freeways have shoulders on each aspects of every directional carriageway, in the median as nicely as at the outer edges of the road, for extra safety. Shoulders are now not meant for use via thru traffic, even though there are exceptions

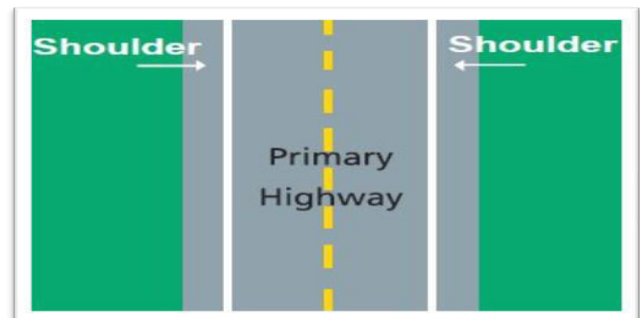


Fig. 4.3: Road shoulder

4.1.4: OUTLET DITCH

A ditch is a small to reasonable melancholy created to channel water. A ditch can be used for drainage, to drain water from low-lying areas, alongside roadways or fields, or to channel water from a greater far-off supply for plant irrigation.

Outlet ditches are drainage constructions that lead the water from the facet ditches away from the street area. The water from outlet ditches commonly discharges to current waterway systems, such as river channels and lakes. The outlet ditch is a essential section of street drainage gadget however regularly ignored. If the outlet is clogged, it can create great troubles to the street over a giant area.

4.1.5: SIDE DITCHES

Side ditches are an imperative issue of any course drainage machine every time there is a trouble of water strolling onto the direction from surrounding areas.



Fig. 4.4: Side Ditches

4.1.6: CULVERT

A tunnel carrying a movement or open drain below a avenue or railway. Culverts are regularly used each as cross-drains for ditch remedy and to ignore water below a street at herbal drainage and circulation crossings.



Fig.4.5: Culvert

4.1.7: UNDER DRAINS

A channel for conveying water or other fluid



Fig. 4.6: Under Drains

4.1.8: STORAGE TANK

To keep the rainwater coming from the street facets which passing from the coarse mesh and then thru the

conduits receives saved into the tank

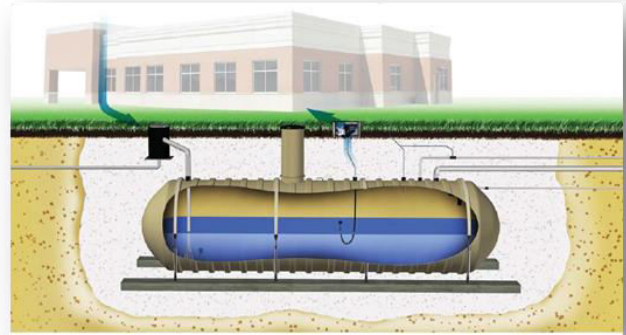


Fig. 4.7: Storage Tank

4.1.9: CHAMBER

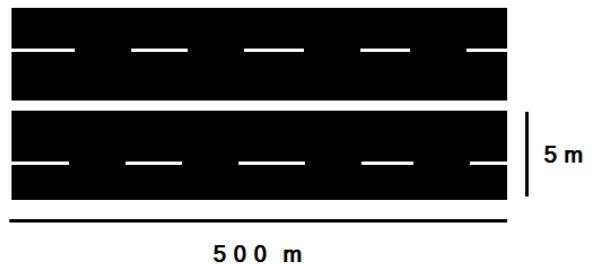
To gather the rain water coming from the floor of the street then to the mesh then storing the rain water for brief reason then transferred into the primary storage tank.



Fig.4.8: Chamber

*** DESIGN OF STORAGE TANK**

Assuming length of road is 500m
 Total area = 500 X 5 = 2500 m²



Average annual rainfall in Solapur = 0.384 m
 Area of Solapur = 184.7 km²
 Therefore,
 Annual rainfall for 500 m Road = 0.0103 mm
 Total volume of water which fall on this area during a year,
 = 2500 X 10⁶ X 0.0103

= 25.75×10^6 liters/year
For one day rainfall = $(25.75 \times 10^6) / 365$
= 70547.94 liters/day.
= 0.0705 MLD

Assuming that 70 % of this water can be saved effectively
= $0.70 \times (25.75 \times 10^6)$
= 49383.57 liters
= 0.049383 MLD

CAPACITY OF STORAGE TANK:

DESIGN OF STORAGE TANK -

Assume,

L = 5m, B = 3.5m, H = 5m.

Therefore volume of tank,

$V = L \times B \times H$

= $5 \times 3.5 \times 5$

= $87.5 \text{ m}^3/\text{tank}$

For one lane,

= 87500 liters/tank

For two lane,

= 87500×2

= 175000 liters/tank

CONCLUSION

1. To enlarge the existence of the street and to minimize the upkeep fee drainage of roads have to be precise provided.

2. The day by using day increase of populace in city areas and growing the demand of water we want to retailer the water successfully way.

3. Road drainage machine get water to the semi-arid area. Due this task we have overcome the two essential matters. That is to retailer the avenue floor from corrugations and growing. The lifestyles of the street and any other one is to store the water for future needs.

4. As drainage helps in averting quite a number sorts of disasters as might also be brought on by using stagnant water on the street floor or its seepage below the pavement, it is necessary to grant drainage facility whilst development of roads.

5. The troubles such as the presence of potholes, improvement of water-logging conditions, or issues

associated to erosion or corrugation need to now not be left out when designing road-side drainage.

6. The task offers a higher and an environment friendly way to choose the lay out proposals for avenue facet drainage and for that reason will additionally fulfill all necessities of an perfect drainage system.

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